

INDIAN AGRICULTURAL
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THE SCOTTISH

Journal of Agriculture.

VOLUME II.

1919.

9739

EDINBURGH
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

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PRINTED BY J. SKINNER AND CO., LTD.

The Scottish Journal of Agriculture.

VOL. II.—No. 1.] JANUARY 1919. PRICE 6d.

THE FOUNDATIONS OF DEVELOPMENT IN AGRICULTURE.

Rt. Hon. VISCOUNT HALDANE, K.T., O.M.

ONE of the lessons which the war has impressed on the world is the necessity of high standards in knowledge and training. The call for more widespread intelligence has become apparent generally, and no longer only in strategy and in the organisation of supply and of munitions. There is no region of civil life where it has not recently been heard. In many of these regions it has met with response. It has met with some response in agriculture and forestry, but the question remains whether the acknowledgment has been sufficient.

In this country we have individual experts in various departments of science who are second to none. There are, however, relatively speaking, but few of these, and of their power of spreading ideas but little use has been made, nor has it even been widely recognised by the public. In physics, in chemistry, in biology, these individuals have done outstanding work, and they have world wide reputations, but their influence on general knowledge within these islands has been restricted and even discouraged. In agriculture and forestry this has been especially the case, and it requires only a little study of what was being done in Germany before the war, and also, in a less comprehensively organised form, in France, in the United States, and in comparatively small countries on the Continent of Europe, in order to appreciate how far we were from keeping pace with our rivals. In Germany the contrast with our own want of organisation was especially marked, and it was an integral part of the policy of the German Government to keep a lead over us in food production.

The key to our inferiority lay in the want of recognition here of the great assistance which science could render, and which high science alone could render. No doubt there were scattered about this country men who knew a good deal and who had done much.

In agriculture I observed the results of their influence through the quarter of a century during which I represented East Lothian in the House of Commons. Although myself unskilled in this branch of knowledge, I had personal friends among farmers there who were no ordinary practical men. They impressed me much. They had, of course, a responsive soil to work with, but they had also what among our practical men was a high standard of knowledge. This had brought about an atmosphere in which the farm servants also had developed. Many of them knew a great deal.

But we want more than this if agriculture is really to develop. It is only in the homes of high science that the highest knowledge can be evolved and diffused among students fitted to apply it in practice. Agricultural colleges are excellent institutions, but they rarely reach a true University standard. I have recently been Chairman of a Royal Commission the task of which was to devise means for the reorganisation of education of a University type in Wales. I observed while there how great was alike the desire for new science to be applied to the tilling of the soil, and the gap which separated practical men from the resources of the University Colleges. Throughout the inquiries which the Commission held in Wales it was impressed on us by the witnesses that it was essential for the Welsh farmers that these resources should be developed, and a much more general resort to them encouraged. This has been done on the Continent and in the United States on a scale and by methods to which we are still strangers.

The impression continues to grow in my mind that the occupation of the farmer and of the forest manager must be connected more than at present with the directing ability of a learned profession, if we are really to improve our position as a nation in these branches of the national industry.

It must be remembered that the attainment of the maximum output in agriculture and forestry is a social as well as an industrial question. No organisation in an industry is ever really great unless those engaged, humble as well as pre-eminent, find satisfaction in it for the general aims of life. The condition of those who labour must be made attractive, and so must that of the men of skill, if the possessors of knowledge of a high standard are to be attracted. The farm hand must feel that he has scope for intelligence and is no mere machine. The farmer must feel that the science which he has at his command gives him an interest and a freedom in his work which develops his mind and gives scope for his abilities. It is training and education that alone can enable this level to be reached and maintained. The schools and colleges do too little in this country to-day to provide the foundation on which capacity of this kind can be built up, either in the farm servant or in

the farmer. It is not desirable for its attainment that the education given should in the earlier stages be of a merely technical character. The object must always be in the first place to build up the mind so that at a later stage it will not be satisfied with a low level in understanding. The technical training should rise on a substratum of general education. No doubt in the continuation school it will be possible here, as it has proved easy elsewhere, to make instruction in things of a practical kind significant, that is to say illustrative of principles which are the more interesting because it is shown how they operate in actual practice. But the higher skill that comes of higher knowledge is the main thing, and it is only through higher knowledge that this skill can be generally attained.

What is true of the ordinary worker is still more apparent in the case of the higher direction. The agricultural colleges will never be really successful unless they are permeated by the scientific spirit which, at its best, develops only in the true University atmosphere. A certain amount of higher knowledge about agriculture can be crammed up by a year of hard study, and may be made the subject of examination for the diploma of a University in whose atmosphere the study has not taken place, but in the end it is of but little use. The teacher in an institution which is not permeated by the highest scientific spirit may possess much command of detail, but he will not raise his students or inspire them unless he gives the sense that the voyage of discovery on which he is conducting them is one in which what he teaches is only an illustration of larger principles which belong to knowledge as a whole. For knowledge is emphatically a whole, and its most valuable influence and assistance cannot be attained by pursuing it in forms that are only isolated fragments.

This is why it seems to me vital that the agricultural colleges should have a high status, both for teachers and for students, and, like the best Technical Colleges of other kinds, should be kept in the closest relation to the Universities that is attainable. For it is in the atmosphere of the Universities alone that, in the main, the highest kinds of inspiration come to teacher and to taught alike. The great professor is a great influence, not merely because of what he knows, but because of the inspiration of his personality. It is the intellectual level to which he raises those around him that makes the whole difference. And this kind of leader and level are impossible in a small institution confined to a single branch of instruction. The edifice is inseparable from the foundation on which alone it can be well and truly built.

The State is taking a new interest in higher education. It is taking this new interest because it has come at last to recognise

that, unless higher knowledge is more widely diffused among our people than it has been in the past, we cannot hope to hold our own against competitors who possess it. It would, I think, be a national misfortune if, at a time when this new development is taking effect in other spheres, the great industries of agriculture and silviculture were left outside. And yet there is real danger of this. People think that it is only by practical work that knowledge and experience come in these subjects. In reality this is just as untrue as it is in the cases of the many industries which have suffered in this country, as has, for instance, the coal-tar dye industry, from starvation in instruction. Science never stands still, and methods in agriculture as well as in other industries constantly require revision in the light of the new science that is constantly arising through study and research in the laboratory.

To me it seems, therefore, that we have reached a critical period in the agricultural history of this country. We must go forward. The interests of the nation require it. And we cannot go forward unless we raise the intellectual level of the whole agricultural community, from the farm servant to the farmer. It is only by the aid of education that this can be done adequately. The schools can do the first part of the necessary work. But the higher education which is required for instructors and for research students, and which should be available also for the best type of farmer, can be got only through study under teachers of adequate standing and range of knowledge. And these will never be common in the agricultural colleges unless these colleges are themselves inspired and their students maintained by their relation to the larger society of the University.

It is on knowledge that the future of the tillers of the land in this country really depends more than on anything else. And that knowledge will do little good unless it is not only sufficiently widely spread, but is also adequate in its quality.

THE GROWING OF BEANS IN SCOTLAND.

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BEANS belong to the natural order Leguminosæ, so called from the legumes or pods in which the seeds are borne. This order comprises a very large number of species, some of which are of interest only from a botanical point of view, and many of great value from an economic point of view, such as beans, peas, vetches and clovers, which are extensively grown in this country as feeding-stuffs for all kinds of stock. In the bean plant there may be

observed the papilionaceous or butterfly flower, the broad and compound leaves, the four-sided, angular and hollow stem, and the strong tap root descending deeply into the soil with abundant lateral fibres attached. The roots are studded with nodules or tubercles containing bacteria, which in forming their own bodies assimilate nitrogen from the atmosphere. The bean roots then absorb the nitrogenous compounds thus formed, and accordingly are not dependent upon the nitrogen in the soil for the supplies they require for the growth and nourishment of the plant. This state, in which the beans and the bacteria are living mutually dependent upon each other, is termed "symbiosis." It must accordingly be borne in mind, when considering the manurial requirements of beans, that applications of a nitrogenous manure are quite unnecessary.

Varieties.—There are two classes of what is generally known as the common bean, namely, the field bean and the garden bean, each containing many different varieties. The field bean includes those varieties grown in farm practice, and the garden bean those more suitable for cultivation on a smaller scale. Before proceeding to discuss the field bean, with which we are here concerned, it may be of interest to mention that there are three distinct kinds of garden bean—(*a*) the Broad Bean, which includes the popular Windsor and Long Pod; (*b*) the French or Kidney Bean, which includes Dwarf Beans such as Canadian Wonder and Sutton's Perfection, and Climbing Beans, such as Giant White and Excelsior; and (*c*) the Scarlet Runner, which includes Scarlet Runner, White Runner, etc

There are quite a number of varieties of the field bean grown in England which are not found in Scotland. Among them are spring and winter varieties, the latter usually sown in October and quite capable of standing an ordinary winter. It will be sufficient to mention but a few, namely, English Horse Bean or Tick Bean, Heligoland Bean, Cluster Bean, Red Bean, Winter Field Bean and Mazagan. Although these and other varieties are not grown in Scotland there is no reason why some of them might not be given a trial. An experiment conducted in 1918 by the West of Scotland Agricultural College, in Stirlingshire, showed that one or two English varieties compared very favourably with the native varieties, and were certainly deserving of trials on a larger scale.

The principal variety of bean grown in Scotland is the common Scotch Horse Bean, or Carse Bean, as it is often called. In the West of Scotland the Kilbride Bean is the favourite, and it is extensively grown in the Renfrewshire district. Many experts, however, are of the opinion that this bean is identical with the common bean, and there is no doubt that Carse Beans grown in Stirlingshire are sold in the West of Scotland as Kilbride Beans, and give every satisfaction. On the other hand it is the accepted belief amongst Carse farmers that the only variety which suits their soil is the Carse Bean, and that the Kilbride Bean is quite distinct. The Granton Bean is favoured in the East of Scotland, and Fifeshire until recently preferred this variety, but the Carse Bean is now more widely grown in that county. In Ayrshire the

Granton Bean used to be largely grown, but since the war many of the farmers have favoured the growing of "mashlum," and for this purpose the Carse Bean is preferred. In Stirlingshire, Perthshire and Clackmannanshire practically nothing but the Carse Bean is grown, and it is seen at its best in the Carse of Stirling and Carse of Gowrie, whence its name is derived. It is therefore to be inferred that in Scotland when a farmer decides to grow a few acres of beans he would do well to begin his operations by choosing the Common Scotch or Carse Bean as the variety to be sown. It is a very hardy, fairly prolific variety, with stems varying from 4 to 6 feet in height. When the stems have grown rank and high, through an excess of manurial requirements, the pods are few and the crop disappointing. The pods contain three or four seeds, pale to dark brown in colour, about half-an-inch long, slightly flattened on the sides, with a black hilum or mark at the end.

Yield.—In Scotland the average yield of beans is between 36 and 37 bushels per acre. A yield of 40 bushels per acre would be considered a good crop, and 48 bushels per acre exceptionally good. The straw should weigh from 25 to 30 cwts. per acre. The bushel weight of good beans is about 66 lbs. In pre-war times beans were looked upon as a rather uncertain crop, both as regards yield and price, but during the last year or two it has been found that the yield has been well up to the average, whilst the price has been such as to encourage farmers to grow this crop more extensively in the future than they have done in the past. That this is warranted is clearly shown in the Abstract of Agricultural Returns for Scotland for 1918. In that year there were 8295 acres of beans grown in Scotland, as compared with 6135 acres in 1917, giving an increase of 2160 acres, or 35 per cent. This percentage is considerably higher than the corresponding percentages of wheat and of oats, which were 30 per cent. and 19 per cent. respectively. To the total of 8295 acres of beans, Stirlingshire contributed the largest area, namely, 2089 acres. Then followed Ayrshire with 1772 acres, Perthshire with 1101 acres, and Berwickshire with 823 acres.

Soil.—The soil on which the best beans are grown is of a heavy and stiff nature, such as a well-drained clay, or clayey loam. This crop requires adequate supplies of phosphates, potash and lime, and the roots descend deeply into the soil in search of these substances. Further, an abundant supply of moisture is necessary, but on the other hand, a water logged soil is injurious, and must be improved by draining. Light thin soils, containing much sand and gravel, and of an open texture, are quite unsuitable for the growing of beans, as they do not contain the minerals which the plant requires, and the crops on such land are liable to suffer from the effects of drought. As has already been mentioned, very fine crops of beans are grown on Carse land, which seems peculiarly adapted to this plant, and on certain areas reclaimed from rivers it also flourishes.

Climate.—Beans grow satisfactorily in many varieties of climate, but they will not stand extremes of either heat or cold, and the

latter, when combined with damp, is especially detrimental to young plants. Late frosts also have injurious effects, but probably more damage is caused in the spring amongst early sown beans by prolonged spells of cold wet weather than by frost. It may happen that for this reason a better crop of beans will result from sowing at the end of March than at the end of February. In Scotland only spring beans are sown, the climate being too severe for winter beans, which are quite commonly grown in England.

Place in Rotation.—Generally speaking beans come after wheat in a rotation, and are followed by a corn crop such as barley, oats or wheat. The following is the old carse six-shift rotation:—oats, green crop and fallow, wheat, beans, barley, hay. This has been extended as follows:—oats, beans, oats, turnip and fallow, wheat, beans, barley, hay. The hay is timothy, which is allowed to lie for about six years before being broken up. The advantage of this rotation is that a large portion of the arable land is down in timothy, which produces large crops, about 3 tons per acre, and sells well. Further, there is much less labour involved, and the work is more uniformly spread over the season. It will be observed that in this rotation there are two crops of beans. The beans coming after the break up crop of oats are not so heavy as those following the wheat. In the breaking up of old pasture land splendid crops of mashlum have been grown the first year. If oats have been grown the first year, an effort should be made to put the land under wheat the second year, but if time and weather in the autumn do not permit of this course being adopted, beans or mashlum, or a second crop of oats, may be sown in the spring. Generally wheat is the best cereal for heavy soils, and in the rotations given above it follows green crop and fallow. On account of its heavy straw it leaves the land cleaner than do oats, and in better condition for the bean crop that follows. Before the wheat stubble is ploughed farmyard manure is applied as available and necessary, and the land is then ready to be prepared for beans. After the bean crop a corn crop should follow, which is generally barley, though oats, and more rarely wheat, are also grown in this place in the rotation. Barley is specially favoured for two reasons, first, on account of its being the most suitable cereal for sowing out with grass seeds, and second, because of the presence in the soil of nitrogenous compounds derived from the roots of the beans and the broken down nodules. Barley requires careful treatment in the way of manuring, or the quality will suffer. Hence applications of strong nitrogenous artificial manures are to be avoided. A supply of nitrogen, however, is necessary, and it can be obtained in a very satisfactory way from the debris of the roots of a bean crop. As already mentioned, instead of barley, oats or wheat may follow beans. The results with oats are quite satisfactory, but as regards wheat the weather in the autumn usually prevents it from being sown. It is only in an exceptional year that the turnip and fallow land can be put into wheat and also the bean stubble. Better hay and pasture are also likely to result through sowing out with barley or oats than with wheat. It is, however, very good practice to sow as much wheat in the "back-end" as the weather will permit

There is thus much less work to overtake in the spring, and in farming operations in Scotland one seldom gets a second chance of good weather.

Manuring.—The general method of manuring beans is to apply farmyard manure on the wheat stubble at the rate of about 15 tons per acre. If, however, the green crop in the previous year was heavily dunged, this might result in a far too luxuriant growth and should not be applied. On land which was previously in fallow it will all be required. Beans require phosphates and potash in plenty, which of course the dung supplies, but it also supplies nitrogen, which they do not require. The practice then of dunging land heavily for beans does not seem to be a very economical one. Experiments have shown that beans can be grown quite successfully with artificial manure alone. A suitable dressing is 6 cwt. superphosphate and 2 cwt. potash salts per acre. Basic slag is also very suitable, and can be applied at the rate of 8 cwt. per acre along with the potash salts. These figures are of course approximate, and the farmer must use his own judgment as to the exact quantities to be applied, having regard to the nature and richness of the soil. Potash is a very important manurial ingredient for beans, but of course at the present time it is unobtainable in any quantity. It should be available before long, but the forced abstinence from potassic manures which the war has brought about does not seem to have had any very serious effect on the crops of those farmers who were formerly in the habit of using them in large quantities, and one is inclined to think that potash was often applied to crops that did not require it, and in excessive quantities to those that did. Lime is also very necessary for good crops of beans, and much of our heavy land is suffering from the want of it Farmers admit that this is the case, and would be very willing to apply it, but the cost of liming is very heavy, and unless the material is to be had locally, the expenses incurred in transit, especially if there is much carting to be done, along with the labour involved in manipulating such a bulky substance, may make it too costly. It is to be hoped that steps will be taken to make an abundant supply of lime more readily obtainable in the future. With regard to the application of nitrogenous artificial manures to beans, a dressing of 1 cwt. nitrate of soda has been found beneficial, but not profitable, and it is not recommended. The use of sulphate of ammonia is also to be avoided.

Cultivation.—There are many different modes of cultivation in the case of beans, but in Scotland the common practice is to sow them broadcast. They may be sown in drills and worked like a green crop, especially if they succeed oats in the rotation, but this method has gone into disuse on account of the labour and time involved. Certainly the process, though costly, cleaned the land, while broadcasting encourages the growth of weeds. Land for beans should, if possible, be ploughed in the autumn. Then, during the last week in February or the first fortnight in March, the beans are sown broadcast at the rate of 3 to 4 bushels per acre according to the quality of the seed. They are ploughed in or "skinned" with a furrow about 3 inches deep, taking the same width as in the

autumn, namely 8 to 9 inches. In a week or two, when the land dries, and before the beans braird, they should be harrowed a double "tine" up and down and a single across, and rolled. If much charlock shows after the plants braird, a single tine with light harrows may be given. On stiffer land the beans may be treated like oats—sow after ploughing with a seed furrow, harrow twice up and down and twice across, or as required, and finally roll.

Harvesting.—Beans are ready for cutting when a general blackening takes place in the straw, when the chaff is off the straw, the seed black on the hilum or "eye," and the pods are showing signs of drying. Before the introduction of the self-binder, beans were cut with the manual and "put off" in bunches. These were pulled back by lifters with hooks, and later on were tied with straw bands and stooked. Now they are cut and tied by the binder and stooked immediately. This method is quite satisfactory, although the wear and tear on the binders is very heavy, especially on the canvases, which continually require repairing and renewing. The knives of machines when cutting beans do not require to be very sharp. Beans often require lengthy drying in the stooks before stacking, and as they are harvested late in the season they are often subjected to much bad weather. This they stand very well, though, if it goes on until the pods burst, the results are disastrous. Such a catastrophe is of rare occurrence, and when a farmer has "everything in but the beans," he considers his harvest as practically secure. It is advisable to put beans up into small stacks so that they may have every opportunity of drying. The beans when hard enough may be threshed. If they have not been harvested well, or have kept badly in the stack, a poor sample with many black seeds in it may result. The seeds are used for feeding purposes or for seed, and the straw and "cavings" for feeding and bedding.

Composition and Food Value.—With regard to the composition of beans, the nitrogen content is high. In the case of the seed the digestible protein is about 20 per cent., whereas in the oat it is about 9 per cent. In bean straw it is about 4 per cent., and in oat straw 1·3 per cent. Beans may be given to all classes of farm stock, but are of especial value for replacing part of the oat ration to work horses, and for feeding to milk cows in the form of bean meal. During the last year or two, when concentrated feeding stuffs have been so scarce, the home produced bean meal has been especially valuable for milk production. Bean straw is very good fodder for horses and cattle, but not such good bedding as oat straw, the latter being more absorbent and also more readily decomposable. Owing to the high nitrogen content or richness of the bean, some discretion must be used in the feeding of stock either on the seeds or on the straw. Excessive quantities must be avoided, especially in the case of young animals, or harm may result in the way of digestive trouble or thickening of the blood.

Mashlum.—In some cases it is preferable to grow mashlum rather than "clean" beans. The growing of mashlum has this in its favour, that the mixture of beans and oats generally chokes out

the weeds better than when beans are grown alone. It is also claimed that a heavier crop will result when the two plants are grown together than when they are grown separately. Beans and oats certainly grow well together, and very heavy crops are often obtained. Mashlum is very suitable for chopping direct from the stack, though a sheaf of beans and a sheaf of oats when put through the chopper alternately will give a similar mixture. On the other hand, beans and oats when grown together may not ripen at the same time, and when harvested late in the year the oats will not stand the same amount of bad weather as the beans Hence it is advisable to use a late variety of oats. The beans are sown at the usual time in the beginning of March at the rate of about 3 bushels per acre, and roughly harrowed. Just before the sprouts come to the surface the oats are sown, also at the rate of about 3 bushels per acre. The land is again harrowed and finally rolled. It is also quite common practice to sow the beans and the oats at the same time, though separately, when the weather in the spring will permit of oats being sown. If a manure is required for mashlum 2 to 3 cwt. superphosphate along with ½ cwt. muriate of potash and ½ cwt. sulphate of ammonia may be applied.

Insect Pests.—The chief insect enemies of the bean crop are the Bean Aphis or "Collier," and bean weevils and beetles. The former attacks the shoots in the field, and little can be done for it beyond spraying with an insecticide, which on a large scale is not very practicable. It is not met with except in a very dry and sunny season. Weevils and beetles may attack the seeds when stored, but their extermination does not generally concern the farmer, as his beans are seldom stored long enough to invite the attacks of these pests.

THE IMPROVEMENT OF AGRICULTURAL CROPS BY SELECTION AND HYBRIDISATION.

SUGGESTED LINES OF RESEARCH.

THE following is the substance of an address delivered to the Glasgow and West of Scotland Agricultural Discussion Society by Mr. T. Anderson, Director of the Board's Seed Testing Station :—

In considering the question of the development of species of plants cultivated as agricultural crops, it is well to remember that development and improvement cannot be pushed beyond the balance of nature, and that, considering the general excellence of the best commercial varieties of cultivated plants, specialisation which may enhance the yielding capacity or the general qualities of varieties cannot be carried much further. For example, the success and popularity of the Victory Oat in competition with the best hybrid varieties show that there may arise naturally

varieties quite as excellent as those developed by careful artificial methods, and there may be as good things in the old established varieties as can be produced by novel methods.

The work of the Swedish Station at Svalöf indicates, in the main, that it is more important than the actual production of new varieties to keep the stocks pure, and to keep these pure stocks under control until a sufficiently large stock can be distributed.

Any attempt at improvement must be supported by a strong educative influence in the direction of impressing on the seed farmer the necessity of growing pure stocks and of taking precautions to keep them pure, and by the active co-operation of the seed farmers in ensuring the production and distribution of stocks in a pure state. Otherwise, any new variety will tend quickly to lose purity and popularity.

The primary object to be attained, therefore, is an efficient organisation which will secure purity of stocks from the time they leave the breeder's hands to the time they are ready for general distribution, and which will maintain pure stocks in sufficient quantity to ensure that the yearly distribution from the initial source shall be of seed that is true to type.

The popularity of the official offer to guarantee pure stocks of immune varieties of potato during the past season has shown that growers who take an interest in their business will welcome a general scheme of official registration of seed crops of all kinds, and such a scheme might be extended, with considerable success, to embrace cereals. In the matter simply of freedom from objectionable admixture, the scheme might be immediately extended to seed crops of Ryegrass.

Provided that the official department concerned can certify varieties at their source—and this should be possible in the case of all new and selected varieties when the proposed Registration and Plant Breeding Stations eventuate—it should be no very difficult matter to certify and register crops produced therefrom by imposing the safeguards that they be grown isolated and threshed pure. The plan of a voluntary registration of wheat crops, similar to that applied in Scotland to potatoes, has been instituted in parts of New Zealand and in England during the past season, and involves the setting apart and roguing of a portion of the crop which will be utilised for seed.

While this method may help in maintaining purity, a far surer way would be to start with pure selected stock and register only stocks derived from it.

The most obvious method of effecting an improvement on the average quality of any plant species or variety is to isolate single desirable forms, and to multiply these by some method of propagation. This method of improvement suggests itself inevitably to every new recruit in the army of plant improvers. In the method are the essential bases of improvement; by it varieties, excelling in different directions, have been extracted from the original species; from varieties which excel in a particular way forms are similarly isolated by subsequent selection, and thus are established a large number of strains, each with special qualities, but more or less alike superficially.

Single and Mass Selection.—With reference to cultivated crops there are two methods of selection practised, and the usefulness of these methods is, to some extent, determined by the characteristic method of production of the species, viz. (1) by the annual, biennial or perennial character of the species; (2) by the customary method of its propagation, viz., by seed or by vegetative parts; (3) by the normal method of its fertilisation.

The mechanism of reproduction by seed is found in the flower; the pollen grain, applied to the stigma, germinates and passes its contents to the ovule, or to an ovule contained in the ovary. An ovule fertilised in this way becomes a seed.

Some species are so developed that the pollen of a flower is incapable of fertilising the ovules of the same flower, or they have such arrangements that self fertilisation is unlikely to happen. These species or varieties are said to be "self sterile," *e.g.* many varieties of apple. Some are capable of becoming fertilised by their own pollen, or by pollen from another flower, with no arrangement for preventing either method, *e.g.* turnip and mangel. Some are normally fertilised by their own pollen, and, by the character of their flowers, or on account of other circumstances, almost exclude the possibility of natural cross fertilisation, *e.g.* Barley, Bean and Potato. In the case of a normally self-fertilised species, *e.g.* barley, the raising of a pure strain of a variety is a simple matter; one selects a single grain, a single ear, or a single plant, establishes the fact that the strain thus selected is—as far as is discernible—stable or breeding true, lets it reproduce and multiply in its natural course. In this way a pure strain or pure line selection is obtained.

In the case of species which in nature are commonly or always cross fertilised, the selection of a form fixed in all its visible and appreciable characters is a difficult and, very frequently, an impossible matter.

The two methods of selection already alluded to are known as "Mass Selection" and "Pure line Selection."

Mass Selection is a method which may be applied to self fertilised annuals and to perennials propagated by vegetative methods. Thus mass selections of a variety of cereals would be accomplished by selecting a large number of the best heads or the heads of the best plants in a crop, care being taken to choose only plants having the characters of the variety from which selections are being made. These would be threshed separately from the rest of the crop and sown out. From the resultant crop the best plants would again be taken, and the process might be continued from year to year indefinitely. In this way, during successive crops, differences due to extrinsic circumstances would be eliminated, and the result should be an even crop of the original variety relatively high in purity and yield. This method of improving cereals has been tried at the Svalöf Station, and has attained a certain amount of success, but not sufficient to recommend its further exploitation.

The method has also been applied with some success to the maintenance of the character of strains of cereals in Canada.

Applied to a crop propagated by vegetative means like the potato, mass selection should be an excellent method of maintaining the vigour of a variety. Its application would find expression in the selection of outstanding plants of vigorous growth, plants typical of the variety, which are at the same time resistant to disease or frost and which throw a good root.

Examples of mass-selected sorts are the varieties known commercially as Resistant Snowdrop and Witch Hill, taken by Messrs. Dobbie & Co. out of the varieties Snowdrop and Witch Hill, which had in commerce become mixed. The basis of selection was the white flesh, and the purpose of the selection in both cases was to take out of the mixed variety the original white fleshed variety on the assumption that it was immune to Wart Disease. The selections were entirely successful; both varieties have now been officially certified as immune varieties.

With proper safeguards the principle of mass selection may be applied to biennials and perennials normally cross fertilised.

In the case of roots, *e.g.* mangel and turnip, this method is the ordinary trade practice of keeping up a strain.

In order to keep a stock true, great masses of the same variety must be grown together and isolated from other varieties in order to exclude the risk of crossing. For example, in the case of varieties of turnips, stock roots true to type are first selected and seeded in an isolated place away from other flowering turnips or plants of allied varieties. The seed produced forms the stock seed, from which bulbs are grown and seeded in the seed-growing area in the East of England. This massing of plants in a big acreage prevents the risk of crossing with another variety.

The improvement of sugar beet on the Continent was in the first instance obtained by mass methods, the basis of selection of roots being the sugar content.

Pure line Selection.—But where mass methods are applicable, pure line methods or pedigree methods are also applicable; although mass methods in general and in particular play the useful role of preliminary to pure line selection. The pure line or pedigree selection method of improvement is a method of individual selection, isolation, and comparison. The work of Sheriff and Hallett was on the lines of pedigree selection.

The broad assumption underlying this method is that there are forms in a variety which are decided advances on the average of the variety, and that these can be reproduced true to type. The experience of selectors and breeders has been that forms which are true to type of the crop, and yet superior to the general average, can be readily found, particularly in old established varieties, and suggests that Darwin's theory of continuous variation in a particular direction cannot be dismissed cavalierly.

Pure line selection in the case of a cereal involves the selection of plants showing special qualities. All plants which show promise of being useful may be taken, whether or not they appertain to the variety from which they are being selected; the possibility of obtaining a useful natural hybrid or sport should not be overlooked.

The produce of each plant is sown separately in plots, each

plot, if possible, being duplicated in order that differences due to character of soil or situation may be eliminated. In this way a miniature crop is grown from each selected plant, and each separate crop can be kept under close observation during the growing season, with a view to determining its fixity and its value as compared with the other selections. The best of the crops can be grown on for some years for the purpose of testing comparatively the value of each in terms of climatic and other conditions.

Pure line selection in perennial crops like the potato involves the building up of a strain from a selected shaw. This is a trade practice of keeping up the vigour of a variety. "Iron Duke" is an example of a variety selected for a special quality, the basis of selection in this instance being freedom from leaf curl, to which the parent variety "President" is liable.

Pure line selection in the case of a root crop like turnip involves: (1) selection of single stock roots, the flowers of which are protected from cross fertilisation; (2) the growing of bulbs from the seed thus obtained, in order to determine fixity and to judge of desirable qualities and size, and (3)—if pure and excelling—the flowering and seeding of mass-selected roots in isolated quarters.

The logical method of selection is a judicious blending of mass selection and pure line selection. Pure line selections may usefully be derived from mass selections. Mass selection gives an opportunity of comparing a larger number of types than is possible by single plot growing. When selecting, one wants in a concentrated area as large a number of forms as possible from which to select, and, when these forms are growing in mass, one obtains a guide to competitive qualities. Pure line selection should follow on mass selection after elimination of the mediocre. The method of pure line selection is applicable in the case of all species in which self-fertilisation is the rule, or in which selfing can be induced by artificial isolation or massing, with the proviso that visible constancy of character is assured before a strain is worked up. The very essence of pure line breeding is the elimination of unstable as well as of weak strains. Success in raising useful pure lines by selection depends on the basis of elimination. The work requires careful judgment, and results must be checked by quantitative estimates.

The application of pure line methods to the development of grasses and clovers presents difficulties which look at first sight insuperable The natural varieties are very numerous and are as yet unisolated. The normal method of seed production is by cross fertilisation. Constant forms are thus difficult to select. One can, however, discover forms that are relatively stable in an essential character and improve on that character. With perennial forms it is always possible to reproduce by vegetative propagation within the selection

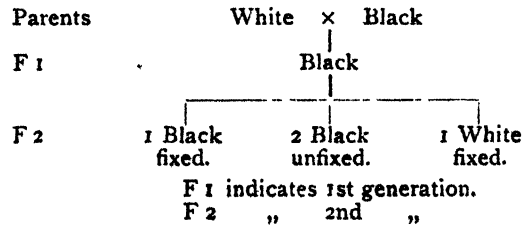
Unfortunately, in the case of grasses, the interests of the farmer who is growing for fodder and of the farmer who is growing for seed are diametrically opposed. A good seeding strain of Perennial Rye grass, for example, is not necessarily a good forage strain. It is possible that some of the hard things said about Perennial Rye grass may be attributable to the development of the species

as a seed plant, without reference to its quality or its ability to stay in a pasture.

The work of selecting and perpetuating useful pure strains is a business which could and should be more definitely engaged in by seed farmers, and it should be one of the functions of a public Seed Station to encourage and assist individual farmers in work of this kind. There is no reason why the specialisation carried on by market gardeners should not extend to seed production in the case of plants grown to be marketed or utilised in mass. The aim should be to produce the maximum number of perfect plants. Local annual shows and competitions, arranged by agricultural societies on a more extensive scale than at present, would greatly help to increase interest in this matter.

The Production of New Varieties by Cross Breeding.—As has been indicated, the tendency in breeding by individual selection (selfing) is to produce forms which are improvements on the original variety in one particular direction. Thus, there may be several strains of a particular variety, each an advance on the mass of the variety, differing from each other, and yet none representing the ideal. Or there may be closely allied varieties excelling in some particulars and wanting in others. The work of the hybridist is to conjoin into one form special qualities distributed among several forms; this work begins where that of the selector ends. Pure line selection gives no more than nature offers when directed along a special route; the hybridist aims at amalgamating into one strain the best qualities developed by selection in two or more strains. Selection of pure lines is a necessary preliminary to experiments in hybridising, and hybridisation is the logical consequent of selection.

The scientific discovery which has opened up immense possibilities in the direction of obtaining new forms rapidly by hybridising is that known as Mendel's law. The following illustration will indicate the general principle of Mendel's law, and its application to the raising of new varieties by hybridisation. If a black skinned barley be crossed with a white skinned barley the result in the first generation is a plant whose grains are black skinned. If the first product of the cross be sown, it will produce plants which are black grained and plants which are white grained in the proportion of 3 black grained: 1 white grained. Only one half of the progeny retains the mixed character of the first generation, the other half reverting equally to the colour of the original parents and breeding true in respect of the colour character, thus :—



F 1 indicates 1st generation.
F 2 „ 2nd „

The black character submerges the white and is said to be dominant.

If, however, there are two sets of Mendelian characters in question, these characters may segregate independently, and in the second generation (F 2) will be plants showing every possible combination of the two characters, thus :—if a black barley with a smooth rachilla be crossed with a white barley with a hairy rachilla the combinations in the second generation are as indicated under.

Parents Black smooth × White hairy.

F 1 Black hairy

F 2

Black[0] Hairy[0]	Black Hairy[0]	Black Hairy[0]	White[0] Hairy[0]
Black[0] Hairy	Black Hairy	Black Hairy	White[0] Hairy
Black[0] Hairy	Black Hairy	Black Hairy	White[0] Hairy
Black[0] Smooth[0]	Black Smooth[0]	Black Smooth[0]	White[0] Smooth[0]

[0] indicates fixed reversionary characters.

Four of the forms breed true, but it is only possible to pick out one, the "White Smooth," in the second generation. This is a new form breeding true to both characters, and quite different from either of the parents The essential fact in the Mendelian system for the hybridist is this fact of segregation.

It cannot, however, be too strongly insisted on that, in its application, Mendelism, as far as our present knowledge goes, only touches the fringe of the problem as it affects the production of new commercial varieties. The features or qualities, *e.g.* in cereals, which are known to segregate according to the Mendelian system, are mainly small, unimportant, morphological features; Mendelian values have, however, been demonstrated by Professor Biffen in certain physiological features in special cases, *e.g.* resistance to rust and milling quality in the case of wheat. In most cases, however, where characteristics are visible or appreciable only as mass characters and cannot be easily distinguished in the isolated individual, it is quite unlikely that they can be separated out in hybrids by Mendelian rules. Nature concentrates the whole hereditary history of a variety in the pollen grain and in the ovule of the single individual plant; the union of these reproductive cells is the start of a replica of the parent. The aggregate hereditary characters represent its correspondence with, and its difference from, other varieties, and these characters are not necessarily only those which are of value for systematic classification. Further, we have to face the facts that, *e.g.* with reference to cereals, segregation is more frequently indefinite than absolute, and that segregation of certain characters in oats and maize takes place in the ear.

Now while, as has been indicated by the illustration given, it is possible to combine two or more visible and appreciable Mendelian characters by hybridisation in one single form which will breed true to these characters, it is another matter to associate with any

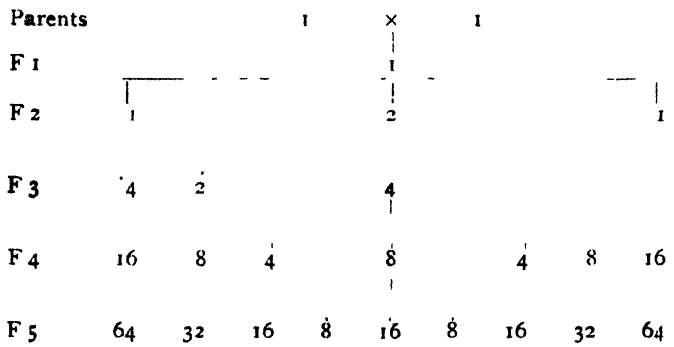
certainty mass qualities of two parents in one derivative hybrid form. In the case of qualities such as meal flavour—an important quality in milling oats—there is no conceivable criterion for determining positively whether this character is Mendelian or not, and even if it were Mendelian, whether segregation takes place as among plants or as among the grains of a single plant.

The value of Mendelian methods to the hybridist, while very great, has been greatly exaggerated and overestimated. To the science of breeding it represents an important addition in the line of advancement of knowledge, an addition which is invaluable, but it is restricted in its application to the problem of raising new and fixed varieties of commercially valuable plants in which it is the mass qualities that chiefly count. The value of Mendel's law to the breeder is that

(1) it will definitely in many cases in the first generation indicate whether a cross has actually been effected or not;
(2) it facilitates the isolation in the second and succeeding generations of forms which will breed true to certain visible and appreciable characters;
(3) it facilitates the breeding of certain characters into strains which are deficient in these characters with certitude and rapidity (or, to state this in another way, the breeding of two characters together in a new form).

There is still a wide field for experiment to discover in how far small unimportant morphological characters may carry other characters linked with them.

It may be laid down as an axiom that it borders on the impossible to raise an absolutely pure line from a hybrid at all. One can raise a line, pure in certain particulars, which can be noted, but strains which are pure in qualities unidentifiable in the individual, or which are constant in mass characters, cannot be selected except by empirical methods. The following diagram indicates the proportionate number of reverting forms in five generations in the case of a pair of Mendelian characters.



i.e. 15 : 1 : constant reverting forms (parent types) : unstable forms.

One can therefore see how far a strain ill selected for a quality character would run back to its originals if that character were hidden and had a Mendelian value.

The successful production of commercial varieties by hybridisation depends, in the first instance, on the establishment of useful strains which are—as far as can be judged—breeding true, and, in the second place, on the judicious selection of hybrids between individuals of the pure line strains which will be an improvement on both the parents. The personal factor is the thing that counts, and the main qualities making for success are enthusiasm, judgment, initiative, imagination, patience, a capacity for work and a mastery of technique.

Lines of Research.—Problems for investigation, in which plant breeding may play an important role, are primarily for the farmer to enunciate. While a scientific investigator cannot go very far wrong in building up improved varieties which tend towards his personal ideal, his improvements may not be of value to a considerable section of the community.

The general trend of breeding and selection is to build up "general purpose" forms of outstanding merit, specially adapted for the best cultural and climatic conditions. The further that this specialisation goes, the more are the poor areas neglected. The initiative in improvement of crops lies with the farmers, who should be encouraged to make a statement of their needs. It may serve a useful purpose, however, to make a few suggestions on particular lines of research which have a reasonable chance of producing useful results.

POTATOES.—The spread of Wart Disease in Scotland has added another problem to the breeder's list, namely, the necessity of producing varieties immune from this disease, in addition to being resistant to Blight, and which are at the same time of high quality and yield, and capable of yielding in a great variety of soils. It is fortunate for the Scottish farmer that the original late varieties were resisters, *e.g.* Clark's Main Crop and Champion (derivatives of Victoria), and that one of the most popular of the second earlies, Sutton's Abundance, is free from the disease, or there is no saying to what extent it might have spread by now. From the scientific as well as from the economic standpoint, the question of immunity to Wart Disease requires working out, and varieties which are constant in the seed sense in respect of resistance to the disease, should be isolated for breeding purposes.

ROOTS.—It is probable that selections could be made from many of the established varieties of turnip and swede for the purpose of obtaining pure lines with high yielding capacity allied to a high percentage of dry matter and sugar content. Selection and hybridisation should also be applied to the production of good strains not susceptible to finger and toe. Commercial varieties which are resistant to this disease are already on the market, but they are deficient in other respects.

CEREALS.—There is a clamant need for general improvement of the type of oat known as Potato. There is probably no oat more widely cultivated, and a large number of new selections, true to this type and suitable for a variety of soils and climates, are

wanted. In no line more than for the improvement of oats is there necessity for a public station. Experiment is needed to produce varieties suited to special areas. In working for the benefit of upland districts, where an upstanding, early ripening, high yielding oat is a necessity, a commercial firm would be working at a loss, but a public station would have relatively unimportant oat districts within its purview. The production of suitable varieties for these districts would give far more trouble than the production of new first class varieties for good arable land.

In the matter of general purpose oats, a finer oat than the usual high yielding varieties is wanted, and one problem before the experimenter is the production of a high yielding, stiff-strawed oat with a fine skin and a good meal flavour. That is a big order, but a few steps in the direction might prove useful to our successors.

In the case of barley, great improvement could, in all probability, be readily made on common Scots. The production of a good variety to be grown after early potatoes would be an advantage. This is another case for a public station, for in this direction the maintenance of a stock would probably be at a loss. Apart from the establishment of new fixed varieties of cereals, experiment should be made to determine the possibility of taking advantage of the exceptional vigour and productiveness of hybrids in the few years following their formation. The success of such an experiment would involve (1) the selection of suitable strains of like habit, which, when crossed, show greatly increased productiveness ; (2) a mastery of technique by a considerable staff of workers ; (3) a high number of crossings ; (4) careful classification of the produce in the second and third generations ; (5) the withdrawal of the variety after a few years ; (6) the annual repetition of the cross in quantity to keep up the supply. Selections as a basis of pure line hybrids could at the same time be made. It is quite within the realms of possibility to produce several acres of even crop in the third generation of a hybrid from the results of a few hours' crossing operations by one skilled operator.

GREEN MANURE.—There is required a good leguminous crop as green manure to make up for the shortage of dung. Such a crop could probably be produced by the selection of seasonal varieties of vetch to suit various systems of rotation.

RYEGRASSES AND TIMOTHY.—It is probable that high seeding qualities of Ryegrass are not compatible with a capacity for grass production and perennial character. Experiment is needed here, and should take the form, in the first instance, of the raising of a large number of comparative lines, and should be followed by a policy of registration of selections. Similar experiments in the case of Timothy might also give useful results.

Summary.—The improvement of crops in an area like Scotland depends on :—

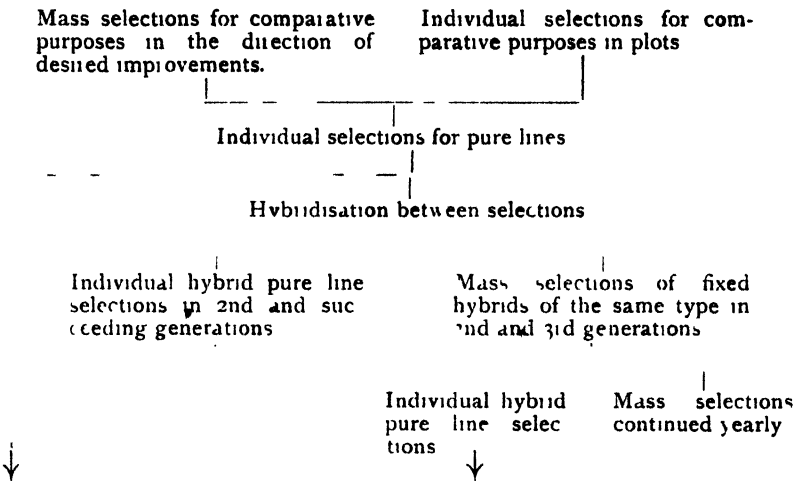
(1) The securing the services of persons capable of judgment in selection and capable of testing selections comparatively, with the provision of opportunity for testing in a variety of conditions. In this matter the co-operation of farmers

in the actual selection and in the indication of the needs of a district is not only invaluable but necessary.

(2) The selection of improvements on existing varieties (whether hybrids or not), the development of the technique, and the application of all methods which after experiment prove useful.

(3) Organised distribution of selections with rigid safeguards for securing the multiplication of pure stock

From a technical point of view the following scheme may be suggested as a profitable plan of operations, particularly with reference to cereals



The establishing of a public institution to carry on this work would be justified on the grounds that, being disinterested, it would readily obtain the co-operation of seed farmers, that it would work for special areas and on special problems even at a relative loss, and that it could develop schemes of official registration which, if carefully carried out, would secure absolutely the predominance of Scotland in the production of those seed crops which are peculiarly her own

RASPBERRY-GROWING IN SCOTLAND.

J. M. HODGE.

RASPBERRIES have been grown in the Blairgowrie district, the centre of the industry, for a long time. About thirty years ago field, as opposed to garden cultivation, became prevalent. The wholesale development of the industry, however, did not begin till 1899, when a small farm of 30 odd acres came into the market,

and started the boom which has not yet quite spent itself. A local lawyer suggested to a Blairgowrie merchant that he should buy this farm, and divide it into small holdings for fruit culture. The merchant, a shrewd business man, saw the possibilities and bought the farm. The best of it was at once let for fruit-culture at £5 per acre, about four times its value from an agricultural point of view. James Stewart, a cobbler, who originally came from Atholl, was one of the first lessees. His holding extended to five acres. He made a calculation and found that it would be better for him to buy the land and pay the price over a period of years. The landlord agreed. James Stewart bought his holding for £100 per acre—then an unheard-of figure—agreeing to pay 5 per cent. on the money and clear the purchase price in six years. Before this transaction was completed, the local authorities of four burghs required ground for an Infectious Diseases Hospital, and he offered on the suggestion of the aforesaid local lawyer to feu to them two and a half acres at £25. They accepted his offer. He then sold the feu-duty for £700. He had thus in a comparatively short time bought five acres of land for £500, sold 2½ acres for £700, and had as profit the remaining 2½ acres, plus £200. A multitude of men followed his example and "went back to the land,"—without, however, making the same money by the way,—bakers, grocers, clothiers, masons, joiners, manufacturers, lawyers, clergymen.

Costs.—The cost of growing raspberries is so high and the risk is so great that a poor man unaided can scarcely go into the trade. Thus few labourers and ploughmen, admirably adapted for the cultivation of the soil on a small scale, are able to become fruit growers. I give the cost of planting an acre of raspberries at the time of which I am writing:—

	£	s.	d.
Preparing the land, which includes ploughing, grubbing, harrowing, drilling, etc.	1	6	0
10 tons farm-yard manure at 10s. per ton	5	0	0
Carting the manure to the field	0	6	0
8000 raspberry canes at £1 per 1000	8	0	0
Spreading manure and planting canes	1	8	0
200 posts at 5d. each	4	3	4
5 cwts. wire at 12s. per cwt.	3	0	0
Labour connected with posting and wiring	0	13	0
	£23	16	4

There are of course other items. There is the cleaning of the plantation during the years the fruit bushes are coming into full bearing. There is the cost of implements and barrels. There are rent and taxes. By the third year the grower has expended between £50 and £60 per acre. Every year afterwards the working expenses are a serious drain upon a poor man's resources. I give the details of the cost per acre of the year's working. The different items vary of course in different circumstances. Sometimes more is done by horse and less by men, but the total does not vary much:—

Cutting strings	£0	6	0
Cutting out canes	0	15	0
Taking out and carrying off canes ...	0	7	0
Tying canes	1	2	6
Cleaning ground in autumn	1	0	0
Putting on farm-yard manure ...	0	8	0
Ploughing in autumn	0	5	0
Cutting tops off canes	0	7	0
Ploughing and cultivating in spring ..	0	5	0
Cleaning twice in spring	1	10	0
Picking fruit, 3 tons at £5 : 10s. per ton	16	10	0
Odd jobs	0	5	0
	£23	0	6

Returns.—The above were the initial and the yearly costs in the early days of the industry What was the return? The best answer will be found not in theoretical but in concrete cases. I take first the case of an allotment holder He had one acre twenty-five poles of ground, which he worked in his spare time. He worked it some years before I had anything to do with it. My figures go back only to the year 1895 The return for every year since then till the plantation was uprooted in 1903 was as follows, viz ·—

Year.	*Crop.*		*Crop per Acre*		*Price per Ton*	*Gross Return.*
	Tons	Cwts	Tons	Cwts		
1895	6	0	5	3	£31	£186
1896	5	5	4	10	£16	£84
1897	5	8	4	13	£31 10s.	£170
1898	3	3	2	14	£38 5s	£120
1899	4	0	3	9	£31 19 2	£127
1900	3	10	3	0	£20 : 9 : 2	£71
1901	3	8	2	19	£20 · 5s.	£68
1902	3	0	2	12	£22 5 · 5	£66
1903	3	10	3	0	£26 · 10s.	£92
						£984

Take now the case of a small-holding. It did not do so well as the allotment just referred to, nor as well as some other small-holdings in the district. But the figures will show that it has no need to be ashamed of itself. It extended to 11 acres 24 poles. It was planted in 1898, and the result of the five years to 1903 was as follows, viz.:—

Year.	*Crop.*		*Crop per Acre.*		*Price per Ton.*	*Gross Return.*
	Tons	Cwts	Tons	Cwts.		
1899	0	19	0	1½	£31 : 19 : 2	£30
1900	7	9	0	13	£20 : 9 · 2	£152
1901	30	12	2	15	£20 : 5s.	£620
1902	48	7	4	6	£22 : 5 : 5	£1077
1903	36	10	3	5	£26 : 10s.	£967
						£2846

The great crops which rejoiced the heart of the grower, and made the industry in those early days a kind of gold mine, are only a memory now. I shall have something to say of the change and the cause of it presently.

The Growth of the Industry.—Meantime the industry was spreading over the braes about Blairgowrie and dipping into the valley at its feet. Men were following each other into it like sheep through a slap in a dyke, not knowing whither they were going, but all expecting something of a fortune by the way. A colony of small-holders was planted on the brae face at St. Fink, more than 500 feet above sea level. Another colony was started a mile and a half east of the town on the land adjoining the highway between Blairgowrie and Alyth. Alyth itself became the centre of the industry in that part of the county. Kirriemuir, better known to the stranger as "Thrums," was smitten with the fever. A business man in 1904 purchased the farm of Knowehead, extending to 70 acres, and divided it into small-holdings Other land was brought into cultivation and the weaver village became a fruit garden. Coupar Angus, to the south of Blairgowrie, followed the lead thus given. The Coupar land is better than some of the land in the other centres of fruitgrowing, but it is bottom land and subject to frost. Still the industry grew till the yearly consignments despatched from the station reached fully 500 tons.

The main development of the industry, however, took place at Essendy, 3½ miles west from Blairgowrie, where 220 acres were divided into small-holdings and laid out as raspberry plantations, and at Aberuthven, near Auchterarder, where something like 200 acres were divided into small-holdings and 400 acres were acquired by Joint Stock Companies, and all devoted to raspberry culture. The progress of the industry will be seen from the following figures, showing the tonnage despatched from the different fruit districts since 1906:—

Year	*Blairgowrie, including Essendy*	*Auchterarder*	*Alyth*	*Coupar-Angus.*	*Kirriemuir.*
	Tons	Tons	Tons	Tons	Tons
1906	1807	.	65	150	85
1907	1872	.	.	...	131
1908	2006	. .	146	111	185
1909	2667	141	363	489	259
1910	2491	456	477	523	303
1911	1901	420	375	389	255
1912	1610	555	274	291	189
1913	1396	564	287	305	178
1914	1512	711	289	320	196
1915	1728	748	335	273	172
1916	1023	550	188	189	98
1917	1502	781	222	274	149

Labour for Picking.—The fruit crop in the smaller centres of the industry is reaped by the villagers. In the Blairgowrie district, at Essendy and at Aberuthven, the picker population has to be for the most part imported, and occasionally the residents have risen

in rebellion against what they call the invasion of the undesirables. At one time there was such an outcry at Blairgowrie that steps had to be taken to secure a more respectable class of worker. It was known that thousands of poor women in the cities were slack during certain weeks in the summer when the fruit fields were needing them—women unable, because of their poverty, to take a holiday, and yet from a national and physical point of view greatly in need of a holiday. The fruit harvest seemed to offer such women an opportunity for a holiday, which would be enriching from both a physical and a financial point of view. It seemed necessary only to tap this source of labour to solve, in large part, the problem. The thing was more difficult, however, than it seemed. Every institution that was likely to help was applied to in vain, and the attempt to get at a class of picker that would be acceptable to the resident population was being given up in despair when the appeal fell into the hands of the Scottish Council for Women's Trades. Miss Irwin, the Secretary, saw that there was a possibility under the scheme of a remunerative holiday in the country for the respectable poor. She took up the work with characteristic energy, and before long was able to promise 100 women, provided they were not associated with the tramp class, and that suitable accommodation would be provided for housing and feeding them. Her requests were readily complied with. The pickers came, and the experiment turned out a success, again and again repeated. The Essendy growers profited by this experiment, and working on a co-operative basis determined to follow the example thus set Their efforts in the early years, when the plantations were young and the crops were small, met with much success. It was otherwise when the bushes came into full bearing and thousand of pickers were needed to reap the crop. The Scottish Council for Women's Trades, who showed us the way to get pickers, found the work too burdensome and gave it up. Mr. John Kidd, a Local Insurance Agent, who was acting as Superintendent at the Essendy Settlements at the time, took it over. It was done by him, as it had been done from the start, on co-operative lines. He secured the pickers and divided them among the growers. He did the work, which was found to be very difficult, better than it has ever been done since, but the result was disappointing, not because of the class of pickers obtained, but because it was necessary to engage at least 1500 pickers or more in order to secure 1000. Mr. Kidd's death in 1912 removed the peg on which the picker question was hanging. It was hoped that the Labour Exchange, not long instituted, would do the work, and because of its more perfect organisation would perhaps do it even better. In this we were disappointed. I hasten, however, to say that the fault for the most part lay neither with the Exchange nor with the officials. Most of them did what they could to solve the problem, and if they failed it was not so much because of any fault on their part, as because success in the present state of our industrial organisation, or want of organisation, is apparently impossible. At any rate we were not able to secure year in and year out more than seven or eight hundred respectable women workers from the towns of Scotland.

There were few local pickers at Aberuthven when the industry started there, and the growers' stand-by was the tramp, who came into residence for the fruit season. He, or rather the liquor which he bought in the public house, which was often so full that the door had to be shut that those within might be served, turned, so the good people of Aberuthven said, the quiet countryside into a region of the damned. Fights of varying skill, according to the stages of drunkenness which the combatants had reached and the sex to which they belonged, became the order of the day and of the night. The more helpless littered the roadsides, drinking till they could neither sit nor stand, and finished the day by hugging to their bosoms bottles in different stages of emptiness, mostly the later stages. If the district suffered by the invasion of the picker population—and who will say that it did not—the fruitgrower greatly benefited. It is not too much to say that the fruit harvest could not have been reaped but for the tramp. And this at least can be said for him—if it were not for the public house, the tramp would in many respects be the most competent and not the least desirable of all the picker population.

But the tramp failed us in the first year of the war. Reserve men, forgetting the folly or the misfortune which brought them to the "road," left the fruit fields on the declaration of war, in August 1914, whistling and singing with the joy that takes hold of a boy as he sets out for a holiday. I can see one of them yet, a great hulk of a guardsman, as he swung along the road, light of heart and light of foot, rejoicing with exceeding great joy that he was soon to be marching with his comrades to the war. The country's call in subsequent months found others who had not been professional soldiers ready, and it was soon apparent that there was to be a shortage of pickers to reap the fruit crop of 1915. But war-workers had then come to the front, and fruit growers gladly availed themselves of their services. Ultimately, after the less patriotic of them who had taken it up because it was new and fashionable fell out, they were not sufficient for the work, and we had to search about for other sources of labour. Ordinary school children, apart from local children, had been found irresponsible, and usually beyond the control of their employers and teachers alike. We thus gave them a wide berth and turned our attention to Reformatory and Industrial School children, because experience in pre-war days had taught us that they at least were disciplined. And we were not disappointed. The Superintendents' first consideration, naturally, was the children's welfare. That settled, they realised that they had come to pick fruit urgently needed for the Army, Navy and the civil population, in a great national crisis, and generally they settled down to the work, making for all of us crooked paths straight and rough places plain, and in the second year of their sojourn they became so important as to constitute a kind of backbone to our picker population, and we were throwing out feelers to find out whether, when the war was over, they would come back again. But we were still short of labour in harvest-time, and had recourse in the last year of the war to two or three hundred German prisoners, who completed the crowd of all sorts and conditions of people who picked our fruit in war-time.

Disposal of the Produce.—The bulk of the Scottish raspberry crop in normal times is sent in cwt. barrels to preservers in the United Kingdom. I have not the figures showing the distribution of the whole Scottish crop. I have, however, the figures showing the distribution of the Blairgowrie crop for the five years immediately before the war, and Blairgowrie being typical of the other districts so far at least as the distribution of its crop is concerned, these figures will give a fair idea of the distribution of the whole crop. The proportion retained by Scotland for its own use is considerable.

Year.	*Total Blairgowrie Crop.* Tons.	*Proportion of Crop used in Scotland.* Tons.
1910	2491	652
1911	1901	506
1912	1610	553
1913	1396	455
1914	1512	339

It had long been felt that a London market, if not necessary, was at least desirable, but the poor train service made it impossible. Many of the London preservers would purchase only on the condition that the fruit was delivered to their works on the forenoon of the day after it was picked. This was possible only by passenger train, and the freight, when returns were taken into account, was about £7 per ton, which was prohibitive. After a good deal of fighting and delay the Railway Company put on a London goods express, which met the demands of the London preservers so far as transit was concerned, and satisfied the growers so far as freight was concerned. The result was the establishment of a considerable London trade.

Year.	*Quantity sent to London.* Tons.
1908	30
1909	416
1910	441
1911	336
1912	80
1913	110
1914	157

The trade with other parts of England, however, was much greater than the trade with London, due largely to the fact that Sir William P. Hartley's Works are situated in Aintree, Liverpool, and the Co-operative Society's Works at Middleton Junction, Manchester. Between them they take a considerable part of the Scottish crop. These are the consignments to English towns outside London:—

Year.	*Tons.*
1908	1363
1909	1464
1910	1305
1911	968
1912	883
1913	780
1914	937

During the earlier years of the war the Government, so the rumour went, had been informed by their experts that raspberry jam caused appendicitis, and therefore should not be supplied to the Army and the Navy. I believe there was some truth in the rumour, but none in the experts' opinion. In any case, the Government made no purchases of raspberries for the troops in 1914-15, with the result that the distribution of the crop remained pretty much what it was before the war, only there seemed to be rather less than the normal demand. In 1916, however, a considerable proportion of the crop was commandeered. By 1917 the Scottish raspberry crop had assumed such importance that the Government commandeered the whole of it, amounting to 3539 tons, using over 2000 tons for the Army and the Navy, appendicitis notwithstanding, which of course entirely altered the normal distribution of the crop. The crop was not commandeered in 1918, but the price was fixed, and the controlled houses—the houses employed by the Government to buy for the Army and the Navy—got the bulk of it.

The result, to the growers, of the Government's action in commandeering the crop and fixing the price considerably below the level at which, on account of the smallness of the crop reaped, raspberries were selling in the open market, is exemplified in the following figures, showing the gross return from the Aberuthven Small Holdings during the four pre-war and four war years:—

1. PRE-WAR YEARS.

Year.	*Acres.*	*Tonnage.*	*Gross Return.*
1911	189½	233	£6,784
1912	189½	368	10,767
1913	189½	413	13,261
1914	196	535	15,723
			£46,535

2. WAR YEARS.

Year.	*Acres.*	*Tonnage.*	*Gross Return.*
1915	196	380	£8743
1916	196	217	4903
1917	196	232	8492
1918	146	211	9581
			£31,719

Thus, unlike the ordinary farmer, the raspberry growers were put into a much worse financial position than they were before the war, necessitating in some cases the uprooting of plantations and the destruction of small-holdings.

Limitation of the Industry.—The main factors which meantime limit the extension of the industry are two, (1) a deficient labour supply, which has now become chronic, and (2) the depredations of insects, which have become so serious as to threaten the existence of our plantations.

LABOUR SHORTAGE.—The shortage of labour is due to the shortness of the season, and the fact that the number of workers

needed to pick raspberries is out of all proportion to the number of workers regularly employed in the raspberry fields. The shortage is not so much felt in the vicinity of villages, where local pickers are available; but it has become serious in the larger centres of the industry, which are not near populous places. It is not too much to say that there is now—I am not thinking of war-time—a real difficulty in reaping the crop, and that a very definite limit has thus been set to the extension of the industry as at present carried on.

INSECT PESTS.—We have suffered especially from three insects. I take them in the order, not of their destructiveness, but in the order in which during the season they attack plantations:—

Raspberry Moth.—Five and twenty years ago we were concerned on many a cold spring morning to see, as we thought, in withered bud and drooping leaf the effect of the previous night's frost. Some one picked off a bud and found that it was not the frost but the red caterpillar of the raspberry moth, popularly known as the "borer," which had eaten its way into the bud and was causing the trouble. It must have been in our plantations before, though we did not know it. It has come to us ever since with the regularity of the seasons and in ever increasing numbers. On the approach of spring, as the sap rises and the buds burst, the caterpillar, bent on destruction, crawls up the canes and pushes its way into the newly formed buds, destroying sometimes one bud, sometimes two and sometimes three, leaving the plant in a half dead condition, struggling to throw leaves which it cannot sustain and to produce fruit which it cannot mature.

Raspberry Weevil—The raspberry weevil took up residence in our plantations later in time than the raspberry moth But it has long since made up and more than made up for its late arrival. It is very like the earth in which it lives, and you may be looking at it for a long time without seeing it. It apparently has instinct of no mean order, for the moment it comes under the vision of the human eye it appears dead, playing the part with consummate skill. Like all evil doers, it does its work under the shelter of the night when respectable people are in bed. It is much more destructive than the raspberry moth. The moth destroys the buds after they have burst, and thus before the bush has exhausted itself in producing a rich foliage. The weevil does not begin in earnest until the bushes are in full leaf, and it goes on until the bloom has burst and sometimes till the fruit is partially formed. It nips the twigs, and with them whole bunches of what in a few weeks would have been luscious fruit. And it works so assiduously and to such purpose that in a very short time it clears a plantation; and this so late in the season that there is no time, even if the bushes had the energy, to produce other leaves and other fruit.

Raspberry Beetle.—Before the weevil has quite finished its work of destruction, the raspberry beetle arrives on the scene. Entomologists are of opinion that the beetle nips off the flower buds. I have never seen them nip off the flower buds, though I believe they are capable of doing this. I have seen them, however, boring their

way inside the buds, and I have seen them in the buds as thick as herring in a barrel. They form a black circle inside the bloom. The result, according to the completeness with which they have done their work, is either malformed berries, which we used to think were caused in large part by defective fertilisation, or no berries at all, which we used to think was due to frost. The beetle thus brings to a fitting climax the work of destruction which the raspberry weevil handed over to it.

The thoroughness with which the work has been done by the trio will be seen if we compare the crops that we used to grow with the crops that we grow now, for the difference, without any manner of doubt, is due largely to the depredations of the insect world.

The acreage under raspberries in the Blairgowrie district has not, so far as I have been able to find out, varied much since 1909, the year in which raspberry-growing reached it climax. But the crop has been gradually going down :—

Year.	*Crop.* Tons.
1909	2667
1910	2491
1911	1901
1912	1610
1913	1396
1914	1512
1915	1728
1916	1023
1917	1502

Now compare four of the best years of some of the earlier with four of the best years of some of the later plantations, taking allotments on which the return is usually greatest as well as small-holdings, and you will find the same tendency equally well marked :—

1. ALLOTMENTS.

EARLIER.

Allotment at Rattray.

Year.	*Tonnage per Acre.* Tons.	Cwts.
1895	5	3
1896	4	10
1897	4	13
1899	3	9

LATER.

Allotment at Aberuthven, Auchterarder.

Year.	*Tonnage per Acre.* Tons.	Cwts.
1912	3	13
1913	3	13
1914	4	0
1918	3	4

The average tonnage per acre of the earlier allotment was thus 4 tons 8 cwts., while the average tonnage per acre of the later allotment was only 3 tons 12 cwts.

2. SMALL HOLDINGS.

EARLIER.

Small Holding at Rattray.

Year.	*Tonnage per Acre.* Tons.	Cwts.
1902 ...	4	6
1903 ..	3	5
1904 ..	3	13
1905 ...	3	11

LATER.

Small Holding at Aberuthven, Auchterarder.

Year.	*Tonnage per Acre.* Tons.	Cwts.
1912 ..	2	4
1913 ...	2	3
1914 ..	2	16
1915 ...	2	11

The average tonnage per acre of the earlier holding was thus 3 tons 14 cwts., while the average tonnage per acre of the later holding was only 2 tons 8 cwts.

And since 1915 the downward tendency has been even more marked. It is questionable whether, taking the ordinary holdings, and not good holdings such as these I have taken, the average now exceeds 30 cwts. per acre. And some plantations which we should not have considered old a few years ago have already reached the low-water mark of 1 ton per acre—a figure which, but for the present high prices, would not pay the working expenses.

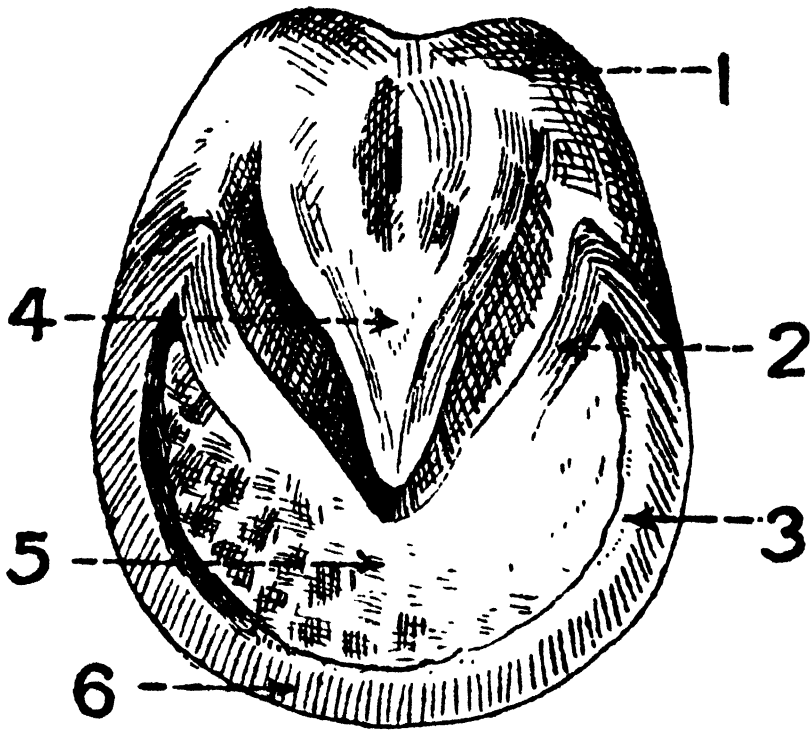
Scientific men tell us that there is within certain limits, determined by soil and climate, a high level of fertility beyond which production cannot rise. We in Scotland must at one time, when the soil was new to the raspberry plant and all the factors of production were favourable, have been in the vicinity of this high level. They also tell us that there is a low level of fertility beyond which production cannot fall. We seem now to be approaching this low level. Can we get up at least mid-way between the two? I think we can, not so much by combating insect and other pests, though something may be done in that direction, as by adopting a more rational system of fruit-culture, in which change of soil and vigour of stock will play a greater part, and make possible the prevention rather than the cure of the diseases that have been eating the life out of our plantations

THE CARE OF THE HORSE'S HOOF.

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THE foot of the horse has always been considered one of the most important parts of its anatomy. More than two thousand years ago, Xenophon, in his work on "Equitation," wrote that "the members are the first parts to be examined in a horse, and in the examination of the legs, look first at the foot." Bracy Clark, the earliest of British writers on the foot and horse-shoeing, over a century ago translated the thoughts of Xenophon in the following words:—"Incerta basis, instabile ædificium." We have the same idea in the present day aphorisms—"No foot, no horse"; "A man is as old as his arteries, a horse as old as his feet and legs."

Structure.—The foot is composed of a central bony core round which all the other parts are moulded. The outer envelope of the foot is termed the hoof. (Hoof, claws and nails are simply modified skin — modified to resist the excessive wear imposed on the termination of the digit.) The hoof is composed of four parts, viz., wall or outer crust, bars, sole and frog. The wall is that part visible when the foot is on the ground, and it is divided arbitrarily into three parts, toe, quarters and heels. It is longest and thickest at the toe, and shortest and thinnest at the heels, where expansion has to occur. This wall does not terminate at the heels, but is reflected inwards, and runs forward to terminate towards the apex of the frog. These reflected portions are called



(1) Heel. (2) Bar. (3) White Line. (4) Frog. (5) Sole. (6) Wall.

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the bars. The wall is therefore an incomplete circle of horn, and this admits of expansion at the heels. The bars act as weight carriers, and being interposed between the frog and the heels, they prevent the latter turning or curling inwards. In a good foot they must be strong and well developed.

The sole of the hoof is concave, and especially so in the hind feet. It is not intended to carry weight except at the outer edge, where it joins the wall. That junction is marked by a white line, quite noticeable in a newly-dressed hoof. The white colour is due to the horn being unpigmented.

The frog is a triangular, india-rubber like, highly-elastic pad, accurately moulded on the plantar cushion above it, and interposed

between the bars and behind the sole. In the centre and at either side there is a deep cleft. It is in these clefts that the disease "thrush" occurs. In a good foot the frog should project beyond the wall, and in both shod and unshod hoofs it should always come in contact with the ground and bear weight. If removed from the ground by high calkins or by an overgrown wall, it soon atrophies and shrinks, thus allowing of contraction of the heels. It is one of the great anti-concussion mechanisms of the foot. It gives the animal a good foothold and keeps the heels expanded, and thus cannot be too well developed or too strong. Around the coronet or upper limit of the foot, just below the skin, there is the periople ring. This secretes a varnish called periople, which covers the outer surface of the hoof and prevents evaporation from, and subsequent desiccation of, the hoof. It should never be rasped off in the process of trimming or shoeing.

Growth.—The wall grows from the coronet all the way round at the rate of about half an inch per month. It takes fully a year to be renewed at the toe, five or six months at the quarters, and three or four months at the heels. The growth of horn is influenced by many factors. It is more active in warm weather than in cold, and in well-nourished healthy animals than in diseased and badly nourished ones. Parallel rings such as are sometimes seen around the surface of the hoof indicate that the animal has been better nourished and been sometimes in better health than at other times. It is important to note that the unshod hoof grows more quickly than the shod.

Horn is a hard, resisting and elastic substance, which remains soft if moisture is present, but becomes hard and brittle and liable to crack if evaporation has taken place. This condition is often seen in diseased feet, or where the periople has been rasped off the wall at shoeing. For diseased, brittle feet, a hoof ointment is very useful. Liquid tar, beeswax and honey, of each an ounce, lanoline and vaseline, three ounces each, is a useful preparation. The growth of the hoof is stimulated by repeated mild blistering. This also encourages the growth of a nice fringe of hair round the coronet, which is essential to the appearance of a good Clydesdale. Liquid cantharides is a very useful preparation for this purpose, and should be rubbed into each coronet for about three minutes. In order to obtain good results it is essential to anoint the part daily, after the blister has been applied, with a non-irritating oil such as colza. The blister may be repeated after a month. In foals, before weaning time, soft soap, well rubbed in, encourages the growth of the hoof and the hair around the coronet. The most marked effect of blistering in young stock is observed in the spring, at which time the hoof naturally begins to grow rapidly.

Treatment.—The parts of the hoof which should carry the weight of a horse are the wall, and that part of the sole adjacent to it, the frog and the bars. It is at once obvious, therefore, that the unshod hoof or the hoof prepared for shoeing should be so reduced as to allow of all the parts named to take on their proper function. Up to recent times it was considered that the foot of the youngster could look after itself, and it received little or no

attention until the animal was yoked at three years of age. There could be no greater mistake. It is during these three years that it is possible to cultivate a good foot, and to correct errors in conformation of the limbs, and not afterwards. The care of the foot should begin with the foal. By the age of six weeks or two months, the wall has often grown considerably beyond the level of the outer edge of the sole, and the heels have begun to grow deep and strong, which condition interferes with the elasticity of the part, removes the frog from the ground, and allows of contraction. The heels of the young animal's foot, as can be seen from their direction, have a tendency to curl inwards, and if left alone may produce a contracted foot. The chief object is to get them to spring, and to slope nicely outwards. Early trimming will bring about what is desired. The wall should be cut down with a sharp drawing knife until it is level with the outer edge of the sole all the way round. The heels especially should be reduced until the bars and frog are pressing on the ground. The toe has a tendency to grow too long, which throws too much stress on the back tendons. It must therefore be shortened, but not so much as to produce a "stumped up" condition where the wall of the toe has been cut, and evaporation of the horn is allowed, to the detriment of the horn. The unshod hoof should be trimmed in this way every month. It is absolutely prohibitive to cut the sole, frog or bars, or to cut out a wedge-shaped piece, between the heel and the frog, as some do, with the idea that it favours expansion. It has the opposite effect, as the frog has nothing to press against. This is all the attention that is necessary for the fullest development of a good foot in an animal with limbs absolutely straight and well formed, which moves straight and close. Such animals do not require to be shod. The unshod hoof grows more quickly than the shod. Shoeing is necessary if the animal is to be shown, when a well-grown and unbroken wall adds to the appearance of the foot. The animal should be shod ten weeks before the show and the shoes lifted twice. The best shoe for this purpose is a very thin plate, which will not raise the foot far from the ground so as to interfere with frog pressure. It should be level on its bearing surface, and just sufficiently wide to press on the wall, and on one-eighth of an inch of the outer edge of the sole. It should press on the bars and their connection with the wall at the heels. The last nail should not be behind the middle of the quarter.

Unfortunately many foals are born with limbs far from being straight and perfect. They may be bent and distorted in various directions. The reaction of the distorted limb on the foot and *vice versa* is a serious matter in youngsters, where the tissues are soft and plastic, and easily moulded to external conditions. It is often possible to improve defective limbs by early attention and shoeing. Unfortunately space will not permit of a consideration of all the defects and the remedies for the same. I will select one example, viz., a youngster going wide behind. In this case often the outer side of the column of bones of the limb is longer than the inner, and hence causes the limb to bulge outwards. Greater pressure is exerted on the outer wall of the foot, which wears away, while the inner wall grows too long, and soon the foot becomes

misshapen and twisted. Such a foot will prevent the limbs from assuming their natural direction, if, as time goes on, they should have a tendency to do so. It is not advisable to shoe a foal much before weaning time. In such a case the inner wall should be cut down, the toe shortened, and the outer wall allowed to grow long. The inner side of the frog may also require to be lowered so as to allow the inner wall to come to the ground. This trimming should not be persisted in longer than weaning time; if so, it may result in a twisted hoof. After weaning time all the alterations should be on the shoe. At this time the foot should be reduced, as directed for a normal foot. A shoe should be applied very thin on the inner branch and around the toe, and thick at the outer quarter and heel, and a small calkin on the outer heel. The thickening, not great at first to cause strain, may be gradually increased or decreased, according to results. With this shoe, a gentle but continuous pressure is exerted on the outer side of the column of bones, which prevents that side from growing as quickly as the inside, and the limb will gradually grow more under the body. The calkin stops the foot suddenly, a little short of the normal step. The toe is made to turn outwards, and consequently the point of the hock will turn inwards.

The foot is the foundation of the animal, and, though not too well shaped in the youngster, provided it has a good coronet and a good quality of horn, it is generally possible, with a little study, care and attention, to cultivate a foot which will carry the animal without trouble during its lifetime.

THE UTILISATION OF WATER POWER.

[CONTRIBUTED.]

ONE of the many results of the tendency to follow an established precedent is well exemplified in the almost universal employment of steam as a "prime mover" under almost every condition, and to the exclusion of practically all other sources of power. Because, at the time of the invention of the steam engine, it paid to establish large steam-driven works in the vicinity of our coal fields, it appeared until recently that it was almost axiomatic that any power user, large or small, should instal steam-driven plant. Pioneers with voices that seemed to be "crying in the wilderness" have pointed out for long that a most valuable prime mover in the form of water was being neglected, to the detriment of the country at large, but it was only recently that public attention was really fixed on this matter, and then only by the sheer necessities of the time, viz., the threatened shortage and actual increase in price of coal. It is gratifying to know, however, that the utilisation of water power is now receiving the attention of the Government, and a Royal Commission is at the present time enquiring into the power available in the United Kingdom, and as to how it can best be used for the good of the nation.

Prior to 1870 water power was much more extensively used

than steam power, but the power was in the majority of cases unscientifically developed and crudely applied. The application of many minds to the perfecting of the early steam engines, and the neglect of inventors to devote adequate attention to the scientific design of appliances for the utilisation of water power, resulted in a rapid increase in the use of the former and a rapid decline in the latter. Of late years, however, there has been on the Continent, in America, and to a lesser degree in Britain, a renaissance in the design of water power machinery, and recently water-driven turbines have been constructed having an efficiency as high as 88 per cent.

To-day reconstruction and the regeneration of rural life and industries are urgent questions, and if Britain is to maintain her place in the markets of the world it is essential that cheap power be made available, and if it can be provided in districts where congestion of population, buildings and traffic is absent, so much the better.

In the upland waters of our Scottish Highlands there is much latent power under just those essential conditions indicated above; in fact Scotland, with its high level gathering grounds, large rainfall, natural storage facilities in the way of lochs and glens capable of being converted into reservoirs, is pre-eminently favoured in this respect. The undeveloped possibilities of our water power are enormous, and it has been calculated that the water at present running to waste, if properly utilised, could be made without excessive capital expenditure to develop upwards of 650,000 horse power, while, by the adoption of suitable measures for the adequate conservation of flood waters, it is probable the above estimate of available power might be very materially increased. Be this as it may, it is obvious that there is in Scotland an enormous potential power in the water of her streams and rivers, and it behoves everyone interested in the nation's welfare to try to see that this power, with its possibilities of wealth production, is developed for the country's good.

As regards agriculture, the uses to which water power can be harnessed are many. When it is realised that a stream of water equal to about 36 gallons per second, if delivered to a turbine with an 80 per cent. efficiency, through a fall of 30 feet, will be sufficient to develop about 16 horse-power continuously as long as the volume of water is maintained, it will be seen that the requirements for the successful exploitation of the smaller water powers are not severe. A turbine of the power mentioned will be ample for the needs of an average 200 to 300 acre mixed arable and dairy farm, and will be sufficient to drive the threshing mill and buncher, crusher, hay and root cutters, cake breaker, etc.,—in fact all the stationary appliances on a farm for which power is required. Provided the available water is sufficient to maintain the flow at night, such a turbine could quite effectively be utilised for the driving of a dynamo-generating current for the lighting of the farm house and steading buildings.

With the combination of turbine and dynamo, it is possible that in the future we may have electrically-propelled motor ploughs and tractors at work performing the bulk of the labour now done by horses. Indeed one has only to visit some of the up-to-date

farms in Fifeshire, where electricity is obtained from the Fife Power Company, to be convinced of the future of electricity in farming, whether obtained from an outside source or generated by the streams on the farm. In one of the farms referred to a 1½ horse-power motor is used to drive two turnip cutters and a Wade's No. 4 churn, while the thresher and buncher, crusher, hay cutter, grindstone and circular saw are driven by a 14 horse-power motor. The farmer is thoroughly satisfied as to the economy of this method of working, even with the high charge of 4½d. per unit for current, and when it is remembered that the cost of producing current by the utilisation of water power is frequently less than a ½d. per unit, nothing further need be said on this point.

The home production of fertilisers is what might well be termed a "key" industry, and is a matter which is engaging considerable attention at the present time. For this purpose cheap electric power, such as can readily be supplied by suitable hydro-electric plant, is essential for the successful production of certain necessary constituents, such as nitrates. Hitherto Chile has practically supplied the world's requirements of nitrates, but the deposits are not inexhaustible, and according to some authorities the end is even now in sight. Germany recognised this fact years ago, and for a considerable time prior to the war her chemists were engaged in research work as to the possibility of fixing atmospheric nitrogen in commercial quantities, and at prices that could compete with the Chilian product. Several processes have now been patented by Germans, and contemporaneously with their investigations, experiments were also made in Austria and in Norway, each of which countries is now producing nitrogen and carrying out other electro-chemical processes from power obtained in the first instance from waterfalls. There is little doubt that very considerable quantities of the nitric acid required by the Central Powers for munitions during the war have been obtained from the atmosphere, and chemists in this and other countries will doubtless be anxious to learn what progress has been made in Germany, since the national necessity will doubtless have evoked the best efforts of their chemists. It appears that for the successful working of plant for the fixation of atmospheric nitrogen, the power required is from 10,000 horse power upwards, if production on a commercial basis is contemplated. When it is remembered that the process is one requiring the full power night and day and seven days in the week, it will be realised that we have here the ideal form of demand from the power producer's point of view, and one permitting of the adoption of the most economical methods in the development of hydro-electric power. There are many sites in the Scottish Highlands where blocks of power suitable for this process can be developed, and where sea and rail transport facilities are readily available, together with the added inducement of cheap land and a resident population which would form the nucleus of a larger community.

As indicated earlier in this article, it is not only in the larger quantities that this latent water power can be utilised; there are hundreds of places in Scotland adjacent to rail, road or sea where it would be possible to develop economically from 100 to 2000 horse power, and thus provide the necessary modern essential

for the reconstruction of our old rural industries and the establishment of new ones.

If a system of hydro-electric power stations were established at convenient intervals along our main Highland roads, a convenient centre would be provided from which neighbouring townships or works might draw power, and charging stations could be created at which electrically-propelled motor vehicles might have their storage batteries recharged. Such a system, with an efficient service of vehicles, would go far to solve the rural transport question, and in many cases relieve congestion on the railways.

Our Highland glens were, prior to the war, being rapidly depopulated by the young people migrating to the towns, but with the splendid possibilities which might be opened up by the provision of cheap water power or hydro-electric power, as the circumstances demanded, one would hope to see this exodus retarded, and employment found for the boys and girls at home in their healthy native Highland atmosphere.

To encourage manufacturers in their quest for sites it would be a great advantage if a Government Department—say the Board of Agriculture for Scotland, which is already empowered to assist "rural" (not necessarily "cottage") industries—were entrusted with the duty of preparing data regarding water power available in the most suitable places in Scotland, with particulars of population, feu duties for sites, rates and taxes, and of facilities for transport, etc. It is only by being in a position to give such positive information that the demands of our manufacturers can be met.

THE EDUCATION (SCOTLAND) ACT, 1918, IN RELATION TO AGRICULTURE.

THE new Education Act, which became law on 21st November 1918, and which will come into force on a day to be appointed by the Education Department, introduces important changes into both the organisation and the scope of school instruction in Scotland. It substitutes for the School Boards that have existed for the last forty-six years County Education Authorities controlling the whole system of public elementary and secondary education within their areas, and it provides a scheme of care and training for boys and girls from the age of five, and in certain cases from that of two, to that of eighteen.

The age-limit for compulsory attendance at school is raised to fifteen, and that for the exemption of individuals to thirteen (Section 14), while important alterations are made in the regulations regarding the part-time employment of children of school age (Section 16). Power is given to the Education Authority to supply or aid in supplying nursery schools for children over two and under five years of age "whose attendance at such a school is necessary or desirable for their healthy physical and mental development," and to attend to the health, nourishment and physical welfare of these children (Section 8). At the other end of the

scale provision is made for the compulsory attendance at continuation schools of lads and girls between fifteen and eighteen years of age (Section 15).

It is enacted that voluntary or denominational schools, as defined in the Education (Scotland) Act, 1897, shall be transferred to the Education Authorities within two years, due provision being made for the maintenance of their denominational character (Section 18). Religious instruction in ordinary public schools is to remain on its present footing of "use and wont" (Section 7). Reformatory and industrial schools are to pass from the direct control of the Secretary for Scotland to that of the Education Department (Section 19). Education Authorities are empowered to facilitate the attendance at secondary and intermediate schools of all boys and girls qualified for such attendance by payment of fees, travelling expenses and maintenance, or otherwise, and they may similarly assist towards attendance at Universities, Training Colleges, Central Institutions, etc. (Section 4). They may also contribute to the maintenance of schools within their area that are not under their own management, and to that of Universities and Central Institutions (Section 9) Finally they may "as an ancillary means of promoting education" provide libraries for the use not only of boys and girls, but of the adult population in their area (Section 5).

The administrative changes made by the Act involve the disappearance alike of School Boards and of Secondary Education Committees. In the Bill as originally drafted it was proposed that education should be locally controlled, as it is in England and Wales, by Education Committees appointed by the County Councils. In the course, however, of the long discussion that took place this was abandoned, and the principle of the *ad hoc* body has been retained. The new education area is the county, including all burghs situated within it, save that Edinburgh, Glasgow, Aberdeen, Dundee and Leith form separate education areas (Section 1). The Secretary for Scotland will by Order determine the number of members who are to constitute each authority, and will divide each area into electoral divisions among which the members of the authority will be apportioned (Section 2). The electors are the persons registered as local government electors under the Representation of the People Act, 1918 (Section 22), and the voting is to be according to the principle of proportional representation, each elector having one transferable vote (Section 23). The cumulative vote is thus abolished, and a more rational method of securing the due representation of minorities is adopted.

For the management of schools or groups of schools, school management committees are to be formed, including representatives of the Education Authority and of the parents of the children attending the schools concerned, at least one teacher, and (where there are denominational schools) at least one person chosen on religious grounds (Section 3).

An Advisory Council will be appointed by the Crown for the purpose of advising the Education Department on educational matters (Section 20), and local advisory councils of a similar character are to be established by the Education Authorities

(Section 25). The Department is in future to be known as the Scottish Education Department instead of "Scotch" (Section 30). Women, whether married or single, are equally eligible with men for appointment to all bodies constituted under the Act (Section 28). No certificated teacher can be dismissed unless (*a*) he receives three weeks' written notice of the motion for his dismissal; (*b*) not less than half of the members of the Education Authority are present; (*c*) not less than two-thirds of those present vote for his dismissal. The appeal to the Department is retained (Section 24).

The provisions of the Act most vitally affecting agriculture are those affecting the conditions of part-time employment of children of school age, and those requiring lads and girls between fifteen and eighteen years of age to attend continuation classes. It is provided that a child under thirteen years of age shall not be employed on any school day before the close of school hours, or on any day before 8 a.m. or after 6 p.m.; nor is any child between thirteen and fifteen years of age to be so employed unless he or she has been exempted from school attendance. Power is, however, given to the Education Authority to vary these restrictions by byelaw, either generally or for any specified occupation. It is thus impossible for a farmer to employ whole-time a boy or girl under thirteen in any circumstances, or to employ whole-time a boy or girl between thirteen and fifteen who has not been exempted from school attendance, while, unless the power of varying the restriction is exercised, such children may be employed only for an hour or so on school days, and only between 8 a.m. and 6 p.m. on Saturdays and holidays.

The provisions regarding the attendance at continuation classes of lads and girls between fifteen and eighteen years of age are more elaborate, and in view of the controversy that has taken place regarding them they should receive the special attention of everyone interested in the future of agriculture in Scotland.

In the first place the Education Authority is to consult persons concerned in local crafts and industries and to make full inquiry into local circumstances before drawing up for the approval of the Department a scheme of instruction in continuation classes. In the case of boys and girls between fifteen and sixteen years of age this scheme is to be submitted within a year after the "appointed day" on which the Act comes into force. The scheme for older lads and girls does not come into force until three years after the appointed day. Then in the carrying out of the scheme, and particularly to facilitate the registration and classification of lads and girls, the Authority is to invite the co-operation of associations or committees of employers and workmen in the various local industries. The scheme is to include instruction in the English language "and in such other parts of a general education as may be deemed desirable," special instruction of a technical character and physical exercises. Attendance is to be for at least 320 hours per annum, "distributed as regards times and seasons as may best suit the circumstances of each locality"; but the classes must be held between 8 a.m. and 7 p.m., and the period of actual employment in any day or week, together with the time spent at classes

and that spent in travelling, must not exceed the period of employment permitted by any Act of Parliament that applies to the person concerned.

Lads and girls whose education is otherwise satisfactorily provided for are not brought under the scheme, and the Education Authority may exempt individuals from the obligation to attend classes where they are satisfied that the circumstances justify exemption.

It has already been stated that the full scheme does not come into operation until three years after the appointed day, *i.e.* some time in the year 1922. Nor does it apply to any boy or girl who reaches the age of sixteen during that period. Its operation will thus be gradual, and abundant time is given for the various industries of the country, including agriculture, to prepare for the new conditions.

The new scheme may shortly be described as one of "universal compulsory continuation classes," save that attendance at classes is no longer to be an addition to the lads' or girls' working day, but is to be taken out of it.

Some of the critics of the Act appear to regard it as laying a burden upon the employer, which he must, in the interests of production, do his best to minimise. This point of view is, however, a short-sighted one, which ignores alike the conditions of modern industry, whether urban or rural, and the provision that the Act makes for the fulfilment of these conditions. Whatever may be the future policy of this country with regard to agricultural production, it is obvious that trained intelligence is essential to the maintenance of the position that Scotland has held in the past. Nor can it be seriously maintained that the conditions of agriculture are such as to justify its exclusion from a national scheme that is intended effectively to co-ordinate elementary, secondary, technical and university education. On the contrary, anyone who is familiar with the educational systems of Denmark, Canada and the United States, to mention no other countries, will see that the new Act gives Scotland for the first time an opportunity of coming into line with the modern development of agricultural education.

Much will depend on the spirit with which the Act is locally put into operation. It makes the fullest provision for those practically concerned with agriculture to take part in its administration, whether as members of Education Authorities and School Management Committees, or as members of the proposed advisory industrial committees, and thus to ensure that the schemes of instruction shall meet the requirements of the various districts of the country, both in their scope and in the arrangement of times and seasons.

The burden laid upon agriculture, if burden it can be called, is no greater than that laid upon other industries. The number of lads and girls under 18 engaged in agricultural work in normal times is estimated at one-sixth of the whole number of persons so engaged. During the war the proportion has been higher, but the period of three years allowed before the scheme of continuation classes comes fully into force should suffice to restore the normal proportion. The period of attendance at classes is to be not less

than 320 hours, which is about one-ninth of the working year of the person concerned. Under any arrangement of times and seasons it is hardly possible for the deduction, including time spent in travelling, etc., to exceed one-fifth of the year. Thus the total deduction from the working year of the agricultural population cannot exceed, and may be considerably less than, one-thirtieth. Now the weekly half-holiday has meant a deduction of one-twelfth, taken mainly from the time of full-grown and thoroughly experienced men and women. The much smaller deduction now contemplated is to be taken exclusively from the time of untrained lads and girls under 18, and thus counts for even less in proportion than the figures indicate.

This calculation should convince critics of the Act that their fears are groundless. Instead of dwelling on the burden laid on agriculture, let them turn to the other side and help to realise the great possibilities that the Act affords for restoring the ancient reputation of Scotland as the best-educated country in the world.

FORESTRY AND AGRICULTURE.

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IT is a well known fact that the production of food and timber has, for many years past, not received that attention in these Islands which the importance of the subject deserved. The experience gained during the last four years has, however, given the matter a new prominence. Special measures had to be taken, not only to arrange for the import of both articles, but also to initiate schemes for augmenting the home production of field crops and timber. Steps were taken to extend the area of land under cultivation, a scheme for increasing the area under forest has been prepared, and its execution has been commenced now that the war has been brought to a successful conclusion. Under these circumstances the relation of forestry to agriculture has become of special interest, and the present article deals with the general aspect of the case. The case of agriculture is so well known by this time that we need not enlarge on it, but this is not the case as regards forestry. I shall begin, therefore, by sketching the general usefulness of forests, then indicate their connection with agriculture, and conclude with the relation of the State to forestry.

The subject of the utility of forests may be divided into two main parts, the direct and the indirect utility. The former refers to the produce of the forest, the labour which it requires and its position as an object of industry. The indirect utility refers to the effect of forests upon climate, soil, hygiene, æsthetics and ethics. The direct utility is by far the more important aspect in these Islands, but we propose to deal first with the indirect effects.

Influence of Forests upon Climate and Soil.—A piece of land bare of vegetation is, throughout the year, exposed to the full

effects of sun and air currents. A piece of land covered by a full growth of trees enjoys the benefit of the following agencies :—

(1) The crowns of the crop of trees provide a roof over the ground which intercepts the rays of the sun, obstructs the movement of air currents and reduces radiation of heat during the night.

(2) The leaves, flowers and fruit, which fall from the trees, assisted by certain plants which grow in their shade, form a layer of organic matter, or humus, which protects the soil against changes of temperature and generally influences the movement of water and air in the soil.

(3) The roots of the trees penetrate into the soil and bind it together

The effects of these agencies have been observed from ancient times down to the present, and the question as to how far they affect the climate, the rainfall, the regulation of moisture, the fertility of the soil, the healthiness of countries and other matters has been much discussed. In all such cases, other agencies, besides that exercised by a crop of trees, are at work, and the difficulty arises of deciding, how much of such effects is due to one or the other agency. During the last fifty years, accurate systematic observations have been made, which have thrown much light on the subject, though many points require further investigation. So far it appears to be established that :—

(1) The temperature inside forests is higher during the night and lower during the day than on open land, thus reducing extremes, and the average temperature is slightly lower. This reduction is communicated to the country outside, but not to any great distance.

(2) The mean annual temperature of forest soil is decidedly lower than that of soil in the open.

(3) If the percentage of area under forest reaches a considerable height, the temperature of a whole country may be somewhat reduced.

(4) The relative humidity of forest air is considerably higher than that in the open ; this is especially the case in, and just above, the crowns of the trees.

(5) The above matters in combination suggest that the presence of forests may increase precipitation. Observations have, however, shown that this effect is very small, if it exists at all. Slight local condensation may occur in the moist forest air, but the rainfall of a district depends on other far more powerful influences than that of the presence of forests.

These results do not confirm views held by many people. To find out whether forests act beneficially, we must look elsewhere, and we find it in their effect upon the preservation of moisture and the protection which they give to the soil. Systematic observations extending over a considerable number of years have proved that, owing to the somewhat lower temperature, the greater relative humidity of the air, the quieter condition of the atmosphere and the

layer of organic matter over the soil, evaporation is considerably smaller in forests than in the open. It is, in fact, under the 50th degree of northern latitude, only about 50 per cent. of that outside forests, and only some 25 per cent. if the humus is carefully preserved. The actual amount varies according to the species of tree, the density of the crop, the temperature and other climatic factors. As a consequence, considerably more water penetrates into the soil. On the other hand, a forest crop consumes a large quantity of water through the action of the leaves. Some experience has been gained as to the actual quantity; it has been found that it is somewhat larger than that of an average field crop, but on the whole there is a considerable surplus in favour of the forest, more especially on hilly ground. Mountain forests may be looked upon as the great preservers of moisture. Here a great part of the falling rain is retained by the organic covering of the forest and has time to infiltrate into the soil, whence it finds its way into the underground reservoirs to feed springs, provided that the geological formation is favourable. These matters affect the water level of rivers; they reduce sudden rises, and the flood levels in low lands. Observations made in France have shown that the afforestation of bare slopes in the French Alps have helped to reduce the high floods in the basin of the Rhone, which were of a formidable nature before the "reboisement" operations in the catchment areas of the French Alps had taken effect.

Water rushing down a bare hill side possesses a great mechanical power, which loosens the soil, carries it down hill and deposits it on the low lands. It may also cause regular landslips and the formation of ravines. Frequently the debris collects in rivers and forms obstructions, which are followed by a diversion of the bed of the watercourses and the erosion of fertile lands. Such damage has, up to date, not been very great in these Islands, but beginnings of such action may be seen in Cumberland and between Chester and Holyhead. The importance of maintaining in all such cases a complete cover overhead was recognised many years ago, so that already in the Middle Ages so called "Protection Forests" existed, which the laws of the time protected against devastation.

Forests also protect the soil wherever it consists of moving or shifting sands, such as are found in some parts of our sea coasts if not inland. The operations carried out by the French, Government in the Landes since the year 1787 are the most instructive instance of this. Here, a dreary waste, extending over some two million acres, has been converted into smiling fields, vineyards and pine forests. The latter have provided us with a million and a half tons of pitwood a year since the outbreak of the war, and it is difficult to say what our coal mines would have done without this help.

Influence of Forests upon Hygiene, Æsthetics and Ethics.—The importance of forests as regards their hygienic, æsthetic and ethical effects is not to be underestimated, though perhaps not in the manner represented in the past.

It has been asserted that forests have a considerable influence in counteracting endemic diseases, such as malaria, and as an

example the case of Eucalyptus plantations in the Italian Campagna has been often cited. A Royal Commission has, however, ascertained that the improvement of the sanitary conditions of the Monastery of the Tre Fontane was due, not so much to the water-consuming Eucalyptus plantations, but to the repairing of the drainage system, which had been neglected for many years previously. Another case which came to our knowledge is that of the military station of Ludiana in the Punjab. About the year 1860 the military authorities insisted on the planting of the land around the station, but by 1881 the sanitary condition had become so much worse that the authorities demanded the immediate clearance of the woods. It may also be mentioned that, according to investigations lately communicated to the Royal Society, there is little or no ozone close to the surface of the ground. On the other hand it has been ascertained in France that the number of bacteria in forest air is only a fraction of that found in Paris air. On the whole it may be said that this circumstance, the absence of smoke, dust and injurious gases, and, above all, the greater tranquillity of the human mind, due to the absence of worry, are the principal causes of the salutary effect of forest air. In addition, the æsthetic and ethical effect of forest life and scenery is not to be forgotten. The ever increasing growth of large towns and of industries is demanding periodic changes from such centres to more invigorating and agreeable conditions. Such have been found in Continental countries in forest clad districts, while in these Islands visits to the seaside have been the more general rule, but the latter are often practicable only for the wealthier classes. For the poorer classes, forests situated within a short distance from the towns are of real importance. They can be reached on Sundays and holidays in a short time and at small expense, and experience has proved that such weekly visits have a most beneficial effect upon the working population. Visitors to Paris have, no doubt, seen the masses of people which stream into the Bois de Boulogne, as the people of Brussels pour into the Forêt de Soyne. The Forestry Commission entrusted with the new afforestation scheme should not overlook this matter, but see that forest clad areas are provided in the vicinity of large towns, wherever suitable land can be secured at a reasonable rate. Municipalities should give a helpful hand in this direction.

The Produce of Forests.—Wood is used as timber in construction and as raw material in industries, also as fuel in domestic and industrial firing. The quantity required in both directions depends on the special conditions of each country. In Britain, wood fuel had, until quite lately, a comparatively small value, owing to the low price of coal over the greater part of the country, but its importance has much increased since the outbreak of the great war. On the other hand, the requirement of timber is very large; thus in 1913 the imports amounted to 11½ million loads, in addition to perhaps 2 million loads produced in the country. This shows that every inhabitant of the United Kingdom used about 14 cubic feet of timber annually, as compared with 12 cubic feet in Belgium and 7 cubic feet in France. There is a distinct relation between

the development of industries and the consumption of timber. The value of the timber imported into Britain in 1913 amounted to 42 million pounds sterling.

Apart from timber and firewood, forests yield a variety of other produce, some of which is of importance in industries and some in agriculture, especially in the poorer parts of the country. The imports of the former in 1913 were valued at 26 million pounds; the value of the latter items is difficult to estimate, but attention may be drawn to forest grazing, fruits and seeds, litter, moss, etc.

The Capital of Forestry.—The produce of the forest represents the return yielded by the capital invested in it. That capital consists of the soil, the growing stock of timber, buildings and means of communication, such as roads, tramways, etc. Of these, the first two are the principal items. The soil may be called the fixed, and the growing stock the shifting and moveable part of the capital. In the case of a single wood, in which the trees are of about the same age, the value of the growing stock, consisting of an accumulation of successive annual growths or increment, changes from year to year, increasing with advancing age. It disappears altogether when the wood is cut over, and is then built up again. In forests consisting of a number of woods of different ages worked on the principle of an annually equal return, the growing stock must be of the same amount year after year; as much as grows in a year is removed by cutting. The proportion between the value of the soil and that of the growing stock depends on the species, the method of treatment, the length of the rotation and the quality of the soil. Thus, in coppice woods the value of the soil may be greater than that of the growing stock; in timber forests the value of the growing stock is generally several times that of the soil. It follows that the net returns from forests must be considerably greater than that from the soil only, as represented by the agricultural value, if forests are to yield the same percentage on the invested capital. From a financial point of view it may be said that land, which gives a higher percentage if converted into forest than in agriculture, may be called forest land. Generally speaking, fertile land yields a higher percentage under field crops and inferior land under forestry.

Labour required in Forestry.—Forests require labour in a variety of ways, such as:—

(1) General administration, formation, tending, harvesting, etc., or work done in the forest.
(2) The transport of produce.
(3) Industries depending on forests for their raw material.

The amount of labour required under these headings differs very considerably. Without going into details it may be said that, based on past experience, the amount of labour required under the first two headings may be placed, on an average, at 4 days' labour a year for each acre under forest. Thus, every 75 acres require one labourer all the year round.

The amount of labour required under the third heading depends on local conditions, more especially on the regularity with which

the produce is placed on the market; it may be said that the amount is at least double that required under the other two headings, when once a forest has been placed under systematic management. Forests require far more labour than land used for light grazing, such as is practised on our mountain and heath lands. On the other hand, it falls far short of the labour required if land is placed under field crops. While the afforestation of mountain and heath land may create a considerable demand for labour, as compared with light grazing, the conversion of agricultural land into forests would cause a far greater reduction of work. Hence, when the Commission of 1909 proposed the conversion of 2 million acres of land under field crops into forest, it vitiated its scheme of afforestation as far as the labour question was concerned.

Allotment of Land between Agriculture and Forestry.—It has been stated above that land which yields better results under forestry than under agriculture, may be called forest land. There are other reasons why the limit between agricultural and forest soil must be determined in a different way.

Food stuffs cannot be produced in any quantity, and for any length of time, without artificial manuring; they require an intensive cultivation of the soil so as to produce and maintain those chemical and physical conditions which are essential for a favourable state of the crops. Moreover, various crops must be cultivated in rotation, because different crops make different demands on the more important nourishing substances in the soil. Trees, on the other hand, are far less exacting in this respect. Of the more important substances such as potash and phosphates, a crop of trees requires only about one-twentieth part of the amount required for an average field crop. The mineral substances required by trees are also much smaller; moreover, by the action of their roots they obtain a certain amount of these substances from a deeper stratum than is reached by field crops. Of the mineral substances required by trees the greater part is deposited in the leaves, and these are again returned to the soil when the leaves fall and form a layer of humus on the surface. The humus of the forest protects the soil against evaporation of the moisture and rapid changes of temperature Thus conditions are created which prevent any exhaustion of the soil, such as must arise in the case of field crops without manuring. The result is that land which cannot be profitably cultivated with field crops is still capable of producing a satisfactory crop of trees. As a natural consequence, good fertile lands are assigned to the production of field crops, while only soils of a moderate and even inferior quality are available for the production of timber. And yet, the forester obtains satisfactory and even good results on these inferior lands by a careful preservation of the leaf mould and a complete cover overhead produced by a full crop of trees. He distinguishes, however, between absolute and relative forest soil. By the former is meant that which is absolutely unfit for profitable cultivation with field crops; the latter consists of land which might produce field crops, but which would yield better financial results if put under forest.

The exact allotment of land between agriculture and forestry is

not a fixture. With the aid of artificial manure and an intensive working of the soil, it is possible to grow successfully field crops on lands which were until lately considered unfit for the purpose. If a considerable area of such lands should be brought under cultivation, forests would be driven to higher elevations and nearer to the upper limit of successful tree cultivation, which, in the northern part of Scotland, may be fixed at about 1000 feet elevation above the sea. In the south, forest culture could gradually be extended to about 1500 feet elevation. However, there are some fifteen million acres of waste mountain and heather land in the United Kingdom. While the cultivation of field crops will have first claim, there is enough land from which to select that area which is likely to be brought under forest in the immediate future, so as to make the country independent in the event of a future emergency. Such an emergency may occur, not only in the case of possible future wars engaged in by this country, but also by wars amongst other nations, as well as by a decline of future imports due to the exhaustion of foreign forests.

Having thus indicated the manner of the allotment of the land between agriculture and forestry, I shall now consider in what respects the existence of forests effects agricultural conditions. A deficiency of agricultural labour has become by degrees increasingly acute. The deficiency has been partly made good by the introduction of more machinery, but that has not met the whole case. An important point is that, by bringing back people from the big towns to the land, or rather by preventing them from gravitating to the towns, we provide more healthy conditions for them, a matter of great importance for the preservation of a vigorous stock. It has been stated publicly that the stature of our troops was below that of the Colonials, who are, after all, the offspring of the same original stock. This is believed to be due to the healthier life led in the Colonies, a far larger proportion of the people living away from the big towns. Whatever the correctness of this statement may be, if we desire to have more people in the country, we must provide them with work there It is here that forests can help. The bulk of forest work can be done between late autumn and early spring, when work in the fields is at a minimum. Consequently, a larger number of agricultural labourers will be available from early spring to late autumn, if the same men (or women) can find work during the winter months in the forest. Mountain and heath land now used for grazing may not require more labour than one shepherd for every 1000 acres, while the same area would require not less than twelve men if put under forest. Besides, various industries, which use wood as their raw material, would be certain to spring up if forests were systematically worked for a sustained yield. The members of a labourer's family would thus find useful occupation, as would even the labourer himself during the slack winter months. To sum up, extended afforestation would meet both demands; it would increase the number of agricultural labourers and help the rural population to live under far more healthy conditions than town dwellers enjoy. To give full effect to this scheme it is, however, necessary that the new forests should not be created in huge blocks, but should be

scattered over the country. As long as each block is large enough (say 500 acres and upwards) to make it worth while putting a man in charge, it can be managed for a sustained yield.

A suitable distribution of the new forests over the country has other advantages. It leads to a better protection of cultivated land, as forests moderate the velocity of air currents, thus giving shelter to men and animals. They are the natural nesting grounds of useful birds, a matter of considerable importance, since we hear more every year of the damage done by injurious insects. As already indicated, forests contribute towards the artistic beauty of the country, and even forests treated on economic principles can be made to provide the æsthetic and ethical effects which make a population happy and contented.

The State in Relation to Forestry.—Until the outbreak of the war, full liberty prevailed in these Islands as regards the utilization of the land. Government interference was considered not only objectionable, but also unnecessary. The experience gained during the war has considerably modified these views. Interference by the State was found absolutely necessary as regards agriculture and also in the case of forestry. The State was obliged to enforce the conversion of extensive areas for the production of food. The bulk of the land being private property, that object has been attained chiefly by guaranteeing certain minimum prices for cereals during the war and for a certain number of years afterwards, which may possibly cause a considerable outlay on the part of the nation. If such an expensive measure was justified in the case of agricultural produce, it holds good, and even more so, in the case of afforestation, because timber requires long periods of time to mature, and it can be successfully conducted only on areas of some extent such as are held by the State, Corporations and sometimes by the proprietors of large estates. Only in these cases can continuity of action be assured, without which successful forestry conducted on economic principles is not possible. The Forestry Sub-Committee of the Reconstruction Committee fully recognised the position, and they proposed in their Report that the State, Corporations and private proprietors should all take a share in the work of afforestation. To give the proposed scheme a good start, the Sub-Committee propose that, during the first ten years after the war, the State should acquire, by purchase or lease, 150,000 acres of mountain and heath land and afforest them, while only 50,000 acres are expected to be dealt with by private proprietors and Corporations, or by a system of co-partnership. It is, however, distinctly stated that in the same degree as private owners come forward and increase their share that of the State may be reduced. This is just as it ought to be, but whether there will be any great effort by private proprietors has yet to be seen. Taxes are likely to be very high for a considerable number of years, and large sums will have to be expended to make good the damage caused indirectly by the war.

Under these circumstances, the Sub-Committee limit its proposals to what is actually necessary to safeguard the country in the case of any future emergency. It does not propose to provide for the whole of the timber required in the United Kingdom, which

would necessitate the afforestation of an additional area of some 8 million acres, but it limits its proposal to one-fifth of that area, and provides for the anticipation of five years' annual cuttings in case of an emergency extending over three years. The annual imports of timber of all kinds before the war amounted to 638 million cubic feet, and one-fifth of that quantity can hereafter be obtained from 1,770,000 acres, of which 100,000 acres will be stocked with hardwoods and the rest with conifers.

As 9 million acres of the 15 million acres of mountain and heath land are situated in Scotland, it follows that the greater part of afforestation will have to be done in that country, but it would be a serious mistake to create all the new woods in Scotland. It is essential that a considerable area should be afforested in England and in Ireland, and especially in the former. The nearer these new forests are situated to the centres of consumption, the better will be the financial results, and the more beneficially will they act as regards the provision of work for the agricultural classes. Such a distribution is essential even in the case of a future invasion, when the scene of warfare becomes the centre of consumption. Let us hope, however, that the suggested League of Nations will render such an emergency impossible.

[It is hoped to publish in subsequent issues of the JOURNAL further articles dealing more fully with special aspects of the subject, as, for example, the relationship between forestry and the various systems of farming, forestry and rural industries, afforestation and small holdings, etc.]

RURAL ECONOMY OF FRANCE.

H. M. CONACHER.

IN a previous article an attempt was made to indicate generally the condition of the rural economy of France about 1860, with special reference to the effect of the changes made at the Revolution in law and custom upon the development of the various rural districts of France in the nineteenth century.

Taking the division of land into small estates as the leading feature of French rural economy and as determining and being determined by the course of French agriculture, one has no hesitation in returning to it.

In 1885 De Foville published his study on "Le Morcellement." At the end of it he felt justified in saying that he did not agree with those who regarded "le morcellement" as an enemy not less dangerous to agriculture than the phylloxera to the vine. Replying to those who attributed the multiplication of landowners to the "inveterate taste" in France for "L'égalité successorale" he observes—"L'hérédité n'est pas l'agent le plus actif du morcellement; les ventes en détail ont créé chez nous plus de cotes nouvelles que les successions."

This seems to give the key to the situation. Landholding may not always be directed towards the good of agriculture either in the hands of the small or the large landholder—and the division

of a unit through the French law of inheritance may lead to results which are bad for agriculture, but if there is otherwise a market for land in small holdings, it is fair to assume that there is some economic ground for the division. This seems borne out by a study of the distribution of land in the different regions of France. Taking 100 hectares as the lower limit of a large holding, De Foville states that there are (*i.e.* a generation ago) about 50,000 of these, covering a total area of 12,355,782 hectares, or about a fourth of the assessable surface of France.

Where are they mostly found? Putting on one side the three Departments (which indeed have little in common) where such holdings exceed 50 per cent. of the total area, viz. :—Les Hautes-Alpes, le Cher and les Bouches-du-Rhône, our author fixes a list of 11 where large holdings cover from 50 to 40 per cent. of the land, and 12 others where they cover 40 to 30 per cent., the first list including such as the Alpes Maritimes, Basses Alpes, Hautes Pyrénées, Pyrénées-Orientales, Var, Corse, Allier, the second Saône, Basses Pyrénées, Gironde, Côte-d'or, Gard, and some others in Languedoc.

Besides the foregoing the lists between them cover a number of Departments grouped together in the middle of France round that section of the Loire which is equally distant from its source and its mouth. Apart from this group, however, it will be noted that the two lists include nearly all the mountainous districts of France, where large holdings obtain for the same reason that they obtain among us in the Highlands and the Southern Uplands.

Then follow 24 Departments—representing the average condition of things in France—in which holdings over 100 hectares form 30 per cent. to 20 per cent. of the assessed lands. These Departments fall into two groups, viz : one forming the Eastern zone of France from the Ardennes to Vaucluse (on the Rhône), the other containing (1) the lower basin of the Loire and (2) part of the Seine, the two being united by the Beauce (near Orleans).

We now come to the parts of the country where subdivision is more marked. In 26 Departments only 10 per cent. to 20 per cent. of the soil is held in holdings over 100 hectares, of which 11 are either actually in the Seine Valley or in the North, 3 in the basin of the Loire, 7 in the Valleys of the Garonne and Dordogne, and the rest in the centre or South.

The 11 Departments in which holdings over 100 hectares cover less than 10 per cent. of the assessed area are the Nord, Manche and Seine in the North, Charente, Charente Inférieure, Lot, Tarn, et Garonne in the South West, Gers, Ardèche and Rhône in the Rhône Valley, and Haute Loire in the centre.

Generally it may be said that small holdings and small properties are to be found in two geographical areas, constituting the 35 aforementioned Departments: (1) in the North, bordering the Channel and covering the provinces of Brittany, Normandy, Picardy, Flanders, Champagne; (2) (to quote De Foville) marking out in the lower half of France a large rectangle, touching the Atlantic at the Charentes, the Pyrenees by the Upper Garonne, Burgundy by the Rhône, and almost the Alps by the Drôme (in Dauphiné).

Of the Northern group it may be observed at once that only one province is vine growing, viz.: Champagne; in all the others the general conditions are comparable to those of the South of England, and indeed reproduce themselves to a certain extent in Kent and Sussex and again in Cornwall.

The Southern group covers a good deal of the Valley of the Rhône and the Valleys of the Dordogne and Garonne, the latter being largely a wine producing area, while in the Rhône there are vineyards and other forms of Mediterranean culture, such as the growing of olives, mulberries and almonds.

At the same time social influences seem to a certain extent to have determined subdivision in the Rhône Valley and the South West.

This leaves the basin of the Loire and the mountainous districts of the Alps, Pyrenees, Vosges, Jura, Ardennes, as the regions where larger holdings are more numerous—and in the case of the latter districts the reason seems to be mainly economic, while in the Loire area it appears to be partly social.

Further light has been thrown on these questions by the publication of a monograph by the French Ministry of Agriculture in 1909 entitled La Petite Propriété Rurale en France, being a series of documents dealing separately with each Department in the country, and based on replies to questions addressed to Professors of Agriculture, Presidents of Chambers of Notaries and other competent authorities. M. Ruau, the Minister who directed the enquiry, thought the time favourable for such an enquiry, as the agricultural community might then be deemed to have emerged from the crisis through which it had passed, and he wished to know how successfully present proprietors had weathered the bad time.

It may be interesting to collect some of the impressions of the reporters, and for this purpose it is proposed to take in the first place groups of reports relating to the principal river basins of France. As the Loire area seems to stand apart from the other large river valleys, attention should perhaps be drawn to it, with special reference to that section of it between its junction with the Allier at Nevers and the sea—for this point makes a good line of division between the main Loire Valley and the upper part, which flows through the central plateau. The Departments into which the area is parcelled out are the Nièvre, Cher, Loiret, Loire et Cher, Indre et Loire, Maine et Loire, Loire Inférieure.

Of the four first-named of these, the Cher is the Department in which large properties seem most to hold their own. Indeed in parts of this Department the reporters speak of small properties as going up to 30 and 50 hectares, and of large properties going up to 300, 400, 500 and 600 hectares. It is in the vine growing districts where the small properties go down to 10 and 15 hectares or less.

One encounters nothing like these figures of large estates elsewhere in the group, and in the other Departments anything above 75 or 100 hectares is a large estate. Moreover in the Department of the Cher it was stated that the value of land had gone up in the twenty years preceding the enquiry, whereas in the neighbouring Department of Nièvre across the river it had gone down during the same time. The Nièvre on the whole is an area of smaller

properties. In the Cher the larger properties are apparently much better equipped with agricultural machinery than the smaller ones. "The great stretches of absolutely level land lend themselves admirably to the use of agricultural machinery of the most advanced type. The small cultivator who works with his own hands and with a horse or donkey finds himself in a position of manifest inferiority."

Not unnaturally these large properties are let out to a great extent to farmers and métayers. In the Nièvre on the other hand all classes of holdings seem well equipped. Machines for sowing are rare—but reapers are spreading even among the small holders. In the hilly part of the Department the raising of cattle is carried on; there is little dairying, the milk being kept for the calves.

Small properties are said to be superior to the large ones in respect of the results achieved. The moderate sized and large properties are let out to farmers and métayers. It is observed that the demand for land comes from small proprietors, farmers who own land and métayers, also from old servants, former coachmen of bourgeois Parisians, and from farm labourers.

The "Loire and Cher" and the Loiret both exclude the districts of the Sologne and part of the Beauce which stretches from West of Orleans nearly to Paris. The Beauce is one of the best known arable districts in France. It is noteworthy that in such a district small properties have increased in that part of it which is in the Department of Loire-et-Cher. In the Loiret portion of it, on the other hand, though both classes exist, large properties on the whole have held their own—and in places they run up to 150, 200 and even 400 hectares. The Beauce is given over to the cultivation of cereals, beet and forage crops—it has no natural meadows, vines, dairies or market gardens, at least in the Loiret—so that the existence of small holdings at all is a noteworthy fact.

Apparently they get the major operations of the hay and corn harvest done by special proprietors of cutting and reaping machines. All the same they are behind the larger people in respect of their means of production: as in the Cher, superiority in capital and equipment makes itself felt. In the less fertile districts of the Department the small man makes a relatively better show of his stock than the big man. "La question d'outillage est balancée par celle d'effort individuel. Les capitaux consacrés à la culture sont proportionnellement de la même importance. Le travail est plus soigné, les soins donnés à la terre plus éclairés, l'exploitation du domaine mieux comprise dans son ensemble. Partout, la petite exploitation est supérieure à la grande au point de vue des résultats économiques obtenus. Le petit exploitant sait tourner et retourner les coins les moins productifs de son bien: il varie le plus possible ses cultures, de sorte que, si l'une fait défaut, l'autre l'indemnise."

It is noted that in the Beauce labour is provided by young workmen from 15 to 25 and by Belgians, who migrate to the district for six months of the year largely to look after the cultivation of the sugar beet.

The Sologne is, as was observed in an earlier article, a reclaimed area. The principal crops grown are rye and buckwheat. It has

also large stretches of land devoted to sport. The small holder has increased in this region in recent times.

The reporter on the "Loir et Cher" remarks that small properties have increased individually in extent in all districts by reason of the migration from the country districts and the low birth rate.

The Department of the Indre et Loire, which corresponds with the ancient province of Touraine, shows diverse forms of cultivation, the district round the city of Tours being given up to market gardens, dairies and nursery gardens, that of Vouvray to the vine, while others show cereals, vines and stock-raising. On the whole the properties are small, and 30 to 60 hectares are given as the lower limits of large properties.

Two tendencies are spoken of as affecting these—(1) towards division, the heirs selling the property on the death of the proprietor; (2) towards consolidation, in order to distribute over a larger area the expenses of equipment and labour.

The reporter for this Department makes some observations, which are perhaps of general application "On ne peut pas, en bloc, parler d'une infériorité ou d'une supériorité de la petite exploitation. Dans la région de culture maraîchère, dans les régions où dominent la vigne, le chanvre ou les grains, la petite exploitation est dans une situation au moins égale à celle de la grande. Mais dans les regions à blé et à bétail la grande exploitation est supèrieure à la petite, du moins pour les moyens de production. Cela est vrai pour deux mêmes modes d'exploitation, mais si l'on compare une petite exploitation à faire-valoir direct à une grande exploitation à faire-valoir indirect, la petite exploitation est partout supèrieure à la grande. Comme impression générale, c'est la moyenne culture qui, en Touraine, est supérieure à la grande et à la petite. C'est elle qui domine manifestement la situation."

The two Departments of the Maine et Loire and Loire Inférieure, in respect of the distribution of land, fall more into line with their neighbours in Brittany and Poitou. Large properties (or holdings) start at 40 or 50 hectares. The greater part of the soil is under cereals or given to stock-raising, and only limited areas are exploited as vineyards or market gardens.

In estimating the respective values of several classes of agricultural land it seems the rule in the Loire valley to put the highest price on market gardens, the next highest on vines, then on natural meadows and on ordinary arable land. That arable land should come after any kind of pasture may seem strange—but it should be remembered that under our fiscal policy only the best land grows grain crops, whereas in France all kinds of land are so used.

Moreover the great division of land into relatively small units tends—even apart from any fiscal policy—to ensure a greater amount of cultivation. The land is the small man's capital, and he puts the utmost labour into it in order to realise its value. Similarly there will always be more cultivated land on a sheep farm after it has been cut up into crofts than there was before.

An observation in the Report on the Department of the Maine-et-Loire tends to confirm the suggestion made in this article that social reasons account to a certain extent for the maintenance of large holdings in the area of the Loire.

"Les moyens et les grands propriétaires sont souvent obligés de rendre successivement des parcelles de leur territoire, afin de se procurer des ressources leur permettant de faire face aux nombreuses défenses de la vie moderne. Seule, la très grande propriété reste à peu près stationnaire: ses possesseurs, très riches, la conservent plutôt par souvenir de famille ou par point d'orgueil que peur en retirer des revenus."

This reporter emphasises what has been said in other reports, namely, that the small cultivator is at an advantage in the valleys (where intensive cultivation is practised) and in the vineyards, the continuous care needed by the vines requiring labour that is always at hand—and such the small man is better able to guarantee.

And even in the regions of cereal cultivation the small man gets some compensation for his disadvantages in being surer of labour, and in not having to face the high wages paid for labour on large farms. Farmers and métayers to a less extent work the land of the large proprietor.

If we turn from the Loire to the valleys of the Garonne and Dordogne, which both issue in the estuary called the Gironde, it is a different picture that faces us. The Departments which share among them the Garonne are the Gironde, the Lot et Garonne, the Tarn et Garonne and the Haute Garonne. The Departments of the Gironde and the Dordogne cover most of the course of that river apart from its upper stretches.

In the Gironde a great proportion of the land is under vineyards, and it is a large vineyard holding which covers 60 acres. The reporter noted an extraordinary drop in the selling value of vineyards in the 20 years before 1909 due to the crisis in the industry —indeed the value of vineyards was hardly higher in several districts than that of natural meadows.

The Department of the Lot et Garonne contains a medley of cultures—vines, tobacco, corn, fruit, vegetables and stock—in the valleys of the Lot and Garonne and other small rivers. In this part of France the cultivation of fruit crops takes the place of market gardens in the valleys of the Loire and Seine, fruit holdings commanding almost as high a price as vineyards. The reporter calls attention to a curious drop in the value of lands in the Department, not confined to vineyards. He attributes this to a slackening of effort, "to love of comfort, mild climate, and the natural fertility of the soil, which makes it easy to obtain the products necessary for existence without much labour."

In other words, an earlier generation competed for land to work at in order to make money—but their successors are a more easygoing folk While pointing out, like most of his colleagues, that the small cultivator is obliged to put up with primitive equipment, or if he wants better, to obtain it by means of co-operative organisation, which indeed seems to have gone far in this direction in parts of France, the reporter on this Department indicates equally that in one district the small man gives to the soil more abundant manure and has more farmyard manure, if less artificial, and that the operations of cultivation are carried out with more care on small holdings, and the return per hectare is higher.

Much the same language is used of the neighbouring Tarn-et-

Garonne. This fact has been appreciated by large proprietors, who have divided their land into a number of small métayer holdings, to be cultivated by the métayer and his family, without outside labour.

He adds: "Il faut noter un mouvement de résistance très marqué contre toute menace de morcellement exagéré de la petite propriété. Le petit propriétaire achète et achète encore, jusqu'à ce qu'il ait une propriété suffisante pour l'occuper, lui et sa famille. L'ouvrier agricole du Lot et Garonne a lui aussi la passion de la terre; il est naturel qu'il aime, ce qu'il connait; son plus vif désir est d'acheter une parcelle ou d'arrondir celle qu'il possède déjà. Tout cela contribue à diminuer la main-d'œuvre agricole déjà decimée par l'exode et la dépopulation. On a fait appel à des ouvriers Bretons, à des familles agricoles de la Véndee et de l'Aveyron."

The Department of the Tarn and Garonne apparently gives an instance of excessive subdivision such as prevailed some years back being corrected. Numerous journalier propriétaires migrated to the towns, selling their small plots to their neighbours. If land is let, it is usually to métayers and not to farmers. The métayers in turn usually buy a small property themselves.

The Department of the Haute Garonne takes us of course up into the sources of the rivers in the High Pyrenees, but dismissing the mountainous and sub-Pyrenean zones, mainly given over to stock raising, we have left a good deal of lowland country round Toulouse. Much of the land immediately in the valley of the Garonne, the Tarn and the Ariège was formerly in vineyards, but to-day these have been replaced by cereals, maize and meadow land. In other parts of the area beans and forage crops are largely grown. Roughly any holding above 60 hectares is reckoned as grande propriété. There has been a progressive encroachment in recent times on the larger properties by the smaller men. Thus the "crise viticole" has found them the better prepared to meet it, "tandis que les grands exploitants, autre que des rentiers, négociants, fonctionnaires ayant d'autres revenus que ceux de la terre, se decouragaient, hypothéquaient, et laissaient rendre."

Again, "Dans la deuxième région (*i.e.* other than the vine-growing) quoique assez réfractaires au progrès, les petits exploitants savent, avec leurs animaux de croît, leurs porcs et leurs volailles, faire des economies, alors que le grand exploitant, mal servi par ses maître-valets, ou bien fermier et métayer peu travailleur et peu solvable, ne tire de la terre que de très maigres revenus."

Hired labour is provided largely by small proprietors, farmers and métayers. The reporter remarks on the number of small journalier propriétaires—for a pure workman without a parcel of land is unknown—and says that six-tenths of the land held in small properties is in lots of this fractional character. The symptom would be alarming in his view but for the tendency of the owners to buy any available land to add to their allotments.

The Department of the Dordogne contains the old province of Perigord, which appears to be unsuited for intensive cultivation. Nuts, chestnuts, fruits, truffles, vineyards and stock are important sources of income.

The district suffered from the "phylloxera" plague, which caused a certain migration to the towns. There has been, however, a certain increase in the extent of small properties. Large properties, however, are usually divided into métayer holdings, the size of any one of which is beyond the purchasing power of the small proprietor. Hence any métairie that is sold is sold to a large proprietor, or if to anybody else it becomes a moderate sized holding.

The reporter on this Department comments rather severely on the unprogressive spirit of the Perigourdin peasant. If his own kind of culture (orchards and vegetable gardens) fails, he is no agriculturist and cannot take up ordinary agriculture, but migrates to the towns.

In some parts of the Department, however, the reporter recognises a meritorious effort on the part of small cultivators to reclaim portions of the "landes" included in their properties.

A safeguard against excessive division is provided by the well established practice under which the eldest son takes charge of the inheritance and renders account to his co-heirs of their shares.

The Rhône Valley is a long, rather narrow trench, maintaining so far the character which it has in Switzerland between the Rhône Glacier and Lac Léman, and the Departments through which it flows usually include a good deal of mountain land. With the exception of the Bouches du Rhône, which includes the low "delta" country between Arles and Marseilles, they lie in pairs on either side of the River (going North), viz.: Gard and Vaucluse, Ardèche and Drôme, Loire and Isère, Rhône and Ain, while the Saône group consists of the Saône, Loire and Jura, Haut Saône and Doubs, and a bit of the Côte d'Or.

In other words, apart from Provence and Languedoc, this river basin, including the Saône Valley, includes portions of Burgundy and Franche-Conté. The Departments of the Ardèche and Gard run up to the Cevennes, of the Isère, Drôme and Vaucluse to the Alps or their outliers, such as the Mont Ventoux, which is a familiar feature in the view from Avignon. The Department of the Bouches du Rhône has some features of its own.

Speaking of the hill districts of the Department, the reporter says:—"La petite propriété diminue, en nombre et en étendue, dans la région accidentée. Cela s'explique par suite de l'émigration vers les villes, et particulièrement vers Marseille, et de l'abandon des terres de coteaux sèches et de qualité médiocre. Ces terres étaient consacrées jadis, pour la plus grande part, aux cultures arbustives: vignes, oliveraies, amanderaies, plantations de mûriers; dans les fonds les meilleurs, on faisait des céréales et quelque peu de fourrages, particulièrement du sainfoin. Aujour-d'hui, l'ancien vignoble, détruit par le phylloxéra, ne s'est reconstitué que dans les terres plus productives des vallées et des plaines. Sous l'influence de la concurrence des huiles étrangères et de celles des graines oléagineuses, l'olivier, d'ailleurs compromis par les maladies, a été de plus en plus négligé. Les plantations de mûrier ont subi le même sort. L'amandier a toujours continué à occuper une place importante; mais à cause du danger des gelées de printemps, on ne peut le considérer que comme une culture d'appoint. Quant

aux céréales et aux fourrages ils ne peuvent, quelles que soient les améliorations apportées à leurs cultures, donner dans ces terres désolées par la sécheresse des étés provençaux que des rendements inférieurs incompatibles avec la situation économique actuelle."

Further, there is no room at present for "la petite propriété dans les steppes salées de la Camargue ou dans le désert brûlant de la Crau."

It is suggested that the irrigation of the land in the Delta of the Rhône would give an opening to the formation of new holdings.

The tendency towards consolidation among small properties, by a decline in the birth rate and the migration into the towns is noted in the case of the Drôme, Gard and Ardèche, being observable more in the higher ground in the latter Department, which in this way falls into line with other mountainous districts.

At the same time one can hardly speak of large properties in these Departments, when in the Drôme any property above 30 hectares is deemed to be large, and in the Gard 25 to 30 hectares is regarded as the lower limit, except in the Cevennes and one other district, while similarly in the Ardèche the limit is 30 hectares except in the hill districts, where it is 50, and in the Vaucluse it is 100 on the hills and 30 elsewhere.

The grubbing of the vineyards and abandonment of certain other southern cultures in favour of special crops of a market garden character is mentioned in more than one of the reports of these districts. Speaking of the respective spheres, where small and large properties have their relative advantages, the reporter on the Ardèche says: "Quant à la seconde région" (the slopes between the valley and the higher hills) "les travaux agricoles qui s'y effectuent, cultures de la vigne, du colza, cueillette des châtaignes et des fruits, éducation des vers à soie, élevage des veaux, engraissement des porcs, demandent des soins constants et minutieux qui sont plutôt le fait de la petite exploitation. Dans les hauts plateaux, où l'exploitant agricole se livre aux spéculations de l'élevage du cheval et du veau, à la production du beurre et du fromage, il y a très peu de petites exploitations."

Tenant farmers and agricultural labourers as distinct classes are rare in these Departments. A tenant farmer looks forward in many cases to acquiring the farm which is let to him. In the Gard the owners of large properties employ a "baylé" or "grieve." Again the smaller proprietors hire out their services from time to time.

The Vaucluse is represented as the "promised land" of the small holder. "Depuis vingt ans, dans la zone des plaines, on constate que la propriété tend à se morceler de plus en plus. Cela tient aux cultures variées que l'on peut entreprendre et qui deviennent chaque année plus rémunératrices."

The reporter represents the small holder as having made the most progress in the adoption of agricultural machinery, while the larger proprietors do so only under pressure, as they have to meet heavy expenses for labour and have "un gros capital immobilisé." Tenant farmers and métayers lose no opportunity of acquiring their holdings, and labourers try to rent farms, which they cultivate with the help of their families. "Très peu de petits propriétaires

vont à la journée. Le morcellement extrême de la propriété est ici un bien et non un mal. Sur moins d'un hectare, dans la zone de plaine, une famille peut vivre et prospérer."

So much for the Rhône Valley between Lyons and Marseilles. North of Lyons the North and South Valley, which is roughly continuous with that of the lower Rhône, is that of the Saône, while the Rhône itself flows South West from the Lac Léman at the Geneva end, and so to speak forms the main Saône-Rhône Valley at Lyons. The territory between the Rhône, Saône and South West end of the Jura is the Department of the Ain, while West of the Rhône and Saône roughly from Macon to Vienne is the narrow tract called the Department of the Rhône. North of this the Saône Valley goes through the Saône et Loire, South Eastern corner of the Côte d'Or (Burgundy) and Haute Saône Departments. On the whole this region gives us an impression rather different from that of the Rhône Valley between Lyons and the sea.

In the Department of the Rhône three zones are recognised, viz. :—

(1) the actual valley of the two rivers ;
(2) a vine growing zone about 12 kilomètres broad ;
(3) the hill region.

(1) has various cultures, cereals, fruit, trees, market gardens, stock raising (cattle), dairying. (3) is agricultural and stock raising (cattle and pigs), butter and cheese also being made.

The Ain is similarly divided into a plain and a mountainous region. The neighbourhood of the great city of Lyons has a natural influence on the surrounding area in each of the two Departments: thus in the Rhône Department dairy farms are kept in the river valley for the sake of the milk supply of the city, while market gardening has received a similar stimulus in the Ain from the existence of the city demand.

Further, in one part of the Ain any tendency towards the breaking up of large holdings has been checked by the fact that they have fallen into the hands of "rich industrials" from Lyons, who maintain them partly for sport, and make enough out of the fish ponds on them to pay interest on the purchase price.

Part of the Ain Department also profits from being near the large town of Geneva, which stimulates dairying. In the Ain a certain amount of the work on farms is done by labourers coming from la Haute Savoie. The farm labourers living in the Department nearly always have some land. This is always true of the Department of the Rhône. Here as elsewhere the lack of labour tends to drive the owners of larger holdings to let them to farmers, who in time do their best to acquire their holdings. Métayage seems rare in these Departments.

In the Saône et Loire the districts near the Saône are the Maconnais and Chalonnais, mainly on the West side of the river, deriving their names from the towns of Macon and Chalons-sur-Saône, and the Bresse on the East side of the Saône.

In the two former, which include well known vine growing areas, large property is anything over 15 hectares for vineyards

and over 80 hectares for other subjects, and in the Bresse the name is given to anything over 40 acres. Apart from viticulture, the inferiority of labour counterbalances superiority of equipment in the case of large holdings, and in the Bresse the small holder is in a superior position. In the Bresse small holders are also tradesmen in many cases. "La main-d'œuvre agricole se raréfie en Saône-et-Loire. Leur service militaire accompli, les jeunes gens abandonnent les campagnes. Le vide qu'ils font dans la population ouvrière agricole se complique de la tendance qu'a le petit propriétaire à ne pas louer ses services à autrui. Les petits propriétaires préfèrent s'endetter pour acheter assez de bien pour s'occuper chez eux que d'aller en journées."

The corner of the Côte d'Or Department which contains the Saône Valley is marked by very small holdings, partly of a market garden type.

The Haute Saône contains a cultivated and a mountainous region, the former nearer the river. In the former wheat, rye, barley, oats, potatoes, are cultivated on a triennial rotation. Arable and meadow land seem to be only of moderate value. Large property is anything above 30 hectares. The small holder is said not to compare well with the large holder in the Department. He is described as "encore *arriéré* et routinier, il n'emploie pas les engrais chimiques: sa culture, faite à bras, sauf les labours et les hersages, représente un prix de revient considérable: elle lui permet de vivre, non pas de réaliser de bénéfices. Le moyen et le grand exploitant sont plus éclairés: ils utilisent les engrais chimiques, les faucheuses, les moissonneuses, les râteaux à cheval, les machines à battre: ils sélectionnent et nourrissent mieux les animaux domestiques." Métayage is unknown. Farmers as a rule have only enough capital to take on a moderate sized, not a large holding. Apparently through lack of labour large holdings tend to be divided into moderate sized ones. Labour is difficult to get from any source.

The Improvement of High Lying Grass Land.

CAPTAIN A. R. MACDOUGAL, Blythe, Lauder, has submitted the following notes on his experience of improving high lying grass land which has been under the plough:—

In a spirit of optimism our forefathers broke in to the plough many thousands of acres of thin, stony, steep or high lying land which was subsequently found unsuited for cereal crops, and on which even now it is economically unsound to grow grain. During the process of finding out that it would not pay, such land went through several rotations As the high fields never or hardly ever had dung driven up to them these fields received nothing but a little artificial manure for the turnip crop. Hence a steady deterioration took place, and when the old virgin turf was exhausted there was little plant-food left for any crop. Eventually they were left in grass, having been sown out mostly with unsuitable mixtures of temporary grasses and clovers. In a few years they became full of agrostis, bent and fog, and we have as a result poor grass land, growing only bad grass, and little even of that.

One of two methods of improvement may be adopted with such land.

1. Manuring, burning, etc., without ploughing.
2. Ploughing.

I have tried both, and so far as my experience goes the first method is slow and uncertain, and the results are small. The second method has been a success both financially and otherwise.

Briefly the principal points to aim at are:—

1. The complete destruction of the existing grasses, so that the new grasses may get a chance and may utilise the dead residue of the old turf.
2. The soil must be left richer at the end of the cropping rotation.
3. The field must finally be sown out with a carefully considered permanent grass mixture.

It is obvious that the ordinary corn-turnips-corn rotation with a rye-grass mixture of seeds will not accomplish this, but will only leave the field poorer than before, whilst in many cases the corn yield will not pay for the seed. Instead of that I have gone on the principle of driving nothing off the land, reducing cultivation expenses to a minimum, and feeding cake as much as possible with the crops eaten on. The following directions are based on actual experience:—

First Year.—Plough up the field deep and wide during wet weather, whenever the good arable land is too wet to work, and leave it until mid-June, when the turnips are all in. Then harrow the field to get as much mould as possible, and sow 10 or 12 lbs of rape per acre. It may be possible to harrow it only ends long, or at best at an angle, as otherwise the tough turf is simply pulled up. No corn is sown, because I have found that the tough old turf being unrotted will not harrow down to a seed bed, the crop is a failure, and a lot of seed and labour are wasted, whilst the poor crop does not do much to hasten the decay of the old turf. Rape is sown because the seed is cheap, and even if the crop is poor the cost is small. Given suitable weather one gets a fair crop, and this is eaten off by sheep getting cake. The tramping of the sheep helps greatly to break down the old turf, and the residue of the cake and the crop go to enrich the field.

Second Year.—Plough in autumn across the old furrows if the turf is rotted enough, and at an angle only if not. As a rule it is best done in wet weather—except of course on clay—when the ordinary land is unworkable. Generally it will be found possible to grow turnips the second year either drilled or broadcast.

In most cases these will be found to be clear of weeds and a good crop. The last field I did had lain 18 years, and it grew an enormous turnip crop all drilled—this at an elevation of 1000–1050 feet. These never were scraped or weeded, but were simply singled and left. No weeds of any kind were seen except a few nettles in one corner. Every-

thing considered, a heavy dose of slag—8 to 10 cwts.—plus some nitrogen, etc., is the best manure to apply both for this crop itself and also with a view to making up the probable deficiencies of phosphates for the future grass. Superphosphate should be avoided, I think, for this particular work. The resulting turnip crop should all be eaten on by feeding stock if possible, or by store hoggs getting cake.

Third Year.—Unless the field is stiff and wet, the turnip crop may with advantage be left till the last to be eaten, and the ordinary work on good arable land done first. One may even wait till mid-June till the turnips are all in. Then the field should be ploughed and sown out with a mixture which contains little or no non-permanent grass. This requires careful study, and no one mixture can be fixed on as suitable. The following is a mixture which I found most successful on the last field I did in 1914—a steep stony field at 1000 feet. After four seasons' grazing it shows no signs of reverting to its old useless state.

Perennial Ryegrass	6	lbs. per acre.
Cocksfoot	16	,, ,,
Tall Fescue	7	,, ,,
Tall Oat Grass	7	,, ,,
Timothy	5	,, ,,
Meadow Fescue	1	,, ,,
Hard Fescue	½	,, ,,
Rough Stalked Meadow Grass ...	½	,, ,,
Smooth Stalked Meadow Grass...	½	,, ,,
Crested Dogstail	¼	,, ,,
Chicory	1	,, ,,
Burnet	1	,, ,,
Yarrow	¼	,, ,,
Late Flowering Red Clover ...	2	,, ,,
White Clover	2	,, ,,
Wild White Clover	1	,, ,,
Total ...	51 lbs.	

In addition to the above 4 lbs. rape per acre was sown. The total cost of the seed, including rape, was in 1914 just about 30s. per acre.

I should be inclined in future to decrease or omit the Crested Dogstail and to omit the Hard Fescue. Neither is a big cropper. Crested Dogstail seems indigenous and soon spreads, and Hard Fescue does not seem to be much liked by sheep. The Yarrow and Wild White Clover were well worth sowing, and the pasture this year has a close bottom of both plants, which are good food for sheep and also drought resisters. No more than 4 lbs. rape should be sown, otherwise, if it is a heavy crop, the grass may be checked. The principle followed in sowing the grass seeds was to sow what would grow and hold its own against agrostis, fog, etc., and also be palatable to sheep. At the same time a sprinkling of the best bottom grasses was sown to fill in the pasture. The chicory and burnet were sown on the chance of being useful. In

any case one must not grudge expense on the grass seed, which is the foundation of the pasture.

Following on the above lines one has at the end of a three years' course a new pasture, and a field richer than before plus the roots of the old pasture, all available as plant food for the new. In the case of the field referred to the cost of the rotation was amply repaid by the turnip and rape crops in the second and third years, and partially by the rape in the first year. I have one sown down with oats in 1901 which is still worth for grazing double what it was before it was lifted. If only a small portion, say 20 acres, is taken at a time it can be done as part of the usual break.

Once laid down this land should be left at least eight to twelve years, so as to accumulate a supply of old turf and roots. If thin hill land is cropped in any way on a close rotation the humus is soon destroyed, and the field becomes so harried out that it eventually will hardly grow anything. What is wanted is a long lie and a short, renovating, enriching rotation In this way the pasture and land may well improve with each rotation.

In giving these notes I do not profess to have discovered anything new. It is largely a corroboration of the Clifton Park system, which many of us have been experimenting with for a long time. One thing I am convinced of is that the ordinary five shift rotation applied to high land is futile and will make matters worse, whereas some scheme such as that advocated—omitting any crop that is driven off—will improve the land in the short period of three years and pay its way. Finally it must be clearly understood that nothing is any use unless the two essential conditions are present, viz.:—drainage and a sufficiency of lime.

It would add greatly to the existing knowledge of grasses if experimental strips of the pure grasses mixed with clovers were sown in all such pastures, so that one could see how the different grasses did on different land,—which the sheep liked best, etc. The different soils and climates vary so much that existing information in books is often misleading. On some soils many so called permanent grasses disappear in a very few years. Perhaps more success as regards permanency may be achieved by sowing seed saved from home-grown acclimatised grasses. At present most of our permanent grass seed comes from abroad. The success of wild white clover on bad land offers a great incentive to our more enterprising seedsmen to try to raise stocks of some of our other grasses from carefully selected indigenous plants.

In trying to get a pasture to lie for some years without reverting, failures must, of course, be expected, particularly on thin peaty land on a clay or moorland subsoil. In four or five years on some fields of this type some portions will have reverted to the feathery brown-purple seeding agrostis, which sheep simply will not eat except as a last resort. Lime seems to help this, but it is expensive.

Having got one's new pasture, its future treatment should be considered. It is here, I think, that manuring may show best results. At any rate it is more hopeful to apply manure to a good pasture in order to keep it up, than it is to apply it trying to improve a bad pasture.

Minimum Wages for Agricultural Workers.

THE term of office of all Wages Committees has been extended to 30th June 1919. The twelve District Wages Committees have now nearly completed their work of fixing the minimum rates of wages for men, boys, women and girls, which they are required by the Act to fix; but these rates do not become enforceable under the Act until they have been passed by the Central Wages Committee. A list of the rates which the Central Committee have resolved not to disallow, and which are therefore now in force, will be found among the official orders and circulars on p. 110. The principal rates so fixed for men may be summarised as follows:—Border Counties—shepherd in charge of a hirsel, 40s. per week; experienced ploughman, cattleman or orraman, 35s.; other male worker, 30s. Dumfries and Galloway—ploughman, 38s.; other male worker, 33s. Clyde and Forth—male worker over 21, 38s.; from 18 to 21, 36s. Forfar and Perth—male worker from 18 to 21, 32s. 6d. North Eastern Counties—male workers over 20, 35s.; from 18 to 20, 30s. The conditions on which these rates are to be applied vary from one district to another, according to the decisions of the different District Committees, which the Central Committee have aimed at maintaining, especially where they represented the practically unanimous opinion of the District Committee, but they have felt compelled to disallow some of the rates fixed by District Committees, and to refer them back for re-decision, on such grounds as that the rates were too low to secure to the experienced farm-worker a wage adequate to maintain his family at a reasonable standard of comfort, that a distinction should be made between youths under 21 and men over that age, or that the conditions on which the wage was to be reckoned required modification. Minimum rates for boys, women and girls have also been finally fixed for several districts. The period allowed by the Board to District Committees to fix the minimum rates required by the Act will expire on 23rd January, after which date the question of fixing any such rate which the District Committee have failed to fix so as to satisfy the Central Committee will be referred to that Committee for decision.

In accordance with a Regulation made by the Board of Agriculture, the Central Committee have defined as follows the general principles on which benefits or advantages, which may be reckoned as payment of wages in lieu of payment in cash, are to be valued for the purpose of being so reckoned:—

1. *House and Garden.*—A house, or house and garden, provided by an employer free of rent and rates in part payment of wages shall be valued at the value last placed upon it in the Valuation Roll, or if it has not been valued in the Valuation Roll, at such value as the District Committee think fit. Provided that no value shall be reckoned for any house which has been condemned by a legally competent authority as unfit for habitation.

2. *Articles produced on the farm.*—Articles produced on the farm and provided by an employer in part payment of wages shall be valued at the producers' wholesale price

current in the district as ascertained and determined from time to time by the District Committee.

3. *Articles not produced on the farm.*—Articles not produced on the farm, provided by an employer in part payment of wages, shall be valued at the wholesale price current in the district as ascertained and determined from time to time by the District Committee.

4. *Potatoes.*—In determining the price at which potatoes shall be valued, the District Committee shall determine it having regard to the producers' wholesale price current in the district at the time when the main crop is lifted.

5. *Cartages.*—The value of cartages done by the employer in part payment of wages (if reckoned at all) shall be reckoned at an average rate per workman, to be determined by the District Committee for the whole district or part of the district.

6. *Keep of animals.*—In valuing such a benefit as the keep of animals provided by the employer in part payment of wages, the District Committee shall have regard to the net value of the benefit to the workman in the district or part of the district.

Under the Regulation it is for District Committees (1) to define by order what benefits or advantages may be reckoned as payment of wages to a workman employed in agriculture in lieu of payment in cash for the purposes of any minimum rate of wages; (2) to define the value at which they are to be so reckoned for such purposes; and (3) to limit or prohibit by order the reckoning of any benefit or advantage as payment of wages in lieu of cash. A few of the Committees have defined the values accordingly.

University Research.

IN view of the attention being devoted at present to the subject of Scientific Research the following extracts from a report prepared for the General Council of Aberdeen University by Professor J. G. M'Kendrick, late of Glasgow University, and published in the November issue of the *Aberdeen University Review*, will be read with interest:—

It must be first of all pointed out that all teachers are not fitted for original research, or, at all events, it is not the distinguishing bent of their minds. Originality is one of the rarest gifts. Not a few may recognize the gaps in our knowledge and yet be unable to fill them up. They see where knowledge is deficient, but they are unable to devise the best means of supplying the deficiency. Such men will find their proper sphere in teaching strictly so-called, in communicating to others what they know themselves. Therein they fulfil an important function in the academic body, and they are worthy of high appreciation. While this is so, we would urge that research should be largely conjoined with teaching, and that it should be the aim of every teacher to advance knowledge. This

aim will give vitality to his teaching, it will interest his students as nothing else can do, and it will add to the pleasure of his daily life. There is no pleasure greater to an observer than when he makes a discovery.

THE CONDITIONS OF RESEARCH.

With these preliminary remarks, let us now briefly discuss the conditions that favour research, and which should be fostered in our Universities.

In the first place, it may be pointed out that nothing fosters research more than the effort of the teacher to attain the highest excellence in his teaching. This is especially true of the subjects that admit of experimental demonstration. In demonstrating by experiment before his students facts that are seldom observed or are obscure, the teacher often gets new light on the subject he is expounding, and he is led to discoveries of the first order. . . .

Much will depend on the methods followed by various teachers. Some favour a systematic way of doing experimental work, in the hope that the pupil may be taught how to conduct research. A kind of practical class is formed. Thus a training is given which prepares for research work, but we doubt if it favours originality. If too systematic, it rather stifles it. Others follow a different plan, employing the student in various departments of laboratory work, under the guidance of the teacher. . . .

In these days of teaching in practical classes, more especially in medicine, a good deal of misconception has arisen as to the value of practical teaching. Such teaching on right lines is invaluable, but it has been urged by some that students should in a sense discover for themselves, and that they should be left alone,—in short, that all students should become more or less researchers, and that knowledge thus acquired is of the highest value. We feel sure that this kind of teaching has been over-estimated. Not one student in twenty can discover facts for himself. He has not been taught the art of observation. In histological work, for example, the teacher will soon discover this by asking the question, "What do you see?" or by asking even for a description of that which the student has under his eyes. The knowledge acquired by reading does not favour the art of observation. Frequently it may be noticed that a student who has excelled in literary studies does not do well if he follows, say, the study of medicine when he has to use his eyes and his hands. At an early stage of his studies he should be trained step by step, and the teacher will find that a good deal of observational work has to be gone through before the student's observing faculty can be depended on. Hence it is that amateurs in science whose observing faculties have not been trained often make mistakes, both in observation and even in draftsmanship. . . .

Another method is to select a subject of researeh, to guide the student in his labours, to advise him in difficulties, and to lead him on step by step. This is the method usually followed in continental laboratories, and is carried out even to such an extent as to be hurtful, if not to the student, at all events to the interests of science. So much is this the case that research papers that at one

time flowed from German laboratories were almost wholly under the influence of the head of the laboratory or the professor. So men became identified with a particular school, and with the line of research work followed by the professor. All the work done was submitted to the professor, it came under his eye; and, if he approved, it was duly published by the student as from that particular laboratory. There was thus a want of freedom, and all that was done was mainly in the interests of the professor and of the laboratory.

THE ENDOWMENT OF RESEARCH

Much has been done, especially in recent years, in what may be called the endowment of research. By this we mean not the establishment of lectureships and the equipment of laboratories, or payments as rewards for work done or in defraying expenses. Those grants for research are made by the British Association for the Advancement of Science, the British Medical Association, and by the Carnegie Trust. A great scheme for the endowment of research in all departments is at present occupying the attention of the Government, and, if our country in the past has lagged behind in this respect, the war has awakened us up, and there are great hopes for the future. Those grants have produced great results, more especially as regards the number of reports handed in and the variety of papers written It is doubtful, however, if the quality of the work done has always been commensurate with the money expended, or with the encouragement of real research Not infrequently the grants have been given at the request of a youthful worker who had somewhat vague ideas as to what had to be done or of how to do it. The grant was usually for a limited time—say, one year—and then a request was made for a report. Often no report could be given, or only a preliminary report, embodying little, as the researcher had insufficient time. The grant might be renewed, but the effect is a kind of forced research of little value. . . .

One of the great difficulties in the way of original research is that of not having sufficient inducements to hold out to young students to engage in research. It is likely that only those who have graduated will be prepared to devote a few years to this kind of work. After a long and laborious curriculum, a student naturally looks forward to the active duties of a profession, it may be scholastic, clerical, legal or medical, and in the future to other avenues of life. Only those who have a strong desire to advance knowledge will enter on research. It, therefore, is evident that every encourgement should be held out to the right kind of student. The professor must be ever on the alert to secure and encourage the right type of man, and, having secured him, to give him every encouragement both by advice and by assistance, it may be even by pecuniary help. . . .

We must always bear in mind that the primary impulse to research is originality, and that originality, as already pointed out, is the rarest of human qualities. It is not too much to say that of one hundred students not more than two or three show such originality as may lead to successful research. We cannot make

one competent to develop original research any more, as has been often said, than we can make a poet; indeed, research demands some of the same qualities. Insight, imagination, the faculty of seeing things as they really are, along with patience and industry, go to the development of a poet as well as of a researcher of the first class This is why researchers are so rare, and why so much that passes as the results of research is hardly worthy of the name. At the same time, research should be fostered and supported by every academic institution, and we are gradually learning how this may best be done.

PRACTICAL APPLICATION.

We shall now look at the practical aspect of the subject and indicate the lines on which we should proceed.

Appliances.—These include well-equipped laboratories in every department. We use the word "laboratories" in the broadest sense. By laboratories we do not mean only technical laboratories, such as already exist for experimental subjects, but also general and special libraries, museums in all departments Books of reference and periodicals in all departments, especially periodicals, should be provided. These may be kept in the General Library of the University, and in the more scientific and technical departments the periodicals may conveniently be kept in the department concerned. . . . As regards apparatus in special departments in the experimental sciences, an effort should be made to keep such collections up to date. It is true that scientific apparatus becomes obsolete, but even old apparatus may be so modified as to meet modern requirements. The maintenance of the General Library, dealing with literature, is so obvious as to require only to be mentioned. In short, libraries are essential to research.

Position of those engaged in research.—As a general rule those engaged in research will be assistants to the Professor, and will discharge duties connected with teaching. The amount of time they should devote to teaching will be determined by the Professor, who should refer the matter to the Board of Studies, and the Board should see that an adequate amount of time be allowed to the student to pursue research This will be in the interests of the student, in accordance with the principles already laid down. It will happen in some instances, however, that the research student may not engage in teaching. This should be determined by the Professor and the Board of Studies. The research student should be guided in his work by the Professor in charge of the laboratory, or in charge of the literary, philosophical, metaphysical or mathematical department chosen by the research student. The Professor should afford the research student every facility for work, and he should be at liberty to offer such criticisms as he thinks may be useful. The research student should be charged no fee. If he has obtained a grant from a public fund, he should devote such a portion of this fund to defray expenses as may be adjusted between the Professor in charge of the laboratory and the public institution giving the grant. He should keep a note of the expenditure, to

be audited by the Professor before the accounts are submitted, along with the report of the research student, to the public body making the grant. In some cases, where no grant has been made, it should be competent for the Professor, with the consent of the Board of Studies and the Faculty having charge of the particular research, to defray the expenses of the research out of the University funds to an amount to be fixed by the Board of Studies, with the consent of the Faculty in charge—say, the Medical or Science. This will meet the exceptional cases of students who have from some cause obtained no grant for research, but who, on due consideration, are deemed worthy of assistance.

Reports.—All reports, whether made to special bodies such as those already mentioned, at a time to be specified, shall be handed in to the body making the grant, and also to the Senatus or the Faculty concerned, along with relative accounts of disbursements; and a list of such reports should be printed in the "Calendar" for the following year, so as to show the amount of work that has been done in the way of original research. The reports might fitly appear in the List of Publications by members of the University that now appears in the "Calendar." The Board of Studies along with the Professor should draw up a report on the quality of work done by each research student, as shown in the report of the researcher, and they may offer such criticism as they deem necessary, with such commendation as the work of the research student seems to deserve. They should not interfere with the publication of the researcher's report in any medium the student may think desirable, such as a special magazine or the proceedings or transactions of a learned Society. The object of these suggested regulations is to encourage research and to secure freedom.

These general views, if carried out in a liberal spirit, would do a great deal to help research. Much, if not all, will depend on two factors: (1) the interest taken in research by the Professor, and (2) the desire to carry on research by the student. The Professor will have the opportunity of selecting and encouraging youths showing originality and a genius for practical research, and the student of research will be able to devote himself to the advancement of knowledge. There should be no cast-iron system of management, but a spirit of give and take. It is understood that these remarks apply to all departments—philological, historical, literary, mathematical, philosophical and scientific. Research should be carried on in each department; and in work of this kind there should be no distinction between scientific subjects, strictly so called, and other subjects that are deemed by many to be outwith the bounds of science. From a broad point of view all are scientific, if carried out on scientific principles, and while methods of research will vary according to the nature of the subject, all combine to the advancement of human knowledge.

THE damage done to grain and other kinds of food by rats has long been realised, but while efforts have been made in individual cases to combat the evil, it is probably not too much to say that these efforts have very often been of a somewhat haphazard character and were seldom conducted on systematic lines. Before the war rats existed in such numbers as to cause an appreciable reduction of the available food supplies, and latterly they have been allowed to multiply almost unchecked: In normal times it was perhaps excusable if the farmer did not view the problem so seriously; so long as the damage did not assume large proportions he was inclined to regard the rat in the light of a nuisance, but at the same time as a more or less unavoidable one. The war, however, with its concomitant food problems, altered the perspective in this, as in so many other matters, and the depletion of the food supplies by the depredations of this pest could no longer be accepted so philosophically. It is generally believed that, while rats are omnivorous in case of need, they are by nature vegetable feeders, and the problem is rendered more acute by the fact that it is not so much the amount actually eaten that matters as how much is rendered unfit for human consumption. It is no exaggeration to say that the position is now serious; one authority estimates the rat population of Great Britain at 40,000,000, and the annual damage as amounting to £15,000,000. In other countries the annual loss attributable to rats has been estimated similarly to reach huge totals. In Denmark it is said to amount to 15,000,000 francs; in France the loss occasioned in 1904 was estimated at 200,000,000 francs; the loss in Germany is officially estimated at 200,000,000 marks; and in America the Biological Survey estimates that the direct annual loss sustained by residents in the towns and cities of the United States amounts to 20,000,000 dollars, while the total annual damage inflicted throughout the United States is put at 200,000,000 dollars. To the actual damage caused by rats there must further be added the large sums which are annually expended on rat-catching operations. In 1909 the capital employed in this country for the purpose had grown to £2,000,000.

Extermination of Rats.

The Board of Agriculture for Scotland have had the matter under consideration for some time, and as early as 1914 made grants in aid of schemes formulated by certain County Councils. As already pointed out, the food economies necessitated by the war brought the question more and more into prominence, and in September 1917 an appeal was made to Local Authorities to undertake schemes for the systematic destruction of rats. County Councils, District Committees and a few of the larger Town Councils were invited to co-operate, and the Board offered to contribute one-third, up to a limit of £100, of the net cost of each scheme. The response to this invitation was fairly satisfactory, and several of the Local Authorities instituted schemes as suggested.

Up to August 1918 all effort was purely optional, and there were no legal powers available to enforce compliance with any schemes initiated by the Local Authorities. At this date, however, the Food Controller made an Order[1] empowering County and

[1] For full text of Order see JOURNAL for October 1918, page 534.

Town Councils to take such measures as they should think proper for the destruction of rats, and, in case of neglect by an owner or occupier to take reasonable precautions, to give directions requiring him to take such steps as in the opinion of the Local Authority might be reasonable and proper for the purpose of preventing the land or building from being infested by rats. At the same time the Secretary for Scotland issued an Order conferring and imposing on Local Authorities, and upon such of their officers as they might designate or appoint for the purpose, the powers and duties necessary to provide for the due discharge within their districts of the functions assigned to Local Authorities by the Rats Order 1918. Authority was also given to meeting from the public health general assessment any expenses incurred in the execution of the Order.

Having summarised the powers now conferred on Local Authorities, the next step is to review the practical methods that have been recommended in recent publications. A valuable pamphlet on the subject written by Mr. R Sharpe has been issued by the Board of Agriculture and Fisheries. Mr. Sharpe, who describes himself as a working keeper, explains clearly the methods employed by him, and a study of his paper will amply repay any farmer who has the misfortune to have his land and buildings overrun by this destructive pest. It is only possible in the limits of this note to give a general outline of the methods employed and recommended. Dealing with poison, Mr. Sharpe is strongly in favour of the use of "Sanford's," as being easy to lay down and harmless to cats and dogs, neither of which will touch it ; care must, however, be taken that it is not put where fowl or game can get at it. There is no need to use bread or any other kind of bait, the method being to plaster a small pellet of the poison on a pebble and drop it into the hole. An essential condition to success is to perform the entire laying process in a single day. The disadvantage of most other poisons is that bait is required, and that generally there must be previous feeding with meal or other foods before the poison is introduced. Mr. Sharpe's experience is, however, that poison is successful only up to a certain point, that no matter what poison is used there will always be a breeding stock left, and that, to complete the treatment, poison must be followed up by trapping. Methods of trapping are very fully dealt with in the pamphlet and are illustrated by diagrams It is recommended that trapping should be started within a week from the time of laying the poison, traps should be set in rat runs where the holes are not accessible, the spring being buried firmly and the pan covered lightly with fine soil. One of the most successful places for trapping rats is in the runs along wet ditches, and in this case the trap should be so placed as to permit the water just to cover the trap. Another very successful place for trapping is at the mouth of drains. Cage traps require a preliminary period of free baiting, as success can only be obtained by breeding familiarity with the traps. The pamphlet also deals with the utilisation of dogs and ferrets and the laying of snares.

Leaflet No. 244 issued by the Board of Agriculture and Fisheries also contains many very valuable hints as to the destruction of rats,

and, in addition, offers suggestions as to preventive measures which might with advantage be adopted. Among these are:—

(*a*) Building ricks on staddles, and granaries on rat-proof piles;
(*b*) rendering buildings as rat-proof as possible by means of concreted foundations, brickwork laid in cement, and galvanised iron sheeting;
(*c*) the use of concrete or metal grain and meal bins in stables and elsewhere, and the covering of the angles of wooden receptacles already in use with tin sheeting;
(*d*) Proper construction, protection and repair of drain pipes, ventilators and basement windows so as to make each dwelling or building as far as possible rat-proof;
(*e*) The disposal of garbage, refuse and waste food, so that it is not available for rats; this is particularly important on the farm, in slaughter-houses and in factories;
(*f*) The protection, where practicable, of the natural enemies of rats.

The disposal of garbage and refuse is especially important in view of the fact that the existence of rats is dependent on the food they are able to obtain. They will not remain or increase in places where food is not easily procured. Rubbish heaps and all places which might afford shelter for rats to breed should be cleared away, and the burrows from which rats have been driven should be filled with concrete, a mixture of cement, sand, and broken glass or crockery, or a mixture of broken glass and tar. The natural enemies of rats are said to be numerous, and among these the leaflet enumerates owls, hawks, buzzards, rooks, crows, ravens, sea-gulls, stoats, weasels and foxes. In the publication issued by the British Museum it is also urged that protection should be accorded to stoats, weasels, owls and kestrels, but Mr Sharpe is not inclined to give much credit to weasels or stoats as rat-killers, and in this connection he adds, "rat extermination is a task which the human race cannot delegate."

A Bulletin issued by the British Museum (Natural History) deals with the scientific and historical aspects of the question, but considerable space is also devoted to the economic standpoint. The following extract will be of especial interest to agriculturists:—

> "To agriculture in all its branches the Brown Rat is especially a most dangerous pest. Grain of all sorts is undoubtedly the chief and favourite food of the rat. Before the grain is sown, in every stage of its growth, and after the harvest, wherever it is stored or in whatever form it is used, it is subject to attack by this animal. An enormous toll is thus levied upon farmers, millers, grain merchants and consumers—a toll which is difficult to appraise, but which, in the case of the farmer, must often be equal to rent and taxes combined. People who keep animals for profit or for pleasure sometimes feed, regularly if unwittingly, some hundreds of rats in addition to their stock. Poultry farmers, breeders of game-birds, pigeon fanciers and others suffer great losses in this way; what is worse, their eggs are regularly stolen, their young and

even their old birds are attacked and killed. Pigs and other large animals are often destroyed, or rendered worthless, either by reason of deliberate attacks upon them made by rats, or through coming in contact with or devouring rats or food contaminated by the latter. In warrens, large numbers of young rabbits are destroyed. Great havoc is sometimes wrought among root-crops, and all kinds of fruit and vegetables are greedily devoured.

"In short, every description of food for man or beast, whether in course of production, store or use, is subject to the attacks of the rat. The quantity actually eaten or carried away is very considerable, but far more is ruined than devoured; and when food, rat-tainted though still wholesome in appearance, is used, it sometimes entails disastrous consequences to the health of man or that of his domestic animals."

In this publication the view is expressed that the country owes its rat population in the first place to the ports. The ports and the towns feed the rural districts with rats; waterways form natural high roads for rats; human traffic, water-borne and land-borne, greatly assists their dispersal. The key to the problem lies in our towns, for the rural districts can never be kept permanently free from rats while the towns are infested. Having these facts in view, preventive and destructive measures specially suitable to towns are recommended. As regards the country, it is suggested that stacks should always be made rat-proof where possible; this may be done by building them upon a platform supported on piles; the platform should be raised at least 3 feet from the ground, and the piles should be furnished with metal rat-guards of at least 4 feet in diameter. Efforts should be made to render farm-buildings, stables, cow-houses, barns, slaughter-houses, mills and rural railway stations rat-proof; and great attention should always be paid to the necessity of keeping the food supplies of domestic animals from contact with rats. Preventive measures are naturally far more difficult in the country than in the towns; nevertheless they are important, and wherever they can be adopted they will amply repay the expense and trouble involved. On the other hand it is asserted that the destruction of rats is comparatively simple in the rural districts and far less costly; for instance, each rat taken by one London Authority costs on an average 1s. 8d., while in Haddingtonshire the average cost was only 3¾d. It is suggested that poisoning should be done once or twice a year—in the spring and in the late autumn. March is said to be the best month for this, because food is short, and the rats will take the poisoned baits more readily. Virus of one sort or another is occasionally effective, but such bacteriological preparations are costly, and they require considerable skill in using them. Their virulence varies, and disappears more or less rapidly on exposure to light and air. The disease communicated usually propagates itself slowly from rat to rat, and, what is worse, doses less than fatal render rats immune. The opinion is expressed finally that not one of the many preparations sold can be recommended as a safe and thoroughly reliable means of destruction. The trapping methods dealt with

are generally on similar lines to those recommended in Mr. Sharpe's pamphlet and in the leaflet issued by the Board of Agriculture and Fisheries.

All authorities agree that organisation and co-operation are essential to success in dealing with the rat problem. A proof of this is shown in the eastern district of Haddingtonshire, where a scheme has been in operation for a number of years, and where in four years the number of rats killed amounted to nearly 90,000. Simultaneous effort is necessary, as, in addition to being very prolific, rats are migratory, and have been known to leave in large numbers a farm which had become over-stocked with their kind. The effect of this has been to penalise a farmer who had already spent considerable time and money in keeping his land free from rats.

[The publications referred to in the foregoing article are :—

(1) "Rats, How to Exterminate Them, and the Taking of Wild Rabbits," by R. Sharpe. (*Price 6d. post free.*)

(2) Leaflet No. 244. (*Free on application.*)

(3) "Rats and Mice as Enemies of Mankind." Economic Series, No. 8, British Museum (Natural History). (*Price 1s.*)

Nos. 1 and 2 are issued by the Board of Agriculture and Fisheries, London, but may be obtained by residents in Scotland from the Board of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh; applications for the British Museum Bulletin should be addressed to The Director, British Museum (Natural History), Cromwell Road, London, S.W. 7.]

Training in Practical Forestry.

THE necessity of properly grown forests from the point of view of national safety was made generally evident at an early stage in the war, and latterly, in considering reconstruction problems, the question of the inclusion of a comprehensive scheme of afforestation in the economic development of the country became one of practicable means rather than of argument. Only the slightest basis already existed, however, on which to build the industry. One of the immediate difficulties to be surmounted was the lack of sufficient men possessing the requisite knowledge and skill to do the actual work in the woods. Most of the foresters in Scotland have gone through a long and arduous training, and have proved their merit in the capable management of the woods under their care. Even before the war, however, their numbers were too few, and it is difficult to see how in the ordinary course of events the needs of private estates alone could be met. The flow of apprentices to the industry was diverted by the war, while the amount of replanting anticipated on the areas felled during the war is out of all proportion to any previous requirements. The management of the young plantations still remaining will require greater care than ever, and in addition the projection of large national schemes of afforestation would draw heavily upon working foresters, foremen and head foresters.

A certain small amount of casual unskilled labour can be

utilised in forestry work, but in the main the operations are dependent upon the numbers of experienced men available, and give directly proportionate results, and in too many unfortunate cases there is evidence of unskilled labour. Many facilities existed in connection with the Universities and Agricultural Colleges for a grounding in the theory and science of forestry, but these facilities did not reach the apprentices and working foresters to any great extent, so far at any rate as actual practice was concerned. The value of instruction designed particularly for foresters was shown in the success of the courses held under Professor Bayley Balfour at the Royal Botanic Garden, Edinburgh, some years ago, when the men worked in the garden during the day, and took classes specially adapted to their requirements in the evenings.

The discharge of disabled men during the war provided a new source (and the only one then available) from which to obtain some of the forestry labour which would be required whenever industrial operations were again possible. The Local War Pensions Committees submitted applicants who desired to make forestry their future profession but these men had no previous experience, and some of them were not at first able to do a full day's work. Arrangements were accordingly made with the Ministry of Pensions under which the men were enabled to take advantage of a maintenance allowance during a preliminary course of training not exceeding six months. The men were placed by the Board in small groups or singly upon various woodland estates, the owners of which had kindly agreed to co-operate in the scheme. The head foresters directly supervised the training, and employed the men upon current phases of the work with a view to their obtaining as general an experience as possible in the short time at their disposal. The full training allowance permissible under the Ministry of Pensions Regulations was granted, *i.e.*, for a private 27s. 6d. per week, with a bonus of 5s. per week on the satisfactory completion of the course. Free accommodation was provided by the proprietors, who, in addition undertook, at a later date, to grant a further bonus of 5s. per week in respect of the work done by the men incidental to their training. It was not possible of course to make foresters in a period covering only half the year's work. Nevertheless the training allowed a man to become acquainted with forestry conditions, and enabled him to begin actual work as an estate woodman under supervision, and several proprietors have expressed their satisfaction with the progress and usefulness of the men under training.

There was more need, however, of men possessing greater technical proficiency than that of the ordinary estate hand, and it was also advisable to afford scope for the steady advancement of the more capable and ambitious of the trainees who had undertaken the short preliminary course. The Board accordingly decided upon the establishment of a School of Practical Forestry, where selected men could go through a sound apprenticeship in essentially practical work, and concurrently obtain a grounding in the underlying principles of silviculture.

The Board had no forest in their own possession, and were consequently dependent upon the goodwill of proprietors for access to

woodlands for purposes of demonstration and instruction. No difficulty was experienced in this connection, as the woodlands and nurseries on the Murthly and Atholl estates were at once placed at the Board's disposal, and Colonel Fothringham of Murthly also granted a site in Birnam village for a building. The demonstration area thus made available is centrally situated in Scotland, and is one of the best that could be found in the country. The woodlands are worked systematically, and they show in the various areas the complete cycle of operations in full rotation, from the collection of seed and its extraction, nursery work in all its branches, the preparation of large areas for afforestation, actual planting operations, and thenceforward in the life of a forest every step in tending, thinning, etc., up to the extraction and conversion of pitwood and large timber.

The scheme has necessarily been initiated on a temporary basis in the meantime, and the building is small, accommodating only twenty-four men. It is built of home wood of various species, and is divided into two main sections, a classroom and a museum, where a small collection of representative specimens is retained principally for use in connection with lectures. The adjacent woods, however, form the real museum of the School. The instruction extends over a period of two years and is divided into first and second year courses. Twelve men can begin each year, and the full complement has already been secured for the first year.

The lecturer has control over all the training, but the practical work in the open is directly supervised by the head foresters on the two estates, and the lecturer concentrates more upon the theoretical instruction upon which the practical work is based. The students must first of all understand the different parts of a tree, their functions, needs and relation to each other. Each of the commoner species requires study of its own peculiarities, individually and as a crop, and its reaction to the external conditions and agencies which control and modify growth. Silvicultural operations may then be entered upon, with the collection, testing, storage and sowing of tree seeds The nursery work also includes choice of site for permanent and temporary nurseries, fencing, soil preparation and formation and care of seed beds, as well as transplanting operations. With planting work instruction is given in the choice of species, the preparation of the area as regards surface vegetation and soil, the age of plants to be used and the different methods of planting. The principles underlying the larger questions of the formation of woods are also explained. Later, the men would be concerned with the tending of woods, thinning, and the various methods of silvicultural treatment necessary.

In the second year the training will be continued, and will also include the special consideration of the protection of woodlands against adverse physical agencies, vermin and disease. The men will further be given some experience in the sawmill and the practical side of timber utilisation generally. So much of surveying and mensuration will be given as will be likely to be needed by them in their ordinary work.

The School was formally opened on the 18th October last by

Rt. Hon. T. B. Morison, K.C., M.P., Solicitor-General, and Colonel Stirling of Keir, in the unavoidable absence of the Secretary for Scotland, and His Grace the Duke of Atholl. The men are showing commendable aptitude and enthusiasm for their work. The existing allowances receivable by the men under the six months' course are continued during their stay at Birnam, and efforts have been made to secure suitable accommodation. A suitable house has been taken over, and it is now managed as a hostel. The lecturer is in charge, and a discharged soldier and his wife have been engaged as caretakers.

Over 60 applications for forestry training have been submitted by Local War Pensions Committees, and it is inevitable that some of the men who had little previous idea of country conditions should have returned to other occupations. Forestry is not highly paid work in comparison with many town industries, and the high wages obtainable during the war for unskilled labour militated greatly against the prospects of the scheme. The work, however, is pre-eminently suitable for many men who suffer from shell shock, lung trouble and minor gunshot wounds, and especially noteworthy has been the improvement in health of practically all the men who have gone any length with the training. Some of the men will always be handicapped to a small extent by their injuries, but while it would be dangerous to overload forestry with disabled men, the industry should be able to give steady healthy occupation to its fair proportion.

The question of the extension of the facilities given at Birnam in order to meet the needs of forest apprentices, demobilised men or discharged officers has already arisen, and forestry opinion in the country is practically unanimous in accepting the two years' training as adequate practical apprenticeship to any further course of higher scientific education at the Agricultural Colleges or the Universities

The Alsace Potash Deposits.

ON November 4th, 1918, M. Paul Kestner, President of the Société de Chimie Industrielle, delivered an important address to the London Section of the Society of Chemical Industry on "The Alsace Potash Deposits and their Economic Significance in relation to the Terms of Peace." (*Journal Society Chemical Industry, Vol.* 37 (1918), 291 *T.*)

M. Kestner deals first with the relative crop production of France and Germany, and with the amount of potash used in these countries and in the United Kingdom and the United States. These figures are given in the following tables:—

TABLE I.

Crop. Year 1913-14.	Country.	Area under Cultivation (Hectares).	Total Production (in Metric Tons).	Yield per Hectare (in Metric Tons).
Wheat ...	Germany ...	1,974,098	4,655,956	2·360
	France ...	6,542,230	8,843,127	1·352
Rye ...	Germany ...	6,414,143	12,222,390	1·905
	France ...	1,201,630	1,238,200	1·105
Oats ...	Germany ...	4,438,209	9,713,965	2·189
	France ...	3,979,270	5,182,600	1·302
Barley ...	Germany ...	1,654,000	3,673,265	2·220
	France ...	760,205	1,043,760	1·373
Potatoes ...	Germany ...	3,412,201	54,121,146	15·862
	France ...	1,548,070	13,585,965	8·776
Sugar Beet	Germany ...	535,309	16,946,000	31·780
	France ...	216,200	6,070,000	28·080

1 Hectare = 2·471 Acres ; Metric Ton = 2204 Lbs.

TABLE II.

CONSUMPTION OF POTASH FERTILISERS (IN METRIC TONS OF K_2O) IN GERMANY, UNITED STATES, GREAT BRITAIN AND FRANCE.

Year.	Germany.	United States.	Great Britain.	France.
1910	359,335	244,910	18,258	22,849
1911	422,340	237,442	20,902	26,468
1912	463,383	215,965	23,414	31,691
1913	536,102	231,689	23,410	33,115

Note.—It is uncertain how much of the potash salts imported into this country was used for fertilising purposes.

In 1912 German lands received 1400 kilos of potash per square kilometer ; British lands 183·9 kilos ; French land 96 kilos ; and American lands 128·9 kilos.

It was pointed out that potash alone had not produced these results, but that it was the use of potash combined with the necessary proportions of nitrogen and phosphoric acid which had ensured the higher yield per acre in Germany. It was also noted that the soils in this country are much less dependent on potash manuring than the very light sandy soils of the Continent, and that the smaller consumption of potash in this country is partly, at anyrate, explained in this way.

Before the war Germany alone furnished the whole world with almost the total quantity of potash used. She thus possessed the most powerful monopoly any nation ever had, and she endeavoured with zealous care to ensure its continuation.

Dr. O. N. Witt, late Professor at the Charlottenburg Polytechnic, and one of the signatories of the famous manifesto of German scientists published in the early days of the war, wrote as follows :— "Our position as sole producer of large quantities of potash com-

pounds gives us the power of causing grave injury to the agriculture of our enemies by stopping the export of the salts which are indispensable to them for manurial purposes."

Whenever foreigners tried to acquire an interest in German mines they were prevented. This was notably the case fifteen years ago in connection with an American Company which had bought mines at Sollstedt. The German Government intervened to annul the sale, and for a short time diplomatic tension ensued between the two countries.

North German Deposits.—The North German deposits of potash were discovered about 1850, but it was not until some time later that the value of potash salts for fertilising purposes was fully appreciated, and the actual working of the potash salts began in 1862. Numbers of companies were formed, not only in the neighbourhood of Starsfurt, but gradually over a wide district, which to-day includes the Duchies of Hanover, Brunswick, Mecklenburg and Thuringia. In 1907 thirty-nine companies for their working existed united into one huge syndicate—the famous Kali Syndikat.

The composition and the richness of the salts from the German mines both vary materially, the amount of potassium chloride varying from 15·5 to 26 per cent. With rare exceptions all the salts from the North German basin contain a fairly large proportion of magnesia, and for the most part must be refined before they can be used even in agriculture. The companies which work them own, for this purpose, huge refining factories, which deliver the salts to the trade with a fixed proportion of potassium chloride.

In 1904 the Alsace deposits were discovered, with much richer salts than those at Starsfurt, and these, immediately coming under the control of the syndicate, completed the formidable economic weapon wielded by Germany.

The Alsace potash beds are situated in the south of the province near Mulhouse. They consist of two beds, of which the first, the more important of the two, has an average thickness of four metres (about 13 feet), and occupies an area of about 200 square kilometres. It is found at a depth of 650 to 1000 metres (2000 to 3000 feet). The upper bed contains on the average 35 per cent. of potassium chloride and the lower one 30 per cent. The layers are nearly horizontal, which greatly facilitates the working. The whole deposit represents more than 300 million tons of potash (K_2O), and would suffice for the world's consumption for many years.

The most interesting fact is that the purity of the salt greatly surpasses that of all other known deposits of importance, and is notably very superior to that of Starsfurt. Refining is unnecessary for the salt intended for agriculture, and so this cost is saved, and in addition the cost of transport is also reduced.

The German Potash Syndicate has taken care to limit the working of the Alsace deposit, and has allowed an output of only 5 per cent. of the total German output. In order to safeguard the interests of the powerful shareholders of the mines of Northern Germany, the paradoxical situation has been created that the deposit which furnishes the richer product, and the mines which can be most easily and most economically worked, have been sacrificed to the poorer.

M. Kestner estimates that the world's consumption of potash for agricultural purposes alone for the year 1913 amounted to 1,004,000 tons of potash (K_2O), and that the requirements after the war will be about double this amount. He points out that by the loss of the Alsace potash mines Germany will be deprived of the economic weapon of bargaining which she thought she could use in obtaining favourable peace terms. Without the monopoly of potash all her system of defence will collapse, and her newspapers have continually pointed out the importance of these riches for obtaining favourable economic terms.

M. Kestner concludes that in order to ensure peace for the future, and save the world from German economic dominance, it is indispensable that Alsace should again become French; that this is not only a question of sentiment and of lofty justice which concerns France alone, but that the essential interests of all the Allies are linked to this act of justice and that it cannot be too much insisted upon.

Report of the Development Commissioners.

THE report of the Development Commissioners for the year ended 31st March 1918 has now been issued and is available to the public as a Parliamentary Publication (H.C. 118, 1918, price 3d. net). The general policy of the Commissioners since the commencement of the war has been rather to refrain from assisting new schemes, and to confine their advances to ensuring the continuity of schemes which were in progress in 1914 and which could not properly be discontinued. This policy has been maintained in the year under review except so far as the special circumstances of the war have called for extended expenditure for new schemes in respect of food supply and natural products, or for the preliminary outlay in the preparation of schemes which may employ labour after the war. In one instance, that of flax growing, the expansion owing to war needs has led to an increase of the undertaking to a scale on which it is no longer of an experimental or educational nature, such as is appropriate for assistance from the Development Fund. The undertaking has accordingly been taken over by the Board of Agriculture and Fisheries and financed from Votes of Credit.

It is not possible in this note to give an extended account of the operations of the Commissioners so far as the whole of the Kingdom is concerned, but the following table shows the extent to which Scottish Schemes have been aided from the Development Fund during the year:—

AGRICULTURE AND RURAL INDUSTRIES.

	Grant.
Aberdeen University and North of Scotland College of Agriculture—Joint Committee of.	
Schemes of Agricultural Research, Year 1917-18	£380
Schemes of Agricultural Research, Year 1918-19	433

Board of Agriculture for Scotland.

Live Stock Schemes in Scotland, Year 1918-19 ...	£9750
Schemes of Special Research in Agricultural Science, Year ending 30th September 1918 ...	395
Extension work at the Scottish Agricultural Colleges, Year 1917-18	5000

Scottish Agricultural Organisation Society.

Grant in aid of the Work of the Society during the year 1917-18	1000

FORESTRY.

Board of Agriculture for Scotland.

Establishment of State Forest Nurseries in Scotland, 1917-18	2000
Establishment of State Forest Nurseries in Scotland, Year 1918-19	2000
Preliminary arrangements for leasing or other proposals for the afforestation of privately-owned land in Scotland—including a flying survey, Year 1917-18	1000
Salary and travelling expenses of additional Forestry Officer on the Board's Staff (1st December 1917 to 31st March 1919) ...	930
Salaries and expenses of Advisory Forest Officers, including cost of local survey work and preparation of afforestation schemes, Year 1918-19	2000

RECLAMATION AND DRAINAGE OF LAND.

Board of Agriculture for Scotland.

Cost of survey of the haugh land on the River Spey between Kincraig and Loch Laggan ...	150

HARBOURS.

Ullapool Pier Trustees.	*Loan.*
Supplementary Loan in aid of the cost of the Pier Extension	350

The grants under the heading "Agriculture and Rural Industries" are all in continuance of existing schemes. The research schemes carried on by the Joint Committee of Aberdeen University and the North of Scotland College of Agriculture relate to soils and drainage and the Isle of Wight bee disease. The work in connection with animal nutrition has been suspended owing to the absence of the Director on military service. The advances made to the Board of Agriculture for Scotland for schemes of special research in Agricultural Science are allocated as follows :—

West of Scotland College of Agriculture.	
Cheese-making problems and feeding of dairy cows	£150
Geological soil survey of the College area ...	200
North of Scotland College of Agriculture.	
Investigation into damage to oats and grass by grub of crane flies	45
	£395

The grants for live stock schemes in Scotland are in aid of the scheme for the improvement of heavy horses and cattle and the extension of milk recording, while the annual advance in aid of "Extension" work at the three Scottish Agricultural Colleges is devoted to the cost of instruction to agriculturists in the Colleges' provinces.

Reclamation and drainage of land are subjects which the war has also brought into prominence. The grant of £150 under this heading was recommended in order to enable the Board of Agriculture for Scotland to obtain a report as to the proposed reclamation of about 30,000 acres of low-lying land along the banks of the River Spey. This is one of those schemes which, if found practicable, promise to provide employment when needed, and to make a useful addition to the area of cultivation.

The Development Commissioners have now set up an Advisory Committee, including representatives of the three Departments of Agriculture, to report to them on applications for "Special Research" grants, and on such other subjects as the Commissioners may refer to them. The Commissioners are prepared to consider, and, if they are satisfied with the applications supported by the new Committee, to recommend an annual grant, not exceeding £5000, for the assistance of special research schemes in the United Kingdom. The Advisory Committee is constituted as follows:—Sir Daniel Hall, K.C.B., F.R.S. (Chairman), Mr. W. Bateson, F.R.S., Prof. Biffen, F.R.S., Mr. J. R. Campbell, Sir R. B. Greig, Mr. W. B. Hardy, F.R.S., Sir T. H. Middleton, K.B.E., C.B., Prof. Noel Paton, F.R.S., Sir David Prain, F.R.S., Dr. G. H. Pethybridge, Dr. E. J. Russell, F.R.S., and Dr. David Wilson.

Grain-drying Sheds.

AS indicated in the article published in July last in No. 3 of Volume I. of the JOURNAL, the Board took steps to encourage farmers to erect grain-drying sheds on their farms. The Board are satisfied that the extensive use of these sheds in suitable districts would result in a substantial saving of grain, and they were informed that many farmers were anxious to provide themselves with this means of securing their crops, but that they were unable to do so owing to the shortage of the necessary materials. In these circumstances the Board took up the matter with the Departments concerned, and succeeded in securing facilities for obtaining the necessary materials for the erection of about fifty sheds in Scotland. This was intimated to the various District Agricultural Committees so that farmers in

the different districts could be informed that, in the event of their being desirous of erecting grain-drying sheds, the necessary facilities were available. The Board also intimated that they were prepared to grant to landlords in terms of Sections 13-16 of the Agricultural Holdings (Scotland) Act, 1908, authority to charge their estates with payments of compensation made in respect of any such sheds erected by their tenants. The Land Improvement Companies were likewise informed that the Board would regard these sheds as permanent improvements in accordance with the Land Improvement Acts.

The approximate cost of the shed for the erection of which the Board were in a position to arrange was £300, and the dimensions of the structure 120 ft. long by 24 ft. wide by 16 ft. high. The number of farmers who have taken advantage of the facilities offered is, up to the present, not so large as was expected. Enquiries have been made as to the results obtained by those farmers who erected sheds, and from the reports received the opinion that a substantial saving both in grain and labour would result from a more general use of such structures is confirmed. In most districts in Scotland the weather conditions during last harvest season were very unfavourable, but where sheds had been built many acres of wheat and corn crops, which would have been lost or much reduced in value had the sheds not been provided, were secured. The shed has also proved of inestimable value in localities where fields are surrounded by trees and plantations. In ordinary circumstances it is not unusual in these localities to find the grain crop still out in November, but in cases where sheds had been provided last season, despite the wet weather, farmers were enabled to secure their crop early in October. The saving of labour and material in connection with thatching has also to be taken into consideration.

Under the present conditions, when it is still of the utmost national importance to maintain the increased yield of crops attained during the last two years, and even in normal circumstances, the Board strongly urge the use of grain-drying sheds by farmers, and they hope that in the near future these structures will be regarded by proprietors and tenants as necessary adjuncts to their farming equipment.

Herb-Growing in Scotland.

ONE of the industries which in pre-war years depended very largely on supplies from abroad was pharmacy; herbs in particular being imported in 1913 to the value of £17,000. As many of the plants imported can be and were in former years cultivated in this country, while some are found wild, the scarcity caused by the war led to a revival of herb-growing and collecting in this country. With a view to making the most of home resources "a Herb growing Association was formed at the commencement of the war, members of which pay a fee of 5s. per annum, and receive leaflets, and also advice on what to grow or collect, how to dry, the extent of the demand and current prices for herbs. The Association is willing to sell its members' produce on commission, when properly prepared. Seeds or plants may be purchased from the Association or from

fellow members by those wishing to take up herb-cultivation. The whole of this work is regarded as a patriotic movement. The head offices of the Association are at 6th floor, Queen Anne's Chambers, Westminster, S.W., with branches in various parts of the country. Central drying stations are to be established and a local secretary appointed, as far as possible, in each county. Members will thus be able to send their produce—grown or collected wild—to the local stations to be dried in the most approved manner, and marketed on an organised co-operative system. This is of great importance and convenience to small growers, who may have only a few pounds of the dried herb for disposal. The wholesale druggist or distiller usually buys by the hundredweight or ton, and does not wish to be troubled with small quantities. This is where co-operation is needed in order to deal with the small quantity of produce, and to check the over-production of certain herbs by small growers in the aggregate. Undoubtedly careful cultivation of the right plants on any considerable scale may show good profits during the next few years, but in the long run amateur herbalists should not take up the work with the idea of making large sums of money out of small plots of ground. However, an outlay of a few shillings for seeds or plants of some particular kind of herb may provide a moderate return."[1]

The City of Glasgow and West of Scotland branch of the Association give the following account of the work in their report for 1917:—

"A small start has been made in the work of collecting and drying medicinal herbs, and the Committee hopes that this year will show a much greater activity on the part of members of the Association. As a drying shed has not yet been established in Glasgow, the Governors of the West of Scotland Agricultural College most kindly offered facilities for drying herbs at the Holmes Farm, Kilmarnock, where the work had the advantage of the supervision of Mr. Hosking, whose report is as follows:—

"'During the summer and autumn 14 members have sent to Kilmarnock various kinds of herbs—a list of which is given below—some in a fresh state as gathered, and some in a dried state.

"'In addition to those sent by members, a few kinds have been harvested from the collection grown at Holmes Farm, and small quantities of various kinds were dried to gain experience of drying, etc. A drying machine has now been installed and a woman engaged to help with the cultivation, seed-collecting and drying, and good results are hoped for next year.

"'In the meantime, the collection of plants, seed-saving, cleaning, labelling, etc. are being attended to. In the summer we shall be in a position to harvest some of the crops grown at Kilmarnock, and to dry and preserve and attend to the sale of herbs sent in by members who are unable to dry them themselves.

"'Another year's working should afford the Association some indication of the possibilities of herb-growing and collecting in Scotland.'"

[1] "Notes on Medicinal Plants," by A. Hosking, Bull. No. 78, West of Scotland Agricultural College.

THE following statements regarding the produce of crops for 1918 were issued on 30th November and 9th December respectively:—

Annual Estimates of the Produce of Crops.

(1) PRELIMINARY STATEMENT showing the ESTIMATED TOTAL PRODUCE and YIELD PER ACRE of WHEAT, BARLEY, OATS, BEANS AND HAY in SCOTLAND in the Year 1918, with COMPARISONS for 1917, and the AVERAGE YIELD PER ACRE of the Ten Years 1908–1917.

CROPS.	Estimated Total Produce.		Acreage.		Average Estimated Yield per Acre.		Average of the Ten Years 1908-1917.
	1918.	1917.	1918.	1917.	1918.	1917.	
	Quarters.	*Quarters.*	*Acres.*	*Acres.*	*Bushels.*	*Bushels.*	*Bushels.*
Wheat	402,000	304,000	79,059	60,931	40·65	39·94	39·87
Barley (including Bere)	689,000	705,000	152,847	159,135	36·08	35·44	35·42
Oats	6,457,000	5,447,000	1,243,816	1,041,343	41·53	41·85	38·90
Beans	33,200	29,700	7,277	6,135	36·54	38·70	36 81
	Tons.	*Tons.*			*Cwts.*	*Cwts.*	*Cwts.*
Hay from Rotation Grass	594,000	657,000	389.476	421,502	30·48	31·19	31·47
Hay from Permanent Grass	131,000	141,000	103,142	112,161	25·39	25·13	30·04
Hay from Timothy Meadows	93,000	103,000	45,737	47,583	40·68	43·19	

NOTE.—The total produce of Wheat, amounting to 402,000 quarters, exceeds that of last year by 98,000 quarters, or 32·2 per cent.; the area under the crop is greater by 18,100 acres, while the yield per acre, 40⅝ bushels, is ·7 bushel above that of last year, and ·8 bushel above the decennial average. Barley, with a total produce of 689,000 quarters, shows a decrease of 16,000 quarters, or 2·3 per cent.; the area under the crop is less by 6300 acres, but the yield per acre, 36·1 bushels, is greater by ¾ bushel than last year's, which was practically equal to the decennial average. The total produce of Oats, 6,457,000 quarters, exceeds last year's record crop by more than a million quarters; the area under the crop is greater by 202,000 acres, while the yield per acre, 41½ bushels, is only ⅓ bushel under last year's yield, and exceeds the decennial average by 2⅝ bushels. To these crops falls to be added "mixed corn," of which 4072 acres were returned, but which is not included in the Table. On an estimated yield of 40 bushels per acre, the total produce is about 20,000 quarters. The total produce of Beans, 33,200 quarters, shows an increase of 3500 quarters, or 11·8 per cent.; the acreage is greater by 1140, but the yield per acre, 36½ bushels, is 2⅛ bushels under that of last year and ¼ bushel under the decennial average. The total produce of Hay, taking all kinds together, is 818,000 tons, which is less than that of last year by 83,000 tons, or 9·2 per cent. Hay from Rotation Grass shows a total produce of 594,000 tons, a decrease of 63,000 tons; the area is less by 32,000 acres, and the yield per acre, 30½ cwts., is ·7 cwt under last year's yield and 1 cwt. under the decennial average. Of the other Hay, the total produce of which amounts to 224,000 tons, the ordinary Meadows yielded 131,000 tons, and the Timothy Meadows 93,000 tons; the former, with a decrease of 9000 acres in area, shows a yield ¼ cwt. above last

year's, while the latter, with a decrease of 1850 acres in area, has a yield 2½ cwts. under last year's. The average yield of the two together, which is not shown in the Table, is 30·1 cwts., which is practically equal to the decennial average.

(2) PRELIMINARY STATEMENT showing the ESTIMATED TOTAL PRODUCE and YIELD PER ACRE of the POTATO and ROOT CROPS in SCOTLAND in the Year 1918, with COMPARISONS for 1917, and the AVERAGE YIELD PER ACRE of the Ten Years 1908–1917.

Crops.	Estimated Total Produce.		Acreage.		Average Estimated Yield per Acre.		Average of the Ten Years 1908-1917.
	1918.	1917.	1918.	1917.	1918.	1917.	
	Tons.	*Tons.*	*Acres.*	*Acres.*	*Tons.*	*Tons.*	*Tons.*
Potatoes	1,150,000	1,110,000	169,497	147,717	6·79	7·51	6·49
Turnips and Swedes	5,464,000	8,053,000	396,686	414,305	13·78	19·44	16·89
Mangolds	49,000	53,000	2,552	2,415	19·23	21·82	19·89

NOTE.—The total produce of Potatoes is estimated at 1,150,000 tons, which is 40,000 tons more than last year, and is the largest recorded since the Returns of Produce were first collected in 1885. The area under the crop shows an increase of 21,780 acres, while the yield, 6¾ tons per acre, is ·3 ton above the decennial average, but ·7 ton below last year's record figure. Turnips and Swedes show a great decrease, the total produce, 5,464,000 tons, being less than last year's by over 2½ millions. The area under the crop shows a decrease of 17,600 acres, and the yield per acre, 13¾ tons, is 3·1 tons below the decennial average and 5⅝ tons below last year's high figure. The acreage and the total produce are alike the smallest on record, and the yield per acre is the lowest since 1903, when it was 13¼ tons. Mangolds, with a total produce of 49,000 tons, show a decrease of 4000 tons; the area is greater by 137 acres, but the yield, 19¼ tons per acre, is 2⅜ tons under that of last year, and ⅜ ton under the decennial average.

Issue of Vouchers to Agricultural Workers.

IN consequence of the cessation of hostilities under the armistice of 11th November, the calling-up of men for military service was suspended on 14th November, and the issue of protection vouchers to men engaged in agriculture and allied industries, in accordance with the procedure described in the last issue of this JOURNAL, was also suspended on that date.

Demobilisation of Pivotal Men.

AT the end of October the Board undertook, at the request of the Demobilisation Department of the Ministry of Labour, to act as Central Authority for Agriculture in Scotland under the scheme for the early demobilisation of pivotal men. A circular letter was issued to District Agricultural Executive Committees asking them to send lists of men whose services were urgently required, a quota

being allotted to each county. These lists have been transmitted to the Ministry of Labour for the further procedure necessary for the demobilisation of the men concerned.

Scottish Women's Rural Institutes.

A NUMBER of new Institutes have been formed during the last three months, and in many directions steady and encouraging progress has been made. The South-Western area is now represented, by Thankerton and Quothquan in Lanarkshire, and by Fenwick and Dunlop in Ayrshire. The number in Fife continues to increase. Institutes have been recently formed at Strathkinness and Kingsbarns. In Berwickshire Institutes are in course of formation; while in the North, Dunnet, Canisbay, Lonmay, New Deer and Deer District have been added to those already formed in Caithness, Banffshire and Aberdeenshire.

An interesting development has been the inter-institute meetings which have been held in several districts, members from one Institute visiting another in the vicinity, and providing the entire programme—address, demonstration, etc.—for the evening. The Institutes, as they increase in number, are gradually forming into groups, with excellent results as regards co-operation. Such federations have been formed in the Lothians and in Inverness-shire. There is a growing feeling that the Women's Institutes might play an important part in the revival of rural industries, such as lace-making, basket-making and toy-making, and that the energy and enterprise displayed by country women with regard to war work, now coming to an end, might be directed by means of the Institutes into other useful channels. The present time, when many war-work parties are being dissolved, is opportune for the formation of Institutes, by means of which those women, who, irrespective of class, have been bound together in a great cause, may still be kept together for mutual helpfulness and for the good of the nation.

The fact that, with very few exceptions, Institutes which have existed for a year or longer began the winter's programme with true enthusiasm and energy, is a very encouraging feature, and shows that the interest has been well sustained.

The making up of a good and attractive syllabus, especially in the case of Institutes in remote districts, is sometimes a difficult matter, but it is hoped that through time the strong Institutes will come to the help of the weaker Institutes in their district by occasionally providing speakers and demonstrators. The help given by the Board in the shape of exhibits, papers and diagrams, which are lent to any Institute asking for them, has been widely taken advantage of, especially in those cases where there is a difficulty in getting demonstrations arranged. These exhibits and papers have been in many cases contributed by Institutes and collated by the Board.

The relief and happiness which the end of the war has brought to everyone has found expression in many of the Institutes by the holding of a number of social gatherings, to many of which soldiers and sailors on leave have also been invited. This hearty co-opera-

tion means a great deal. Not the least important work to be undertaken by the Women's Institutes in the near future will be the organising of social centres, on proper lines, for the returning soldiers, many of whom after a life of adventure and comradeship may find it difficult to settle down in the isolated village. The "open night" which finds a place on most Institute programmes, to which men are invited, has proved very successful, especially if there is an interesting lecture or discussion. The problems of reconstruction, especially the housing question, have naturally secured attention on these occasions.

The possibilities for future work, theoretical and practical, are very great, but at the same time it must be remembered that Scottish Institutes are as yet in their infancy, and that patience must be exercised during the time they are slowly but surely developing; too much must not be expected of them in the initial stages.

The following is a list of the Institutes established up to the end of the year:—

	Institute.	*County.*
NORTH-WESTERN AREA.	Arisaig	Inverness.
	Fort-William ...	Inverness.
	Kilmallie	Inverness.
	Spean Bridge ...	Inverness.
	Rosehall	Sutherland.
	Ardgay	Ross-shire.
	Keiss	Caithness.
	Canisbay	Caithness.
	Dunnet	Caithness.
NORTH-EASTERN AREA.	Arradoul	Banffshire.
	Barry	Forfar.
	Cornhill	Banffshire.
	Glamis	Forfar.
	Longmanhill ...	Banffshire.
	Muir of Alford ...	Aberdeenshire.
	Rathven	Banffshire.
	Rothiemay	Banffshire.
	Tough	Aberdeenshire.
	New Deer	Aberdeenshire.
	Lonmay	Aberdeenshire.
	Deer District ...	Aberdeenshire.
CENTRAL AREA.	Auchterarder ...	Perthshire.
	Balbeggie	Perthshire.
	Balmerino	Fifeshire.
	Braco and Greenloaning	Perthshire.
	Ceres	Fifeshire.
	Kilmany	Fifeshire.
	Largo	Fifeshire.
	Milnathort	Kinross.
	Kingsbarns	Fife.
	Strathkinness ...	Fife.

	Institute.	*County.*
SOUTH-EASTERN AREA.	Athelstaneford ...	Haddington.
	Cousland	Midlothian.
	Gordon	Berwickshire.
	Longniddry... ...	East Lothian.
	Macmerry	East Lothian.
	Newton	West Lothian.
	Pathhead	Midlothian.
	Ormiston	East Lothian.
	Tranent	East Lothian.
	Winchburgh ...	West Lothian.
SOUTH-WESTERN AREA.	Quothquan	Lanarkshire.
	Thankerton... ...	Lanarkshire.
	Fenwick	Ayrshire.
	Dunlop	Ayrshire.

Fish Meal.

THE supply of the ordinary kinds of concentrated feeding stuffs during the period of the war has been so far short of the demand that farmers have found it necessary to give a trial to articles which, in normal times, they would have been very diffident about feeding to their stock. Among these is Fish Meal. Considerable quantities of this article are now being used for cattle feeding, and there is no reason to believe that on the return of normal conditions its use for this purpose will be discontinued. The probability is that Fish Meal as a feeding stuff may be in still greater demand in the near future

In view of these facts, one of the Official Agricultural Analysts under the Fertilisers and Feeding Stuffs Act, 1906, has raised the question as to whether Fish Meal is to be regarded as an "article artificially prepared" within the meaning of Section 1 (2) of the Act. The importance of this question lies in the fact that if Fish Meal must be so regarded all merchants must give to their customers an invoice stating the respective percentage of oil and albuminoids contained in any consignment of the article they may sell as a feeding stuff. Section 1 (2) of the Fertilisers and Feeding Stuffs Act reads as follows:—"Every person who sells for use as food for cattle or poultry any article which has been artificially prepared shall give to the purchaser an invoice stating the name of the article, and whether it has been prepared from one substance or seed or from more than one substance or seed, and in the case of any article artificially prepared otherwise than by being mixed, broken, ground or chopped, what are the respective percentages (if any) of oil and albuminoids contained in the article. . . . "

The application of the Section quoted to any feeding stuff obviously depends upon the process employed in its manufacture. The raw material of Fish Meal consists either of whole fish or fish residues, and in its preparation for feeding purposes is subjected to a heating process. After consideration of this process and its various effects upon the raw material employed, Sir James J. Dobbie, Chief Agricultural Analyst for Scotland, has furnished to the Board an opinion to the effect that Fish Meal is artificially

prepared by a process other than by being mixed, broken, ground or chopped.

The Board have adopted this view, and are informing all Official Agricultural Analysts and Samplers in Scotland under the Fertilisers and Feeding Stuffs Act to that effect. The point is one of importance to farmers who use Fish Meal as a feeding stuff, and should be carefully noted.

Agricultural Conditions.

THE weather during October was varied, the latter half of the month being more favourable for work than the earlier part, especially in the north-east; in the west and south-west, on the other hand, there were few dry days. Rain was again abundant in most of the western districts during November, while in the east and north-east conditions were generally good, although frost suspended potato-lifting and turnip-storing for a time. During the early part of December the weather was extremely mild and good progress was made with cultivation almost everywhere; frost set in about the 22nd, but caused no serious interruption.

The oat harvest proved a tedious process, and in the west and south-west much grain was damaged by long exposure to wet weather. The gross yield, however, exceeded expectations, and the total produce of the crop was greater by a million quarters than the record produce of 1917.

Potatoes were lifted under good conditions in the eastern districts, while in the west much of the crop was harvested in a wet and dirty state. There is very little disease, but the tubers are as a rule smaller than those of the 1917 crop. The yield per acre slightly exceeded the average, and the total produce is the largest on record.

Turnips and Swedes made some progress in the late autumn, but they proved, as was expected, the poorest crop of the season, the total produce being the smallest on record; the roots are however generally sound.

"Seeds" grass came on very well owing to the abundance of moisture and absence of frost during the autumn.

Autumn cultivation was greatly retarded in the west and south-west by the late grain harvest and the continued wet weather, but in the eastern and north-eastern districts it was well advanced by the end of the year. Wheat sowing was completed under average to good conditions, and the crop is brairding satisfactorily in the earlier districts.

Grazing cattle were in most parts kept out later than usual, and came off the grass in fair condition. Winter feeding is, however, a matter of considerable difficulty, both in their case and in that of dairy cows, which have failed considerably in yield of milk. Sheep, both on arable farms and on hill ground, have thriven well, except in some of the south-western districts, where the excessive rain was unfavourable.

There was in many districts a marked shortage of workers for

potato lifting, but school children were largely employed, and German prisoners gave useful assistance in Perth and Forfar. A large number of skilled ploughmen were released from the Army for autumn cultivation, and on the cessation of hostilities it was arranged that these men should remain on the farms. The scheme for the early demobilisation of soldiers formerly engaged in agricultural work is dealt with elsewhere.

RECENT PERIODICAL LITERATURE.

The majority of the following extracts and summaries are taken from recent bulletins of the International Institute of Agriculture. Full references to the bulletins, and to the original publications quoted therein, may be obtained on application to the Secretary, Board of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh

Wheat Yields per Acre and Prices for the fifty years 1866-1915 in the United States.—The year 1915 completed the first fifty years during which the United States Department of Agriculture has collected annual data on the yield and value of the most important crops in the different States of the Union. The bulletin under review gives the annual figures for wheat from 1866 to 1915. The tables referring to the different States are preceded by general figures for the production in the whole of the United States and six divisions of the country.

The ten year averages of wheat yields in bushels per acre for the whole Union and for these six divisions respectively were :—

	United States.	North Atlantic.	North Central, East.	North Central, West	South Atlantic.	South Central.	Far-West.
1866–1875	11·9	13·7	12·2	13·5	8·4	8·5	15·7
1876–1885	12·3	14·1	13·9	12·0	8·9	8·0	14·1
1886–1895	12·7	14·2	13·8	12·4	8·8	9·6	14·2
1896–1905	13·5	16·2	13·4	13·1	10·8	11·6	17·3
1906–1915	15·0	18·1	16·3	13·6	13·0	12·4	22·4

Experiments in the Cross-breeding of Oats. *A. St. C. Caporn.*—There are many possibilities of great economic progress in such experiments as have been carried out at the University Farm of Cambridge during the past few years. The account of two endeavours to cross different varieties of oats is of special interest to the farmer interested in the scientific development of farming. Oats with tight grain-sheaths, such as "Thousand Dollar," have never more than four grains to the spikelet, whereas the wild *Avena nuda*, with loose sheaths, carries as many as ten. The loose sheath, however, leads to a loss of grain by shedding during ripening. If therefore the heavily laden spikelets of *Avena nuda* could be united with the tight sheaths of "Thousand Dollar" a new and valuable variety would result. Crosses of these varieties were made, but the results do not give much hope of success along such lines; for in no case was a union of the desirable qualities effected, and Mr. Caporn shows that between tight sheaths and many-grained spikelets there appears to exist some incompatibility which makes union impossible.

An endeavour to determine the heritability of early and late ripening in oats was made by crossing the varieties Mesdag and Hopetoun, the former being the earlier ripener by from one to three weeks. The ripening of the first crosses was intermediate in time between that of the parents, but subsequent generations showed a breaking up into Mendelian components. Mr. Caporn came to the conclusion that early and late ripening had much to do with tillering, the tillering of late varieties always being good, that of early varieties, poor. (*Jour. Genetics*, vol. vii., 1918, pt. 4.)

Pure Line Selection of Oats and Barley in Quebec. *Jas. Murray, Agric. Gazette of Canada.*—By individual selection the author succeeded in isolating strains of Joanette oats differing in many ways from the parent plant; these strains are Nos. 407, 607, 2007, 2707, and 3307. The data given below are the averages of a five-year period.

The *duration of the vegetative period* for Joanette is, on the average, 99·2 days; No. 2007 is, however, much earlier, 94 days; No. 407 is much later than the original variety, 105·6 days.

The *percentage of hull*, 26·9 for Joanette, is 28·8 for No. 2007 (an undesirable character), but drops to 24·4 for No. 3307.

Yield in grain.—Joanette yields 59·67 bus. per acre; it is exceeded only by No. 607, which yields 70·09 bus.; all the other strains are more or less inferior to the original variety.

Still more satisfactory results were obtained with Mandscheuri barley, as is seen by the five-year averages for the original variety and the selected strains Nos. 6809, 7008, 7408.

Duration of Vegetative Period.	*Bushels of Grain per Acre..*
86·8 days	62·84
86·8 „	69·95
84·6 „	66·69
86·2 „	67·29

The pure strains give a higher yield than the original variety, and one is equally early, whereas the two others are earlier.

It may be noted with reference to the above extract that this variety was tested in the Cabrach district of Aberdeenshire by the North of Scotland College of Agriculture, when it was found to ripen considerably earlier than other varieties, but to give an unsatisfactory yield.

Effect of Sulphur on Different Crops and Soils. *O. M. Shedd, Jour. of Agr. Research, Washington.*—There has recently been some discussion as to the importance and supply for plant growth of sulphur in its various compounds in soils, and whether or not it may be a limiting element in crop production.

While it is one of the essential elements, the amounts found by the old method of ashing plants were so low in most cases that it was generally assumed there was an abundant supply of its compounds in soils for all crop requirements. More recently, however, it has been demonstrated by improved methods of analysis that most plants contain much more sulphur than was formerly thought to be the case, owing to the fact that in many instances by the old method the bulk of the sulphur was lost on ashing the plant, and therefore was overlooked. The question then arose as to whether there is an ample supplement of sulphur compounds in soils for crop needs, and especially for the best growth of those which are now known to have a high sulphur content.

Some investigators contend that, although some soils are low in sulphur, lower in many cases than in phosphorus, this is compensated for by the amount brought down in the rainfall; and as a result it will never be a limiting element in crop production. There are others, however, who maintain that the sulphur brought down in the rainfall will not equal the loss of this element in the drainage. To establish the point whether the application of sulphur compounds may be beneficial for the maximum production of crops high in sulphur when they are grown on soils that are low in this element, numerous experiments have been carried out. The results were in some cases decidedly beneficial, in others indifferent, and in still others injurious. In order to avoid the difficulty arising from the use of the element to be tested in combination with others—which makes the results not easy of interpretation—the writer used flowers of sulphur mixed, at the rate of 100 and 200 lb. per acre, with soil to which the necessary fertilising ingredients were added, together with calcium carbonate. Eight surface soils, taken to a depth of 6⅔ in., each representing a distinct type in Kentucky and more or less impoverished by cultivation were selected. Soybeans, clover, oats, alfalfa and wheat were grown in the greenhouse on these soils.

The results show that the sulphur increased the production of some crops, had no effect on others, and on some was injurious, depending on the crop and the soil on which it was grown. There was a preponderance of gains, however, from the sulphur application, but these were generally small.

Analyses of some of the crops show that the sulphur increased the total and sulphate-sulphur content of the plant, and the greater the application, the greater the increase.

Fertilising Value of Ammonium Nitrate. *Th. Schoesing, Jr.*—Ammonium nitrate, hitherto little known by farmers because it has never been available in large quantities, will be able to be supplied liberally to them when no longer used for the purposes for which it is required under present circumstances. For this reason the author made tests of its fertilising value by pot experiments. Maize seeds of equal weight were sown in each pot, which contained about 17 lb. of soil with an initial moisture percentage of 12·9 and 15 gm. bipotassium phosphate as basic fertiliser. Except in the two control pots the nitrogenous fertiliser added to each contained 3·37 gm. of nitrogen; four pots contained ammonium sulphate and four ammonium nitrate. The plants were cut down to the ground at the beginning of earing, and the following average weights per pot of the air-dried crop were obtained:—Control pots, 87·6 gm.; pots with ammonium sulphate, 106·8 gm.; pots with ammonium nitrate, 108·4 gm.

The soils in the pots were kept very moist. It was found that, although nitric nitrogen fertilisers give slightly heavier crops than ammoniacal nitrogen fertilisers, there is little difference in yield in very wet years.

It is usually admitted that the nitrogen of ammoniacal fertilisers must be nitrified before it can be used by plants. Several workers (Muntz, Mazé, Schoesing Jr.) have, however, shown that absorption occurs in the ammoniacal form as well as in the nitric one. The only difference is in the rate of absorption, a difference which might be explained by an influence of the absorbing properties of the soil on the ammonia. Till it is nitrified ammonia will also be less mobile. For this reason an excess of water, while favouring the equilibrium movements which cause the dissolution of new quantities retained in the soil in proportion as absorption progresses, exercises a very good influence in this case.

Manurial Value of Haulms and Tops of Root Crops.—It is generally recognised that the ploughing in of leaves, etc. of root crops has some effect in manuring the soil for the following crops. Some Danish experiments were designed to test this, and the results published in 1917 are suggestive though not conclusive. Plots of mangels, swedes, turnips and potatoes were grown and harvested, then from half of each plot the tops were removed while on the other half the tops were ploughed in, the results were tested by the yield of barley grown in the following year, and by a mixed clover and grass crop in the second year. The series of roots, barley and hay was repeated on a new series of plots six times at each of three experimental farms between 1900 and 1907. During the various years there was a considerable variation in the four root crops. Mangels and potatoes gave the largest crops (roots and tops) in the warmer years 1901 and 1905. Swedes and turnips gave their higher yields in the colder and wetter seasons 1902 and 1903. As regards weight of tops per acre, mangels always gave the heaviest crop; swedes on the average produced about two-thirds, and turnips about half the weight of tops given by mangels. A cool moist season always increased the weight of tops. A chemical analysis of the root crops (except potatoes) extending over three years showed that:—swedes and turnips add relatively more solid matter to the soil than mangels; swedes have the greatest amount of phosphates, while turnips are higher in the nitrogen and potash. These advantages of swedes and turnips are counterbalanced by the greater average weight of tops produced by mangels. The relative residue from the tops per acre is shown by the following, mangels in each case being represented by 100.

	Solids.	*Nitrogen.*	*Phosphates.*	*Potash.*
Mangels	100	100	100	100
Swedes	79	98	182	102
Turnips	71	109	136	97

There is thus an increase of 11 per cent. in nitrogen in turnips as compared with swedes, and 44 per cent. in swedes over turnips; potash is much the same for all three crops. The effect on the succeeding barley crop, as seen by comparing yields on half-plots with tops taken away, with half-plots where tops were ploughed in, was an increase for almost every one of the six years after mangels, swedes and turnips. After potatoes there was a distinct decrease

during four years and a merely nominal increase during two years, which indicates that potato haulms add little or nothing to the nutritive value of a soil. As a rule, a heavy crop of tops of mangels, swedes and turnips ploughed in produced more grain and straw in barley than a light crop of tops, but this was not always the case. The removal of a heavy crop of roots (not tops) tended to reduce the barley crop, but it did not prevent some increase where the tops were ploughed in. The average increase of barley after turnips was 21 per cent., after swedes 20 per cent., after mangels 17 per cent., after potatoes little or nothing. The effect on clover and grass hay (second year after roots) was not so marked. After swedes and turnips there was an increase of 10 per cent., turnips giving a little more than swedes; after mangels the increase was very little, but after potatoes there was a 5 per cent. increase, which is interesting, since no effect was observed on the barley crop.

If money values are placed on the various units, it is possible to compare value of the tops (except potatoes) as manures, and their value if eaten as fodder. The result of such a comparison is that the fodder value of the tops is greater than their manurial value, and that it would pay better to feed the tops to stock, and utilise them as farmyard manure. Whether, other things being considered, it would pay to cart the tops (say to indoor cattle) seems to require further investigation in view of the difficulty of placing correct money values on the various units.

The Decomposition of Green and Stable Manures in Soil. *R. S. Potter and R. S. Snyder, Jour. of Agric. Research, Washington.*—This paper is a continuation of previous studies the principal aim of which was to determine the rate of decomposition of original or added organic matter in soil by estimating the amount of carbon dioxide evolved from manured soils. The last experiments were made in two series—one with applications of calcium carbonate, the other with liming.

The principal results show that the organic matter in soil decomposes more rapidly in soil treated with calcium carbonate or lime than in untreated soil. The decomposition of the total organic matter of a soil treated with stable manure or green manure (clover or oats) is hastened by the addition of calcium carbonate or lime.

Stable manure seems to hasten slightly the decomposition of green manures accompanying it, and these two forms of manure help to preserve the lime in the soil. No appreciable difference was noted in the rapidity of decomposition of green manures when applied dry and as a fine powder or fresh and in large pieces.

The Relation of Weed Growth to Nitric Nitrogen Accumulation in the Soil. *L. E. Call and M. C. Sewell, Journal of the American Society of Agronomy.*—The favourable effect of tillage upon nitrification is generally attributed to the incorporation of organic matter, the distribution of bacterial flora, aeration and moisture. The authors attempt to prove that too much importance has been attached to these factors, and that the good effects of tillage are due above all to the destruction of weeds which might absorb the nitrates.

After reviewing the publications on this subject (which show that nitrification is not essentially increased by greater aeration and a higher water content, though these factors are necessary), the authors give the results of various experiments made at the Kansas Agricultural Station during several years on plots of wheat cultivated by eleven different methods. A comparison of the yields, moisture contents and nitrate contents shows that marked differences in yield cannot be attributed to the water content, which is nearly always constant, but that there is a close relation between yield and nitrate content. Experiments conducted by the authors themselves showed that the accumulation of nitrates is much larger in soils free from weeds even when such soils are not farmed. They conclude that, in a sufficiently light soil, much labour may be saved by adopting only the essential cultivation processes and destroying the weeds by other methods, such as rotation and grazing by livestock, especially sheep.

Studies in the Cost of Market Milk, Production in the United States. *A. C. Anderson and F. T. Riddell, Journal of Dairy Science, Baltimore.*—The data presented in these studies cover a period of two years, from 1914 to 1916, and include figures from 25 farms near Grand Rapids, Michigan. Most of the

other figures secured on this point in the United States were collected in New England or Atlantic Coast States. The data were secured by a one day visit to each farm monthly. All the farms visited produced market milk, some of them being dairy farms solely, although most of them were coupled with grain, vegetables, live stock or food production, and each farm was conducted according to the ideas of the owner or operator. The average expenditures of the farms visited were as shown in Table I.

TABLE I.—AVERAGE EXPENDITURES.

Items of Expenditure.	1914.	1915.
Total number of farms	25	25
Average number of cows per year	459·4	428·57
Man labour	$ 28·68	$ 27·19
Hauling milk and other horse labour	15·54	14·77
Feeds :		
Roughage	31·02	30·38
Concentrates	28·61	26·68
Pastures	8·36	7·66
Cash Sundries	1·96	1·77
Veterinary services and drugs	0·86	0·99
Taxes, interest and depreciation on herd	9·88	9·49
Taxes, interest, insurance and depreciation on buildings	8·72	10·33
Depreciation on barn tools and dairy utensils ...	0·50	0·48
Actual losses on live stock	1·95	6·25
Added earning power of owner due to knowledge, experience and interest in excess of that possessed and used by ordinary labour	6·00	6·00
Added risk due to instability of market for product as whole milk, which in single years amounts to 30 per cent., and in one year out of every five would be 6 per cent.	8·47	8·30
Total	150·57	150·29

The average receipts of the farms visited, for the dairy, were as shown in Table II.

The authors bring in a new point, that of "instability of market for product as whole milk," which in a single year may amount to 30 per cent., and occurs, as they estimate, one year in five, which would be 6 per cent. of the total cost of production, in this case $8·47 for 1914 and $8·30 for 1915.

TABLE II.—AVERAGE RECEIPTS.

Items of Receipts.	1914.	1915.
Average pounds of milk produced ...	6928 lbs.	7156·8 lbs.
Gallons of milk produced	834·70 gals.	862·3 gals.
Average price per gallon delivered into Grand Rapids	16·90 cents.	16·35 cents.
Value of milk produced	$ 141·35	$ 139·01
Credit by manure...	17·45	17·59
Total value of products per cow ...	158·80	156·60
Net profit per cow	8·23	6·31
Cost of production per gallon	15·90 cents.	15·39 cents.
Net profit per gallon	1·0 cents.	0·7 cents.
Cost of production and delivery per hundred pounds	$ 1·916	$ 1·854
Cost of production per quart	3·475 cents.	3·848 cents.

The investment on the farms studied, expressed in percentage, is as follows :—

Investment in cattle	45 per cent.
Investment in buildings ...	54 „
Investment in equipment	1 „

For 1915 the distribution of cost factors was as follows, expressed in percentage : –

Grain	17·8 %	Taxes, interest and depreciation on buildings	6·9 %
Roughage	20·2	Same on cows	6·3
Pasture	5·1	Losses on cows (tuberculosis, etc.)	4·1
Hauling milk	9·8	Management	4·0
Man labour	18·1	Depreciation on tools, etc. ...	0·3
Market losses	5·5	Veterinary services	0·7
		Cash items	1·2

The authors point out that during the last two years the cost of labour has increased 25 per cent., concentrated feeds 30 to 35 per cent., roughage 10 per cent., and minor supplies and milk room equipment 25 to 60 per cent.

Testing of Purebred Dairy Cows in New Zealand. *W. M. Singleton, Jour. of Agric., Wellington.*—The support accorded by the breeders of purebred dairy cattle in New Zealand to the certificate-of-record testing system during recent years, evidences an effort that will produce a marked influence on the economic position of the dairy industry in New Zealand.

The number of breeders now testing cows shows an increase of 20 per cent. over the number testing a year since, and with sufficient testing staff could have been increased to 25 per cent.

The work is destined to make rapid growth in New Zealand with the coming of normal conditions.

Not a sufficient proportion of the breeders are yet possessed of a due appreciation of the work, and not a sufficient percentage of the dairy herds are yet headed by a purebred butter-fat-record dairy bull. The growth of dairy husbandry in New Zealand, however, suggests that for many years to come the scope for this work will be unlimited. During the year 1917 certificates have been issued for eight Friesian records of production exceeding 600 lb. of butter fat. Three of the class averages show an increase over the preceding season.

The Four Essential Factors in the Production of Milk of Low Bacterial Content. *S. H. Ayers, L. B. Cook and P. W. Clemmer, U.S.A. Dept. of Agr. Bull.*—This paper is a new contribution to the hygienic factors influencing the bacterial content of milk. The authors wished to confirm once more the necessity of observing the well-known sanitary rules by supporting them by indisputable scientific data. They made several bacterial counts of milk taken under the following conditions :—(1) sterilised utensils ; (2) clean cows with clean udders and teats ; (3) small-top pail.

The following data taken from the numerous tables given in the bulletin, show the degrees to which the cleanliness of milk is to be attributed to the observation of these principles.

(1) STERILISED UTENSILS.—This is the factor with the greatest influence on the bacterial content of milk. Counts made from 60 samples of milk showed an average of 6306 bacteria per cc. when the utensils were sterilised and 73,308 when they were not sterilised ; the difference (67,002 bacteria) can, thus, only be attributed to the sterilisation of the utensils.

(2) WASHING THE UDDER AND TEATS.—When the animals and barn were kept clean the bacterial counts per cc. of 65 milk samples gave the following figures :—(1) *udder and teats washed*, minimum 620 bacteria, maximum 5400, average, 2154 ; (2) *udder and teats unwashed*, minimum 1050 maximum, 20,400, average 4,524.

(3) SMALL-TOP PAIL.—The small top-pail is of the ordinary type with a fixed top leaving only a small semi-circular opening near the edge. Throughout the experiment milk taken in this pail always had a much lower bacterial content than that taken in an ordinary open milking-pail whatever the other

conditions were. The maximum number of bacteria per cc. in the first case was 750,000, in the second 1,200,000.

In order the better to control their results, the authors combined the various factors in different ways. Data on the contamination of milk by fæces are also given.

Finally, the *effect of temperature* on the bacterial content of milk was observed. Counts were made of fresh milk kept at 4·4°, 10°, and 15·5°C. and 21·1° C. for 24 hours in 4 days. At the end of 96 hours the figures for the bacterial growth in all the samples tended to resemble each other. The optimum temperature is 10° C. or less.

The authors believe the three factors considered and the keeping of the milk at a temperature near 10° C. to be the most essential conditions for the production of fresh milk with a low bacterial content, and that too much attention has often been given to other less important factors. Moreover, these conditions may easily be observed, even in medium-sized dairies.

Experiments on Determination of Cow Manure in Milk; Moisture Content and Solubility of Cow Manure. *G. B. Taylor, Jour. of Dairy Science, Baltimore.*—A series of experiments was conducted on cow manure from the experimental farm at Beltsville to determine primarily whether the manure in unstrained milk can be measured quantitatively by chemical methods. A method was found which gave good results provided the original quantity of manure present was fairly large. For average milks, however, this chemical method is impractical on account of the fact that, while manure is always present, it is as a rule in such small amounts that it cannot be measured chemically.

The experiments lead to the conclusions given below.

Conclusions:—The moisture in the cow manure examined averaged nearly 83 per cent. Air dry manure contains about 6 per cent. of moisture; 5 per cent. of the remaining solid matter is soluble in milk. This would indicate that only 11 per cent. of dry manure dissolved in milk, 6 per cent. of this being water. Nearly 85 per cent. of fresh cows' manure will dissolve in milk, 83 per cent. of this being moisture. Manure in whatever condition is less soluble in milk than in water. Of the manure present in bottled milk, 91 per cent. will be visible on the bottom, leaving 9 per cent. of foreign matter in suspension.

Influence of the Age of the Cow on the Composition and Properties of Milk and Milk Fat. *C. H. Eckles and L. S. Palmer, Jour. of Agric. Research, Washington.*—The question of the changes in the composition of milk with successive lactation periods, and particularly the question relative to the percentage of fat in the milk of the heifer, has been of great practical importance to the dairyman, as a possible index of what may be expected from the mature animals. The conclusions so far reached from data compiled by several investigators have not been entirely uniform. This paper offers new data on the question, taken from the records of the University of Missouri dairy herd, composed of pure-bred animals of the Jersey, Holstein, Ayrshire and Shorthorn breeds.

These data show that the percentage of fat in the milk of Jersey cows attains its maximum with respect to the average for the entire lactation period during any one of the first three poriods, but the chances appear to be greater that this will be attained in the second or third period rather than the first.

Holstein cows on the contrary almost invariably show the highest average percentage of fat for the lactation period during the first period, and the conclusion seems justified that this is a breed characteristic.

Ayrshire cows more frequently show a higher average lactation test during the first than during subsequent periods, but less frequently than in the case of Holstein cows.

The variations in the average percentage of fat among the first few lactation periods are not sufficiently great to be of much practical importance, but the gradual decline in average test accumulates to a figure of considerable importance as the number of lactation periods becomes greater.

The data concerning the influence of the plane of nutrition during growth, indicate that this factor may be of importance in connection with the average fat test for the first lactation period. The light-fed Jerseys showed both a lower average test in the first lactation period and also a less frequent tendency

for this period to show the highest test, while the heavy fed Jerseys showed exactly opposite results. The strong breed tendency for the Holsteins to show a higher average test in the first lactation period than in any subsequent period was also materially diminished by light feeding during the growth of the animals.

It must also be considered that the light feeding of the animals for both breeds was by no means extreme, although it was widely different from the heavy feeding carried out with the other animals in the experiment.

The data bearing on the age of first parturition indicate that a difference of 16 months between the first parturition of the Jerseys had little influence upon the breed tendency already noted for the higher test to accompany the second lactation period. In the case of the Holsteins, however, calving at a more advanced age seemed to decrease the breed tendency for the first lactation period to show the higher average test. As far as the composition and properties of milk of aged cows is concerned neither the percentage composition of the milk nor the physical and chemical constants of the milk fat of aged cows show any abnormalities attributable to old age.

Butter made from the milk of a cow 19 years old and in her thirteenth lactation period was pronounced to be of excellent quality, and kept for a period of three months at a temperature of 8° to 10°C. without showing any marked deterioration.

Methods Adopted in the Production of "Clotted Cream" in Devonshire and Cornwall. *W. Sadler, Jour. of Dairy Science, Baltimore.*—Enquiries have been conducted on behalf of the Board of Agriculture as to the methods adopted by the producers of "clotted cream" in the counties of Devonshire and Cornwall in England. Experiments have subsequently been undertaken at the Midland Agricultural and Dairy College, Kingston, Derby.

The results of these experiments so far tend to show :—

(1) That provided a suitable system be adopted and reasonable care be taken in management and manipulation, clotted cream having the typical and characteristic properties can be produced in any district.

(2) That, while a rich milk is preferable, it is not at all essential for the production of characteristic clotted cream to have only the breeds of cattle favoured by the producers in Devonshire and Cornwall.

(3) That the flavour and keeping properties of the cream are problems of a bacteriological nature.

(4) "Scalding" for 20 to 30 minutes with a final temperature of 187°F. proved to be a satisfactory procedure.

(5) One pound of clotted cream was produced from 23 pounds of milk.

(6) The average percentage of butterfat in the clotted cream was 62 to 64 per cent.

(7) The average butterfat content of the scald milk was 0·75 per cent.

Digestible Hay Cake and Hay Paste. *E. Gain.*—In order to utilise hay to better advantage the author states the principles by which he was governed in making digestible hay cake and hay paste, with the intention of giving later the physiological characteristics which he is still studying, and which may support his claims for its practical value. He tested the use of cake prepared by his method on horses, which ate it readily. The method of raising the yield of hay by making cake and paste includes physical and chemical-biological procedures which permit the modification of the physical condition, digestibility, nutritive ratio and adipo-protein ratio. The aim is to increase the quantity of useful nutritive matter.

A. PHYSICAL PROCESSES.—Crushing and partial cooking:

It is sufficient to crush, sift and pass the powder through an electro-magnet to remove the metallic particles. By mixing the product with water, cake, lozenges, etc. may be made. Crushed oats may be incorporated. Better results may be obtained by partially cooking the cake by drying at 60° C., followed, if desired, by rapid superficial heating. The author also tested short treatment in the autoclave.

B. CHEMICAL AND BIOLOGICAL PROCESSES.—Special chemical, diastatic and fermentation treatments, to affect the chemical composition to a more marked degree than by the physical processes.

The nutritive ratio (or food quotient of hays) and the adipo-protein ratio

may easily be altered; by changing them the coefficient of digestibility is modified. To the crushed hay may be added other products:—concentrated foods such as oil cakes (1 to 5 per cent. only), small fodder seeds or flours, young leaves of forest trees, reeds, sedges, etc., and even foods with a specific action or simple chemical addition (*e.g.* glycero-phosphates).

C. FERMENTATION OF THE HAY POWDER BY COMPRESSION.—The ferment actions capable of influencing the real value of hay vary in nature. They may be concerned with the different immediate principles, especially the liberation of useful elements, by attacking more or less severely the ligneous covering in which they are often enclosed. Hay from stomachs often gives a useful flora capable of acting on the powder to be made into cake. The author made several tests with the classical diastases, hay from ox's stomach and hay from sheep's stomach, commercial yeast, a hay infusion, and finally with partial sterilisation and the dissociative action of steam under pressure in the autoclave.

One of the chief elements of the value of hay lies in the seeds of the plants composing it. The harvest is, however, hastened so that the hay may be tender, and ripe seeds are rarely found in hay. With digestible hay cake it would be advantageous to harvest later.

A small part of the hay might be fed as paste, the preparation of which only requires crushing, sifting and kneading, with three or four times more water than powder, by weight. The product is very similar in appearance to hay from sheep's stomach. It may be dried in the air, compressed or fed fresh mixed with other food. Crushed seed, nettle leaves, leaves of young trees, sedges, reeds, etc. may be added.

Food Value of the Pea Nut (Arachis hypogæa). *Amy L. Daniels* and *Rosemary Loughlin, Journal of Biological Chemistry, Baltimore.*—Up to the present the pea nut has been used chiefly as a cattle feed with such excellent results that the authors undertook a study to determine more exactly its food value. Feeding experiments on young rats showed the pea nut to be lacking in M'Collum's fat-soluble food accessory.

If the pea nut is compared with the soya bean it is found to be poorer in mineral matter, especially in calcium, potassium, magnesium and sulphur. If a pea nut ration be completed by the minerals necessary to give it a mineral content equal to that of milk, which has been shown to be adequate for growing animals, a suitable food is obtained. Pea nut meal, which contains a large proportion of hulls, seems to contain sufficient mineral matter to maintain normal growth in young animals if 5 per cent. of butter fat be added.

In view of the large acreage suitable to the cultivation of the pea nut, and the fact that there is a tendency to use considerably more plant seeds in the diet, the authors do not hesitate to suggest the use of the pea nut as a human foodstuff. As in the case of the soya bean it is only necessary to add to it those elements in which it is lacking, *i.e.* certain inorganic material and the fat-soluble food accessory, to make it a complete food.

Potato Peelings and Heather as Coarse Fodder for Horses; Researches in Holland. *P. A. Van Driest.*—POTATO PEELINGS.—According to the author, these constitute an excellent coarse feed for horses. Chemical analysis shows that washed and finely chopped peelings contain 12 per cent. of starch, 1·27 per cent. of albuminoids and 83·4 per cent. of water. Although, according to Sjollema, the albuminoids in the peelings are of good feeding value and digestibility, the peelings are principally a starchy food.

As regards solanin, the author found that of 2 samples of peelings, one raw, the other having been boiled for 12 minutes, on analysis by the Meyer method the first was found to contain 80·4 per cent. of water and 0·016 per cent. of solanin, and the second, 90 per cent. of water and 0·006 per cent. of solanin. The increased water content, therefore, results in a reduced solanin content. Further, the author has found that solanin is almost completely soluble in boiling water containing a very small amount of vinegar. Therefore, he advises, so as to avoid entirely the bad effect of solanin, that the peelings should be cooked for 10 to 15 minutes in water containing a little vinegar, then immediately removed as, on cooling, the solanin might be precipitated and be deposited again on the peelings.

Cooking the peelings has the advantage that their relatively high potash content, which is supposed to produce bad effects, is considerably reduced. In

fact, the author found that a sample of raw peelings contained 1·14 per cent. of ash, while after cooking there was only 0·58 per cent. As potassium compounds are mostly soluble, it may be admitted that in this way the greater part of the potassium is removed.

HEATHER.—To determine its feeding value, 2 pairs of draught horses were used that gave the same amount of work. The first team received each day 6·6 lb. of heather over and above the normal ration; the second team served as control. The animals were weighed every 2 days; the heather did not in any way influence the increase in live weight of the animals.

Pests of Live Stock.—Many papers dealing with the pests of farm stock in various parts of the world have been published of late. These show that a large proportion of the harm done is caused by the attentions of flies, especially of such as are of blood-sucking habits. In Saskatchewan it was found that a common species of Simulium, the eggs of which are laid on exposed stones or weeds in rapid streams, so worried live stock by their swarms that in one locality 100 head of cattle died during the summer. In South Australia similar serious trouble is caused to horses and cattle by another species of Simulium. The best means of preventing such attacks seems to be to dress the stock with a repellant such as fish-oil. Apart from direct attacks much damage is done by such as stable flies, horse flies and mosquitoes, which may carry infection from a polluted source to healthy stock, and by flesh flies, whose infestations have long threatened the sheep industry of various parts of the world.

Tick-resistance in Cattle. *T. H. Johnston and M. J. Bancroft.*—It has been found that in very many herds of cattle in New South Wales there occur individuals, which, through some natural property, are not attacked by the cattle-tick. This resistance is the more marked as the particular animals occur in infested herds and in infested paddocks, and yet have never been dipped, sprayed or subjected to any preventive treatment. In order that, if it be possible, this resistant quality be propagated and spread, the authors endeavour, by a series of questions addressed to farmers, to discover the breed of resistant animals, the colour and oiliness of their skin, the length of their hair, and whether the property is hereditary, is influenced by food, by dipping, or by the nature of the country. It is hoped that this inquiry may result in the gain of definite information, which may lead to endeavours to spread tick-resistance by breeding.

Observations on Abortion Disease in the United States. *E. C. Shroeder and W. E. Cotton, Jour. of Agric. Research, Washington.*—As far as the writers have been able to learn in their wide experience with the disease, the abortion bacillus is an obligatory parasite. It may live and retain its virulence for a long time in infected material expelled from the uteri of infected cows, but no data are available to support the belief that it can maintain itself or multiply under natural conditions as a saprophyte. Hence, the chronic persistence of the microparasite in the bodies of infected cows is probably the most important among the causes responsible for the propagation, the perpetuation, and wide prevalence of the disease.

The favourite habitat of the abortion bacillus in the bodies of cows is the udder, and the udder is seemingly its only habitat in the bodies of non-pregnant cows. One cow under test for 7 years gave abortion bacilli continuously in her milk. The bacillus was never found in the milk from a cow unless both her milk and her blood serum possessed agglutinating properties for it, but repeatedly cows were found which reacted, but the bacilli were not found in the milk. By experimental inoculation of a cow, the authors were able to demonstrate that the bacilli passed from the udder to the uterus. They believe that the abortion bacilli in ingested milk do not penetrate deeply or abundantly into a calf's body.

Observations on the Etiology of Epizootic Lymphangitis. *H. Velu.*—The author gives an account of his observations on the etiology of epizootic lymphangitis, resulting from work carried out in the research laboratory of the "Service de l'Elevage" at Casablanca.

(1) *Contagion.*—Epizootic lymphangitis is transmitted by simple direct or

indirect contact; immediate contagion is the rule. Inoculation takes place through the harness or grooming, infected hands of veterinary surgeons or farriers, soiled grooming tools, etc.

Experiments on the part played by flies gave negative results, without proving, however, that they play no part.

(2) *Penetration.*—Transmission commonly occurs by means of some skin (harness wound, kick, fracture, injury, war wound, etc.) or mucous (auto-inoculation) erosion. Any break may serve as an entry to the Rivolta cryptococcus, which appears to be a saprophyte common in warm, damp climates. In Morocco, where the cryptogamic flora is extremely rich, epizootic lymphangitis is an ordinary complication of all severe wounds or fistulous sores that do not receive regular antiseptic dressings.

Flies as carriers of Anthrax. *H. Morris.*—Recent experiments carried out at the Agricultural Experimental Station of Louisiana have shown that blood-sucking flies such as mosquitoes and horse flies can carry anthrax infection from a diseased to a healthy animal. The infective bacilli are carried on the proboscis of the fly, so that the infection seems to take place in a purely mechanical manner. The experiments, although carried out only with guinea pigs, suggest that any anthrax-infected animal should be guarded from blood-sucking insects, and that in general epidemics of the disease the more valuable animals should be sheltered in fly-proof sheds. (*Bull. Louis State Univ. Exp. Stn., No.* 163, 1918.)

Destruction of Warble-flies. *C. Warburton.*—An effective mode of destroying ox-warbles is recommended by Mr. R. Stratton, who simply injects a few drops of paraffin into the warble holes. As a result the fly larva is killed, and disappears without harm to the animal infected. The method is much neater and is said to be more effective than that often adopted of covering the cattle with preparations supposed to prevent the attacks of the warble-flies—a method described as not only useless, but troublesome and expensive as well. (*Jour. Roy. Agr. Soc. England*, vol. 78, p. 217.)

A Study of the Effect of Cottonseed Meal versus Beef Scrap upon the Egg Production, Fertility and Vitality of Poultry. *B. A. Ahrens, Oklahoma.*—The object of these experiments was to determine the value of cottonseed meal as a feed for egg production when compared with beef scrap, and to determine also the effect of cottonseed meal in moderate as well as in excessive quantities upon the fertility and hatchability of eggs. The conclusions arrived at are as follows :—

(1) Cottonseed meal fed in combination with other feeds to form a proper nutritive ratio, or even when fed in excess, does not lower the fertility of domestic fowls, but in many cases the fertility was higher than when beef scrap or animal protein was used.

(2) The percentage of fertile eggs hatched shows greatly in favour of cotton-seed meal when compared with beef scrap if fed in a properly balanced ration, but when fed in excess gives rather poor hatching results.

(3) The percentage of all eggs hatched also shows in favour of cottonseed meal compared with beef scrap when fed in a properly balanced ration, but when fed in excess the results are very poor.

(4) As a feed for production of eggs only, aad not considering effect on hatchability, beef scrap is superior to cottonseed meal, and more than makes up for its greater cost by apparently causing greater production.

(5) The mortality of chicks was a great deal higher in pens fed cottonseed meal, both the normal and excessive ration.

The Use of Seaweed in Poultry Feeding.[1] *P. Dechambre, L'Agriculture Pratique, Paris.*—The author describes the experiments made by M. Motte, at Trégastel, Côtes-du-Nord, on the feeding of poultry with seaweed. Ten hens and ten ducklings were fed first on *Laminaria* then on all kinds of algæ. The algæ were freed from salt by being washed several times in fresh water (this washing is not indispensable). They were then chopped into small pieces

[1] For the utilisation of algæ for feeding purposes, see this Journal, vol. i., No. 3, July 1918, p 358.

from 3 to 5 mm. long; this is easier if they have previously been partially dried. They are then mixed with boiled crushed potatoes, and put in a baker's oven for three hours or cooked over a low fire. When the whole is well jellied it is kneaded and distributed to the poultry. The ration given the poultry experimented with varied from 6·6 to 8·8 lb. of algæ mixed with 2·2 lb. of potatoes. No grain was fed.

Later the potatoes were deducted from the rations for the ducks, which ate the algæ alone and fattened as rapidly as those fed normally. This was also attempted with the hens which, however, refused the algæ alone, so that the potatoes had to be added and, later, swedes. The hens developed well, laid normally and their flesh had no peculiar flavour. The results were satisfactory in every way.

The Effect of Daily Inhalation of Ethyl Alcohol and other Poisons on Poultry. *R. Pearl, Jour. of Exper. Zoology, Philadelphia.*—The animals used were hybrids from Black Hamburgs (males) and Barred Plymouth Rocks (females). The subjects were divided into 3 groups according to the poison administered—ethyl alcohol, methyl alcohol and ether. These substances were administered by the use of well-closed galvanised iron tanks, in which the animals were placed each day for at least one hour. The floor was made partly of heavy galvanised wire gauze, which connected the tank with a cylinder below which was filled with absorbent cotton soaked in the toxic substance. Similar experiments made previously by Stockard have shown that the birds absolutely refuse to drink water in which the substance is placed, so that this method is impracticable.

The organic and physiological effects of the inhalation of the toxic substances were studied with the following results :—

(1) The *mortality* among the treated birds was much lower than among the control birds from the same parents. After 15 months' treatment the difference was 41 per cent in favour of the treated birds. This is opposed to the accepted idea that alcoholism shortens life. Too much importance is not attached to this fact, and it is believed that as the experiments continue and include more animals this difference will gradually decrease. The photographs show that there is very little difference in the appearance of the treated and untreated birds.

(2) The *body weight* of the treated birds began to increase immediately after the beginning of the treatment in autumn. This increase, which probably was not due to the treatment, was greatest in January and February, and was followed by a sharp and prolonged fall till May or June, when there was another steady increase till the following February (1916). At this date the treated birds were on the average 9·9 per cent. heavier than the untreated birds.

(3) *Egg production* showed no marked difference between the treated birds and the control birds; both groups of birds laid normally in each season. Throughout the 15 months of the experiment the average production per bird was 184·74 eggs for the controls, and 183·97 for the treated subjects; the difference—0·77—is negligible.

Moveable Pig-houses. *J. M. Edward and J. B. Davidson, Missouri.*—After describing the requirements for the site and the construction of pig-houses, the authors give the advantages and disadvantages of pig-houses consisting of single, isolated and portable sties as compared with central permanent piggeries containing many sties with or without moveable partitions. Among the advantages claimed for single-sty pig-houses each containing a sow and her litter, are :—

(1) the ease with which the house may be taken down and moved about to suit the needs of the farm;
(2) the rapid isolation either for sows about to farrow, for protecting the young, or for the growth of young pigs, and for selection;
(3) improved sanitary conditions, both for the prevention of disease and rotation of pasture;
(4) simplicity of construction.

These pig-houses are more practical and cheaper for beginners or breeders on a small scale, and they are more suited to farming conditions, being portable. A limited number of the houses can be warmed with oil-lamps, and the risk of fire is less. The single-sty, portable pig-house combines perfectly

with permanent piggeries by acting, when required, as a supplement to the latter. Amongst the disadvantages, it should be noted that:—More labour and time is required for tending the herd as the houses are scattered about; they do not last as long; it is difficult to heat many houses at the same time; the lighting and ventilation are imperfect; the manure is often not removed on account of the distance between the sties; the care, feeding and watering are more difficult.

Agricultural Machinery in the United Kingdom. *F. S. Courtney, Jour. of the Royal Soc. of Arts, London.*—In describing the history of the development of agricultural machinery in the United Kingdom, the author draws attention to the fact that the double-furrow plough was developed by Lord Sommerville (1802) and improved by T. Pirrie (1867). It was used for a number of years, but it fell into disuse until the last 20 or 25 years.

As early as 1866-67 the Royal Agricultural Society made an inquiry on the subject of steam cultivation, and a most interesting report gives details of the work done, which was about 6 acres *per diem*. Direct haulage of the plough by the engine was tried as early as 1865, but it was abandoned owing to the soil-packing caused by the engine. Of all the cable haulage systems, the one that has maintained its position is the double-engine system, which is still pre-eminent for efficiency. Out of 540 sets of double-engine sets at work in England, 267 are over 40 years old, 99 between 30 and 40 years old, 13 between 20 and 30 years old, 28 between 10 and 20 years old, and 133 under 10 years old. The author next considers the internal-combustion tractor, and refers to the interesting paper by Mr. Legros, entitled "Traction on Bad Roads or Land";[1] he then deals with cultivators, scarifiers disc-harrows, and rotary diggers (a machine of this type was patented in 1857). After dealing with harrows, rollers, seed drills, potato planters and diggers and manure distributors, the author passes to mowing and reaping machines, harvesters, threshing machines, straw elevators, straw trussers and pressers, the history of which he gives as well as the improvements they have undergone and the driving power they require. In 1849 the Royal Agricultural Society held its first trial of portable engines, built somewhat on present lines, *i.e.* with locomotive-type boiler and horizontal engine. In 1850, as the result of further trials, it was found that the engines were much improved owing to better design and the use of increased steam pressure. In 1872 still greater improvements were found.

After describing the development of road traction for carrying agricultural produce, the utility is shown of applying water and electric power to agricultural purposes. In comparison with other countries there is relatively little water power available in Great Britain, but the author advises farmers to utilise as fully as possible any such water power that is available in their district.

Hints on the Use of an Agricultural Tractor. *La Journée.*—It is important, in the first place, that the field of action of the tractor should not be too wide. If it is true that the majority of tractors are well sprung nowadays, it is none the less true that their chief use is not that of running about on the road. First, these journeys waste time, petrol and oil, and end by over-working if not damaging the machine. This results in time wasted, expensive repairs, the machine being held up, and the delay of urgently-needed work, without considering that all these journeys and delays considerably decrease the daily yield of the machine, and that the extra cost due to running on the road increases the bill of the tractor. This means a higher cost for ploughing an acre, the price in reality falsified by the bad use of the tractor. For example, a 20 H.P. tractor working on a 20-acre field at the rate of 5 acres per day, will, by long, frequent journeys, decrease its yield to 2·5 and 3·7 acres, a yield which does not justify the use of a tractor.

The tractor should also be used intensively, *i.e.* night and day, weather permitting, so as to increase its yield. In bad weather, animals should be used to do the work. It is true that with the use of chain-track tractors and the tractors used in electroculture, the slipping of the wheels in wet soil is avoided.

Another point worth considering is that tractors do not give their full yield unless they are used with such implements as are suitable to them, which is not always the case.

[1] See page 103.

For agricultural work other than ploughing, the full power of the tractor should be used so as to obtain the best yield. Thus, a 20 H.P. tractor hauling a single binder will not give a good yield; two or more binders should be hauled at once.

Similarly, light work is best done by draught animals. The tractor is not meant to do away with draught animals, but to do better than them, more quickly and cheaply, and where animal traction is obviously insufficient to attain the desired end.

These hints will be specially useful to agricultural groupings formed for mechanical cultivation.

The Dirube and Sabaria System of Cable Traction Applied to Agriculture. *C. Giagnoni.*—With previous systems of cable traction (Fowler and Debain, Howard and Fischer), nearly 25 per cent. of the power is lost in overcoming a series of passive resistances, which, however, are said to be eliminated in the Dirube and Sabaria system of traction. In this the machine moves to the end of the furrow carrying with it the traction platform to which the anchored cable is attached. Meanwhile the steel cable rolls on a drum coupled to the engine in such a way that the remaining part of the cable lies on the furrow. After this the operation recommences for the next furrow up to the anchorage already prepared on the opposite headland. In this way the resistance due to pulleys and cables is avoided, thus giving an efficiency of 88 to 92 per cent. The inventors have patented both the machine and the fuel, which is a gas. The machine has a pull of 45 H.P.; it weighs 8800 lb.; works a breadth of 131 in. and a depth of 6 in.; the coefficient of circular friction is 0·15; the tractive effort per sq. dm. is 60 kg., the work per hour (10 hour day with 8½ hrs. actual work), is 2·35 acres; actual work per 10-hr. day is nearly 20 acres. A driver and one assistant are required. The machine with all accessories (platform and engine, balance plough, about 5000 ft. of metal cable, anchor, etc.) is 12,250 paper *pesos* (about £1078). The fuel (a patent gas) is consumed at the rate of 500 gm. per H.P.-hour; it costs 25 *pesos* (£2, 2s.) per metric ton. Allowing 236 working days per year, the author finds that the cost of ploughing 1 hectare is 4.02 pesos. (about 2s. 10d. per acre).

The inventors have also built a 60 H.P. model. They intend to exploit their invention not by selling the machines, but by hiring them out.

Traction on Bad Roads or Land. *L. A. Legros, Engineering.*—The author deals with the problems involved in the design of vehicles for hauling goods or agricultural implements over the land or bad roads. He deals chiefly with tractors having more than two driving wheels or provided with a chain track. These two classes of tractor are applicable to different conditions, and while the methods cannot be considered as competitive, the limitations of each can be best appreciated by direct comparison of their respective peculiarities and advantages.

In the first part the author, while considering various types, deals successively with four-wheel driving, four-wheel steering, four-wheel braking, automatic differential locking gears, and the application of the four driving wheels for bad roads and arable land. Comparative figures for the different types of vehicle, their horse-power, speeds, load weight, wheel base, track width, turning radius, and overall dimensions are given by the author in a table.

The author concludes that for the transport of goods over bad roads on gradients varying from 1 in 15 on roads in which the tyres sink 2 in. to 3 in. in depth to 1 in 5 on hard roads with bad surface, and for speeds varying from 1·5 m.p.h. on grades to 12 m.p.h. on fairly level roads, the four-wheel drive tractor has great advantages over the ordinary two-wheel drive tractor.

In part 2 of the paper chain-track tractors are dealt with and classified. The author considers methods of springing, truck frames and truck-frame connections, steering, driving gear, engines, ignition and starting, radiators, speed, draw-bar pull, climbing power, etc., and he describes various English, American and French tractors, the various types being shown in illustrations. Chain-track tractors have been built in the U.S.A. and used for hauling logs since 1904, some of the original ones being still in use; these machines have intermediate roller chains ("Phoenix," Allis-Chalmers and Diplock). The author gives, in a second table, a summary of the various chain-track tractors, afterwards giving details of their construction.

The author gives numerous examples of the use of chain-track tractors for ploughing and for transport on bad roads unsuited for the conveyance of heavy loads. He calculates that the cost of traction is one-third to one-fifth that by means of horses or mules. Besides their use for cultivation and road haulage, the author mentions the use of chain-track tractors for excavating drainage trenches; amongst these, the Parsons excavators (20, 30, 45, 62 and 80 H.P.) and Austin excavators (15 to 85 H.P.) are described.

There is probably room for considerable improvement in the chain-track itself as well as in its supports and its anti-friction devices. The variation in resistance to haulage is so great as between one system and another, not merely in static resistance to starting, but in dynamic resistance to haulage, that, as the author has already suggested, the various track systems should form the subject of comparative tests at some of the great agricultural colleges. One feature that is particularly remarkable is the small amount of power lost in compressing soft marshy land under the feet of the track chains.

A Study of the Plough Bottom and its Action upon the Furrow Slice. *E. A. White, Jour. of Agric. Research, Washington.*—Geometrically exact mouldboards (plough bottoms) have often provided the basis for more perfect developments, but the results obtained by empirical plough designers were so far superior to the results obtained in the laboratory that the theories were abandoned, the makers basing their work on practical experience only.

This paper is an attempt to begin a fundamental analysis of the plough bottom and its work, in the hope that some light may be thrown on the work, and other attempts stimulated to study the theory of this important implement. The writer's work can be divided into three parts.—(1) a study of the forms of plough bottoms; (2) an attempt to analyse the motion of the soil particles as they pass over the surface; and (3) a mathematical analysis of the surfaces of the most important historical plough bottoms which were designed to be geometrically exact.

For this work the author developed the equation for determining the surface of a plough bottom.

In studying the motion of the soil particles in ploughing, observations were carried out in grass-land with a sod plough in order to determine the compression or stretching of the furrow slice and the movement (speed and acceleration) of the soil particles composing the furrow slice. The observations obtained are discussed in detail, and some are supported by the mathematical results obtained.

Trials of Disc Harrows with Tractors in France. *M. Ringelmann, Paris.*—With tractors turning the last furrows it is often necessary to use teams for scarifying and harrowing; these teams can be replaced by double disc-harrows working over a large width and thus doing much work. They are also very suitable for preparing the soil for autumn or spring sowing by replacing the scarifying and harrowing. A seed drill or a broadcaster may even be mounted on the disc-harrow, thus sowing during the same operation, should the state of the soil permit it.

The author deals with trials with two ordinary Osborne disc-harrows; on light soil that had been fallowed, with a 16 HP. Mogul tractor and a 14 disc harrow, about 53,820 sq. ft. are worked per hour with a consumption of 9·9 lb. of petrol per acre; on recently ploughed land with the same machines, about the same area is cultivated (53,389 sq. ft.) with a consumption of 12·4 lb. of petrol per acre. The speed was 3662 yards per hour on fallow and 3692 yards on recently ploughed land.

After describing the double disc-harrows with smooth and toothed discs built by M. Pilter of Paris, the author gives the results of the 1917 trials, using a double disc-harrow and a seed-drill:—

	I.	II.
Average depth cultivated in inches	2·95	4·4
Average traction in lb. ... ... total	1026·08	1288·32
„ „ „ lb. per sq. dm. (=0·1 sq. ft.)	47·74	41·8
„ „ „ lb. per disc.	31·9	40·26
Quality of the work	Very good.	Excellent.

The angle of each disc with the direction of traction was 77° in the first trial and 74° in the second.

Under ordinary conditions the smooth discs work quite well. The toothed discs might be reserved for soil liable to cake strongly; as regards this point the author has not sufficient information to allow him to give any definite information.

The Russell Turnip Turner. *The Implement and Machinery Review, London.*—There exists no turnip thinner that leaves only a single plant, but with a good machine, it is possible to leave a very small bunch of plants at regular intervals. A satisfactory machine which has proved its worth has been constructed by the Malden Iron Works Co., Ltd., Maldon, Essex. It may be used for thinning roots in general.

The Russell thinner is provided with a serrated cutter, which can be quickly adjusted to leave very small or large bunches of plants. The thinning apparatus is nicely balanced, and is entirely under the control of the man working the machine. If the crop is patchy, the attendant can lift the cutters so that plants required to be left in are not taken out. The machine is fitted with 5 speeds, for gapping 8, 10, 12, 14 or 16 inches, whilst the cutting apparatus and road wheels are arranged to slide along the axle to suit varying widths of row.

The "Universal" Electric-drive Thresher.—This thresher, built by H. Wolf & Co., of Zurich (Switzerland), includes a wagon frame mounted on four wheels, at the back of which is placed the closed box containing the motor. The box contains the motor, the cut-out, and a drum with 325 to 650 feet of cable. On the front of the frame a thresher is mounted with a straw shaker, caving screen, elevator and bagging device. The machine is driven directly by the motor. The belts can be tightened as required, a spring friction-roller being provided. The feeding table and the straw delivery should not be removed for transport, so that the machine can start working in a few minutes. When the threshing season is over, the thresher can be removed by unscrewing four screws; a circular saw or other machine can then be mounted on the frame so that the motor can be used all the year round, which is a distinct advantage.

Safety Devices for Chaff-cutters. *Italy.*—The author considers fly-wheel chaff cutters, which are the most used, and the means of preventing the accidents that are so common with these machines. These accidents can be classified as:—(*a*) accidents due to the fly-wheel; (*b*) accidents due to the feed rollers; (*c*) accidents due to the gearing and drive in general. The safety devices applied to chaff-cutters are based on two different principles:—

(1) Devices stopping or changing the movement of the feed rollers and platform by quickly moving suitable mechanisms by the hand or foot. The devices, though improving the working qualities of the machine, are only relatively efficacious, as they are rather *attenuating* than *preventive* devices, and should be supplemented by others.

(2) Devices, automatic or not, that make it impossible to pass the arm or hand beyond a certain limit into the mouth where the forage enters. For hand-driven fly-wheel chaff-cutters, the author describes guards, made of wood, cast iron, sheet iron or grating. As regards protection against accidents that might happen when feeding the machine, a board, fixed on the edge of the hopper, and of sufficient length, will prevent the arm passing beyond a safe limit.

One of the essential conditions for the safety of machine-driven chaff-cutters is that there should be both a fixed and free pulley together with the disengaging gear that is so often lacking in the older machines. It should be so made that the belt cannot suddenly slip from the free on to the fixed pulley and thus start the machine. A lever disengaging gear mounted on a bracket is very suitable for belt-driven chaff-cutters, which should have a guard for the fly-wheel and a lattice protecting the knives.

This lattice, even when lowered on the feed-trough, allows the workman to see the position of his hands and watch the work more closely, and as it is connected by a lever to the side mechanism controlling the cylinders and feed platform, if the workman's hands happen to pass into a dangerous position, the lattice lifts, thus stopping or reversing the movement.

The Use of Potato-Drying Plant in Rhodesia. *E. A. Nobbs, Rhodesia Agric. Jour.*—Considering the possibilities of exporting Rhodesian potatoes

to England and owing to the impossibility of sending fresh potatoes such long distances, the author advises that they should be dried, and to that end describes two British systems together with the plant necessary. The first system, that of James Milne & Son, Ltd., Milton House Works, Edinburgh, who have supplied a number of potato-drying plants to the Food Production Department in England, consists in steam-cooking the washed potatoes and passing them, by a rough crushing process, over a special type of drying machine. They are washed in a canal, about 2 ft. wide, 2 ft. deep and about 100 ft. long, with a fall of less than 1 per cent. A good flow of water enters with the potatoes and removes most of the sand and dirt. At the end of the canal is a grating through which the dirty water and sand escape, and the potatoes shoot down into a rotary washer with a horizontal shaft. This vat has four partitions with holes in each through which the potatoes pass, and revolving arms agitate them constantly in their transit from end to end of the machine. The washing is perfect, and the potatoes leaving this machine are taken up a slope elevator and conveyor which distributes to hoppers over the cookers and drying machines. The cookers are arranged in duplicate over each drying machine. As the cooked potatoes emerge from the steaming vessels they are roughly crushed between small rollers, and then pass between 2 much larger steam-heated cylinders, which run practically in contact one with another; the film adhering to each cylinder dries in the course of about ½ revolution, and is removed by sharp knives. The drying cylinders are worked at a pressure of about 80 to 90 lb. per sq. in., and require a very special mixture of iron to be sufficiently hard and yet strong enough to resist the pressure. The flake from the drying machines is milled and sifted to remove the peel, which commands a good price as a cattle feed. The cost of the plant when installed depends on the number of machines:—£1500, £1800, £2200, £2500 for 1, 2, 3, 4 machines respectively.

The yields depend on the content of dry matter; with 15 per cent. of dry matter in a season of 25 weeks of 60 hours each the yields for 1, 2, 3, 4 machines are 135, 270, 405, 540 tons of flour respectively and 34, 68, 102, 136 tons of peel respectively; with 25 per cent. of dry matter for the same season the yields of 1, 2, 3, 4, machines are 225, 450, 675, 900 tons of flour respectively and 56, 113, 170, 226 tons of peel respectively.

Figures are also given showing the cost of working 1, 2, 3 or 4 machines, which varies according to the cost of fuel, etc.

The second system, that of Messrs. L. Lumly & Co., Ltd., the Minories, London, consists in evaporating the water of the potatoes in their "Invicta" fruit and vegetable dryer and evaporator, which is made in 5 sizes. It consists of a furnace for heating air which passes through an inclined chest or frame filled with trays on which are laid the potatoes, fruit or vegetables to be treated. The greatest heat is concentrated upon a tray when it first enters the machine, and each tray subsequently introduced pushes the previous one into a lower temperature. The circulation of the hot, dry air ensures rapid desiccation of the outside, so that colour and flavour are unimpaired. By this process thin-sliced potatoes can be rapidly changed into a hard, light, dry form, which will keep and bear freight to distant points for further manufacture or consumption.

Beside these systems the author says there are many others, duly protected by patents.

The Douglas Fir: Its Importation and Cultivation in Central Europe. *A. H. Berkhout, Wageningen, Holland.*—The American tree commonly known as the Douglas fir was discovered in North America in 1792 by the explorer Archibald Menzies and imported into Europe by David Douglas in 1827. The Douglas fir has many names in America—red fir, black fir, hemlock, swan pine, etc. The confusion of botanical names is no less great, and is due to the fact that botanists disagree as to the genus to which it belongs; they call it *Abies Douglasii* Lindley, *Pinus Douglasii* Sab., *Pinus taxifolia* Lamb; *Picea Douglasii* Link, *Tsuga* or *Pseudotsuga Douglasii* Carr. There are many varieties of Douglas fir—blue, green, blueish-green (*glauca*), etc.; the last of these has smaller cones and is of slower growth. Douglas fir is one of the most widespread trees in America, and is found particularly in the Rocky Mountains, Sierra Nevada, Colorado and British Columbia. Its geographical distribution is between 43 and 52° north latitude. A well aerated, very light soil, containing a certain proportion of sand and stones, suits it best. It can

stand a damp atmosphere better than excessive drought and should be sheltered from continuous winds. In the State of Washington it does very well up to 1150 feet, and in Oregon up to 1800 feet; above this altitude its growth is more restricted. According to Mayr Douglas fir is very resistant to frost in its native country, indeed, it grows in districts where the temperature is sometimes below -25°C. If its importation into Europe has not always given the expected results this is due to the fact that care has not always been taken to use seed from a district in which the environment conditions are similar to those of the district in which plantations are to be made. It has also been shown that the poor sandy soil, as well as the marsh soil or excessively clayey soil of central Europe, do not suit it. The young plants may also be attacked by a fungus—*Botrytis Douglasii*—and by a canker—*Pestalozzia funera* Desm.

The rapid growth and excellent quality wood of the Douglas fir make it one of the most profitable trees for silviculturists. Data collected by Hanzlick on several plantations show this tree to have attained the following average weights and diameters (in the middle):—in 20 years, 29·83 feet and 0·35 feet; in 40 years, 76·32 feet and 0·69 feet; in 60 years, 101·25 and 1·01 feet; in 100 years, 125·55 feet and 1·34 feet. This fir may reach a height of 330 feet and a diameter of 16·40 feet. On the damp west coast of North America it generally attains in 80 years a height of 130 feet and a diameter of 2·62 feet. Of two neighbouring plantations at the Experiment Station of Wageningen one of these plantations of 18 years had an average height of 38·15 feet and an average diameter of 0·45 feet. The data show that this tree had a diameter of 0·49 feet at Wageningen *five years earlier than in its native country*. Growth is not less rapid in other parts of Europe. In Germany (Oldenburg), a 37-year old plantation had an average height of 59·04 to 65·60 feet and an average diameter of 1·95 feet. Similar figures were obtained in England.

The wood of Douglas fir is solid and very resinous and used for many purposes, such as building wood, props and supports for mines and shipyards. As timber and wood for commercial purposes it polishes very well, and is used for cabinet work and for making parquet and wainscotting. In Germany, the wood of a 25-year old tree had a specific weight of 0·536 and a resistance to pressure of 443 to 531 kg. per sq. cm.

The author foresees more numerous plantations of this tree in all central Europe, especially in places sheltered from strong winds and in clearings. The necessity of the choice of seed suited to the district, *i.e.* from a country where the climatic conditions are as similar as possible, is emphasised. In Holland such seed-control is assured by the "Nederlandsche Heide-Maatschappy" (Dutch Association for the Development of Land).

The Larch. *J. Schotte, Stockholm.*—This paper is a study on the genus *Larix* and its different species spread through the various countries of the globe made in view of their importance to silviculture in Sweden. At the same time it is an important contribution to silviculture in all countries. The author and his collaborators study above all the identification and geographical distribution of the different species of larch known throughout the world, their varieties, forest characteristics, susceptibility to disease and insect attack, production of wood, the quality and utilisation of this wood, and the division of the different species of larch into pure and mixed stands. To distinguish the species are given two tables of identification, which enable the forester to distinguish 11 species of the 16 already known.

The following details are given on the use of larch in silviculture, especially with regard to Sweden, for the most suitable species.

The European larch is grown almost all over Sweden up to Haparanda; it was imported in 1750, and the first plantations made in 1780 with seed obtained chiefly from Scotland. The plantations are remarkable for the size and regularity of the trunk and not very thick top, which has led the author to believe that there is a Scotch variety of the European larch. Since the middle of the 19th century a large part of the larch seed used in Sweden was imported from the Tyrol, giving plantations with a high proportion of twisted trunks and of bad shape, with an insufficient growth in height and a thick top. These characters make the Tyrolese larch unsuitable for mixed stands and of little value for the production of wood.

Scotch larch, on the contrary, may be profitably cultivated in the best forest soils, and produces timber ready for sale in about one-third of the time

the Scotch pine requires to do so. Since the larch is fairly often subject to canker (produced by an ascomycete, *Dasyscypha Willkommii*), it is advisable to form plantations mixed with other trees wherever possible. For this purpose plantations of Scotch larch mixed with Scotch pine or birch are to be specially recommended; spruce should be avoided, and, in any case, treated as a dominated tree. It is also advisable to use only seed of Scotch and Silesian larch, even though produced locally. The thinning of European larch should be early and intense, so that the first frees the tops and liberates the plants dominated. Intense low thinning should then be practised to eliminate the dominated trunks with bushy tops, especially if there is a dominated class in the plantation. These methods make the plantation more resistant to canker; to avoid attack by this disease trees of 20 to 30 years should be cut. European larch wood is appreciated for use as timber, for scaffolding, telegraph and telephone posts, and supports of all kinds. It keeps much better when in contact with soil than does Scotch pine.

Siberian larch is to be recommended for plantations in central and northern Sweden. Like the Scotch larch its trunk is high and straight. As it is equally subject to canker, the same care is necessary. Its wood has qualities similar to those of Scotch larch.

The Carbonisation and Distillation of Peat, Wood-shavings, Household Waste and Other Light Organic Products. *C. Galaine and C. Houlbert, Paris.*—Even when after the war coal-mining again becomes normal in all countries, the peat industry will have a great future before it, because this product is less important as fuel than for the distillation of the peat itself or of the "*tourbon*" [1] as a substitute for wood in the manufacture of acetic acid, methyl alcohol, ammonia and tar, which forms the basis of so many colouring matters.

With very dense matter, such as coal, small, rectangular, elliptical, relatively narrow retorts can be used, but for peat, or light products, it is necessary to use a large retort which will allow a more easy transmission of the heat from the periphery towards the centre. From their experiments the authors concluded that the best results were obtained with a revolving retort. They describe their apparatus which is constructed on the principle of roasters for organic matter (coffee, cacao, chicory, etc.), and is fitted with a recipient for collecting the distillation gases. The apparatus has three characteristic peculiarities: — (1) revolving retorts which successively bring the substances to be carbonised into contact with the heated wall; (2) perfectly continuous working; (3) easy emptying and charging with fractional separation of the distillation products.

The apparatus may also be used for the carbonisation and distillation of wood, lignite, saw-mill waste, household waste, and all more or less completely dry organic residues.

The Control of Field Mice by Acetylene Gas. *Bull. of the Royal Hellenic Soc. of Agric., Athens.*—The author reports the very satisfactory results obtained by him at the Agricultnral Station of Thessaly with a new acetylene gas method for destroying field mice. In many parts of the vast cereal-producing plain of Thessaly field mice, aided by favourable conditions, have multiplied so considerably that they are a serious menace to the coming harvest. In the absence of other chemical products, such as strychnine, carbon bisulphide, etc., the author applied calcium carbide, produced in large quantities by a local firm working a waterfall at Gorgopotamos, near Lamia. Small pieces of calcium carbide the size of a pea are placed in the holes dug by the mice, a little water poured in and the holes stopped up. The mice are

[1] "Mr. Eckenberg of London has shown that peat heated under pressure at a temperature above 150°C. loses its gelatinous consistency and can be easily dried by compression. For purely technical reasons it has not hitherto been possible to apply Eckenberg's method industrially. Nevertheless the product obtained therefrom has very interesting properties; it is no longer peat, but a new substance to which we give the name "*tourbon*." (Galaine-Lenormand and Houlbert, Sur l'exploitation économique des tourbes de Châteauneuf-sur-Rance (Ille-et-Vilaine), in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLXV., No. 10, p. 337. Paris, Sept. 3, 1917.)

suffocated by the gas. If new holes open in two or three days the procedure is repeated. The method is harmless to those using it, easy to apply, and cheap.

The use of Bats in the Control of Insects, especially Fortricidae, Injurious to Pine Woods. *A. Jolyet, Paris.*—On account of the damage suffered by French forests on account of the war, the author considers the possibility of invasions of injurious insects. Among those attacking pine woods, he fears *Evetria* (*Retinia*) *resinella*, *E. bouliana* Schiff. (pine-shoot tortrix moth) and *E. turionana* Hb. (pine-bud tortrix) the most. As bats destroy great numbers of these insects, the author proposes to breed these most useful Chiroptera or, rather, to encourage them to come to live near pine woods requiring protection. To do this it is sufficient to erect cots in the midst of the pine wood to serve as refuge during the day, and where the bats can winter without suffering from the severe cold.

The author has devised a cot consisting of a wooden box with double walls (leaving an air space of about 1 in.) of cubical form with sides 3 ft. 3 in. long. The box is protected from the rain by a double roof of planks covered with tarred paper and projecting beyond the sides.

The space thus left between the box and the roof should be filled with hay to keep out the cold. On the side of the box facing east an opening 12 in. high and 8 in. broad should be cut. A slide moving up and down grooves will serve to shut or open the door, through which the bats will enter or leave the shelter. The slide should be so arranged that it can be opened and closed by pulling a string, as the box should be placed about 10 feet high on a wooden scaffold or on a small tower built of stones without mortar. Inside the box rods will serve as perches for the bats.

The author advises the choice of bats belonging to the family Vespertilionidae (gen. *Vesperugo*), which hibernate in barns, towers, hollow trees, rather than bats belonging to the genera *Rhinolophus*, *Synotus*, *Plecotus*, *Vespertilio*, which are sensitive to cold and hibernate in caves and underground places. The first mentioned stand the cold better, are hardier, and live more peaceably with other bats than the latter, and also take to the cots more easily. In the genus *Vesperugo*, the large *V. noctula* and *V. serotinus* are of special interest. These attain a length (without the tail) of 3·1 and 2·7 in. respectively, the spread of the wings being 14·1 and even 16·5 in. for the first and 12·9 in. for the second. *V. noctula*, so common, is particularly suitable on account of its size, its rapid high flight, and because it leaves its hiding place at nightfall. The author also remarks upon *V. pipistrellus* (1·1 in. long; spread of wings 3·1 in.), a small species, but the commonest and easiest to adapt to a state of semi-domestication.

The Common Honey Bee as an Agent in Plum Pollination. *A. H. Hendrickson, College of Agr. Bull., California.*—The results of these experiments, which are a continuation of those of the preceding year, may be summarised as follows :—

The average yield per tree of French (Agen) plums was increased by the use of bees in the orchard, but there was no increase in the yield of the Imperial variety. The percentage of setting was greatly reduced for both varieties when all pollen-carrying insects were kept away from the trees. The percentage of setting in a French plum tree enclosed in a tent of mosquito netting with wooden supports alone or with an Imperial tree and a colony of bees was higher than the orchard average for the variety. An Imperial tree gave a good crop when alone in a tent with bees, but a slightly higher yield than the orchard average when enclosed with a French plum tree and bees. The French plum tree, which had given a heavy crop in 1916 when enclosed in netting with bees, gave a very light crop in 1917 when left free. A plum tree which had given a small crop in 1916 when under a tent alone, gave, in 1917, a percentage of setting which was satisfactory, although below the general orchard percentage. Both the Imperial trees which had given a small yield in 1916 gave heavy crops in 1917 under open orchard conditions. The percentage of setting of the French varieties was in inverse proportion to their distance from the Imperials.

The results of the two years' work led to the following conclusions :—

(1) Both French and Imperial plum trees set better if hives are placed in

the orchard during the flowering period, provided the trees are in normal healthy condition.

(2) If there are no bees in the orchard the precentage of setting of these varieties may be low.

(3) The French plum does not absolutely require to be interplanted with the Imperial, though such interplanting may prove beneficial to both varieties.

Agricultural Experiment Stations of Canada.—In Canada there are the Dominion Experimental Farms and Stations administered by the Experimental Farms Branch of the central Department of Agriculture of the Government of the Dominion, and the Provincial Colleges, Schools and Departments of Agriculture which also conduct agricultural experiments.

DOMINION EXPERIMENTAL FARMS AND STATIONS.—Under the Experimental Farm Stations Act, 1886, were established a Central Experimental Farm at Ottawa for Ontario and Quebec, and four branch Farms :—(1) for the Maritime Provinces at Nappan, Nova Scotia ; (2) for Manitoba at Brandon ; (3) for the North-west Territories at Indian Head, Saskatchewan; and (4) for British Columbia at Agassiz. After these five Farms had continued in operation for twenty years, the first steps were taken towards their extension in number by the establishment of new Experimental Stations for Alberta, viz., one at Lethbridge in 1906 and the other at Lacombe in 1907. Since this date development in the number of the Farms and Stations, and in the work carried on by them, has been rapid and continuous ; and every province has now one or more Farms or Stations. The five original farms established in 1886 are known as "Experimental Farms," those added since are styled "Experimental Stations" ; no distinction in the work is expressed by these titles.

Summing up, in 1916 there were altogether twenty-one Farms and Stations with an increased acreage over 1915 of 2213, or a total average of 11,148, as compared with the original five Farms, having a total area of 3472 acres.

Ranging over the whole of the wide fields of agriculture, arboriculture and horticulture, the work of the Farms has included experiments and studies relating to the breeding and feeding of farm live stock, the production of butter and cheese, field crops, natural and artificial fertilisers, cereals, grasses and other forage plants, fruits, vegetables, plants, trees, plant diseases and injurious insects. The Farms are also bureaux of information to which agriculturists resort for practical advice.

The more strictly scientific side of the work is carried on at the Central Experimental Farm at Ottawa, and is organised in thirteen divisions as follows :—(1) Field Husbandry ; (2) Animal Husbandry ; (3) Horticulture ; (4) Cereals ; (5) Chemistry ; (6) Forage Plants ; (7) Botany ; (8) Poultry ; (9) Tobacco ; (10) Economic Fibre ; (11) Illustration Stations ; (12) Apiculture ; (13) Extension and Publicity. What was formerly the Entomological Division became in 1914 the separate Entomological Branch of the Department of Agriculture.

OFFICIAL ORDERS AND CIRCULARS.

Minimum Rates of Wages for Agricultural Workers.

THE following is a summary of the minimum rates of wages for agricultural workers which, after having been fixed by District Wages Committees, have been passed by the Central Wages Committee, and are now enforceable under the Corn Production Act, 1917, Section 4 of which renders an employer liable to a fine of £20 if he pays a worker in agriculture (man, boy, woman or girl) at a rate less than the minimum rate applicable to the case. For a fuller explanation as to how the rates are to be calculated, reference should be made to the notices published in the newspapers by the different District Committees. The rates are inclusive of the value of any house or allowances received by the worker in part payment of wages, such value to be reckoned on a scale prescribed by the District Wages Committee.

Any worker who, owing to infirmity or injury, is incapable of earning the minimum rate applicable to his employment, may be granted a permit allowing him to be employed at less than that minimum rate, on his applying for such a permit on a form to be obtained from the Secretary of the District Wages Committee within whose area he is or desires to be employed.

MINIMUM RATES NOW IN FORCE.

Wages District and Area to which applicable.	Class of Worker.	Rate in Shillings per week.	Date from which the rate takes effect.
Border Counties—			
Berwick.	Shepherd of 18 or over in		
Roxburgh.	charge of a hirsel ...	40	7·10·18
Selkirk.	Experienced cattleman or		
	orraman of 18 or over...	35	
	Able-bodied experienced		
	ploughman of 18 or over	35	
	Other male agricultural		
	worker of 18 or over ...	30	
	Boy under 18—		
	during fourth year ...	28	
	„ third „ ...	22	
	„ second „ ...	16	
	„ first „ ...	10	
	Experienced woman of 17		
	or over	20	
	Other woman of 17 or over	18	
	Girl under 17—		
	during third year ...	18	
	„ second „ ...	14	
	„ first „ ...	10	
Dumfries and Galloway—			
Dumfries.	Ploughman over 18 ...	38	1·9·18
Kirkcudbright.	Male worker over 18 ...	33	
Wigtown.	Boy from 16 to 18 ...	24	
	Boy from 14 to 16 ...	3d. per hour	
	Experienced casual woman		
	worker	4½d. per hour	28·11·18
Ayr—			
Ayr.	Woman of 16 and over ...	4½d. per hour	1·11·18
Clyde and Forth—			
Lanark.	Male worker over 21 ...	38	14·10·18
Renfrew.	Male worker from 18 to 21	36	
Dumbarton.	Boy from 16 to 18 ...	24	
Stirling.	Boy from 14 to 16 ...	15	
Clackmannan.	Boy under 14	2/- a day	
	Woman over 17	20	
	Girl from 15 to 17 ...	16	
	Girl from 14 to 15 ...	12	
	Girl under 14	2/- a day	
Fife and Kinross—			
Fife.	Boy from 17 to 18 ...	21	7·12·18
Kinross.	Boy from 16 to 17 ...	18	
	Boy from 15 to 16 ...	15	
	Boy from 14 to 15 ...	12	
	Woman or girl over 16 ...	18	
	Girl from 15 to 16 ...	15	
	Girl from 14 to 15 ...	12	
Forfar and Perth—			
Forfar.	Male worker from 18 to 21	32/6	23·11·18
South-East Perthshire.			

MINIMUM RATES NOW IN FORCE—*continued.*

Wages District and Area to which applicable.	Class of Worker.	Rate in Shillings per week.	Date from which the rate takes effect.
N.E. Counties— Kincardine. Aberdeen. Banff.	Male worker over 20 ... Male worker from 18 to 20	35 30	19·11·18
S.W. Highlands— Argyll. Bute. Arran. North and West Perthshire.	Boy from 16 to 18 ... Boy from 14 to 16 ... Byrewoman or Dairymaid over 16 ... ... Other woman over 18 ... Other girl from 16 to 18... Girl from 14 to 16 ...	20 15 25 3/6 per day 18 15	19·10·18

All the minimum rates hitherto fixed by the Border Counties District Committee and by the Clyde and Forth District Committee have been passed by the Central Committee. In the case of the other District Committees, some or all of the rates have not yet been finally disposed of by the Central Committee.

The attention of farmers is directed to the following Orders and Notices relating to the sale and distribution of Agricultural Produce and Supplies :—

Grain.

Export of Oats from Scotland:—Under the Oats (Scotland and Ireland Restriction) Order, the Board of Agriculture for Scotland are given power to control the export of oats from Scotland to other parts of the United Kingdom. The purpose of the Order is to ensure, so far as may be possible, that Scottish Millers will have at their disposal adequate supplies of milling oats, and further, that the supply of feeding oats in Scotland will be sufficient to meet the home demand. There is no intention to place unreasonable restrictions on the trade in oats, but the following regulations must be observed by all exporters :—

Seed Oats may be consigned to destinations outside of Scotland, but the consignors must furnish to the Railway Company at the loading station a declaration to the effect that the oats are to be used for seed or have been sold specifically for that purpose. Specimen declaration forms may be obtained on application to the Board, but consignors are expected to type or print copies for their own use.

Milling and Feeding Oats will only be accepted by the Railway Companies if accompanied by a licence granted by the Board. Applications for such licences should be made on a form provided for the purpose, and supplies of the form may be obtained from the Board.

Price of Barley:—An Order entitled "The Grain (Prices) Amendment Order" has been issued by the Food Controller amending the prices chargeable for barley. It reads as follows :—

1. Where Barley is bought by a person requiring and holding a licence granted by or under the authority of the Food Controller to purchase Barley for a manufacturing business carried on by him, or by a Recognised Dealer buying for the purpose of filling a specific order given in writing by such a manufacturer, the maximum price shall be ascertained by adding 3s. per quarter to the Standard Rate.

2. Notwithstanding the provisions of Clause 9 of the Principal Order a person shall not until the 1st January, 1919, buy or sell or offer to buy or sell any Barley for the purpose of seed at a price exceeding the maximum price for Barley applicable under the Principal Order.

3. Infringements of this Order are summary offences against the Defence of the Realm Regulations.

4. (*a*) This Order may be cited as the Grain (Prices) Amendment Order, 1918, and shall be read as one with the Principal Order.

(*b*) This Order shall come into force on the 14th November 1918.

Modification of Restrictions on the Use of Cereals:—The Ministry of Food make the following announcement :—

"Certain Orders relating to the use of cereals are revoked and amended. The present position is as follows :—(1) None of the articles mentioned below may be used in the manufacture of malt or spirits or glucose except under licence ; (2) The alterations do not affect Orders such as the Horses Rationing Order, prescribing the maximum ration of cereal foodstuffs for horses, or the Cattle Feeding Stuffs (Distribution) Order, laying down certain rations for live-stock, or any Orders fixing maximum prices ; (3) Subject to (1) and (2) the following changes take effect :

"*Maize and Oats*:—Formerly maize and oats might only be used for seed or human or animal food. They may now be used for any purpose except that oats bought as seed or for milling may only be used for seed or milling, as the case may be.

Rye and Rye Flour:—Formerly these articles might only be used for human food. They may now be used for any purpose.

"*Wheat and Rice*:—The restrictions on the use of rice remain. Wheat is however taken out of the Cereals (Restriction) Order 1918 ; so that, while it is not lawful to use for any purpose except seed or the milling of flour any wheat except wheat so damaged as to be unfit for milling, it is no longer necessary to submit damaged wheat to a grain officer and obtain a certificate that it is so damaged as to be unfit for milling.

"*Barley and Dredge Corn*:—These are unaffected."

Orders have been issued by the Food Controller regulating the sale of all classes of potatoes (ware, seed and brock) in Scotland. The full text of each of these Orders is given below :—

Potatoes.

The Potatoes (*Scotland*) *Order* 1918 (*No.* 1460) :—

In exercise of the powers conferred upon him by the Defence of the Realm Regulations, and of all other powers enabling him in that behalf, the Food Controller hereby orders that, except under the authority of the Food Controller, the following Regulations shall be observed by all persons concerned :—

PART I.—GENERAL PROVISIONS.

(*a*) The Food Controller or any person authorised by him in that behalf may from time to time issue directions relating to the sale, delivery, distribution, use, or allocation of any potatoes, and in particular may :—

(i.) Give directions to any person relating to his use of or dealings in potatoes or use of or dealings in potato bags.

(ii.) Require any person to sell or deliver any potatoes to any person or place, or require any wholesale dealer to buy or take delivery of potatoes from any grower.

(iii.) Prohibit or regulate the sale, delivery, or transport of any potatoes or class of potatoes by any person to any person or to any place.

(iv.) Fix the maximum amount of potatoes which may be acquired by any person in any period, and the persons from whom potatoes may be acquired by him or which may be sold or delivered by any person in any period.

(v.) Require any person to keep books, accounts, and records relating to his dealings in potatoes, or any matter connected therewith, and to produce the same, and to afford facilities for the inspection thereof, and of his premises and stocks of potatoes and potato bags.

(vi.) Give directions prescribing the matters to be prescribed for the purpose of this Order.

(*b*) Directions given under this clause may be given so as to apply generally, or so as to apply to any special locality, or so as to apply to any special grower, dealer or person, or class of grower, dealer or person, or so as to apply to all

or any potatoes or any special variety, kind or selection of potatoes, and shall have effect notwithstanding any contract entered into by the person to whom the directions were given.

(*c*) Where any such directions have been given it shall be the duty of all persons concerned to comply therewith, and the person shall not sell, use, deliver, or otherwise dispose of any potatoes or potato bags to which such directions apply, except in accordance with the directions.

(*d*) Where a person is required to sell or deliver any ware potatoes or any damaged or undersized potatoes, such potatoes shall be sold or delivered at prices not exceeding the maximum prices applicable under this Order, except that the price payable for damaged or undersized potatoes ordered to be sold or delivered by the grower thereof shall be at the rate of £3 per ton f.o.r. or f.o.b.

(*e*) The subsequent provisions of this Order shall have effect subject to any such directions.

2. (*a*) Except under a licence granted by or under the authority of the Food Controller, a person shall not move or consign or agree to move or consign any potatoes from Scotland to any place outside Scotland, and a person shall not buy or take delivery or agree to buy or take delivery of any potatoes to be so moved or consigned except from a person so licensed.

(*b*) Where any potatoes are delivered to a railway company or shipping company for carriage, such company and their servants and agents shall be entitled to assume, until otherwise instructed under the authority of the Food Controller, that any necessary licence has been granted.

(*c*) Nothing in this clause shall apply to seed potatoes sold as or for seed, or to potatoes of the varieties mentioned in the Third Schedule sold as or for seed.

3. (*a*) Except under a licence granted by or under the authority of the Food Controller, a person shall not use or treat any potatoes or any product obtained from potatoes or any article containing potatoes or containing any such product except for the purposes permitted by this clause, or sell or buy or offer to sell or buy any potatoes except for such purposes.

(*b*) The permitted purposes, in the case of ware potatoes which are fit for human food, are seed or human food, and in all other cases are seed, human or animal food, and the manufacture of articles of human and animal food, but do not include the manufacture of spirits.

(*c*) Nothing in this clause shall prevent the use or treatment for any purpose of potatoes or products of potatoes or articles containing potatoes or containing any such product which are unfit to be used for any of the permitted purposes.

(*d*) Any person authorised by the Food Controller may, if he suspects that any article is being dealt with in contravention of this Order :—

(i) enter any premises on which he suspects such article to be ;

(ii) inspect and take supplies of such article ;

(iii) demand from any person in possession or control of such article production of any licence granted under this Order.

4. Except where a grower is selling potatoes in the ground, a person shall not sell or buy or offer to sell or buy potatoes otherwise than by weight or otherwise than in a reasonably clean condition.

5. (*a*) Every person who is the owner of potatoes or has potatoes in his possession or control or under the control of his employees or servants shall at all times take or cause to be taken reasonable precautions to protect such potatoes from frost, damp or other damage, whether such potatoes are growing or in transit or in store or otherwise.

(*b*) In particular, any person who consigns potatoes for transport by rail in open trucks, either on his own behalf or on behalf of any other person at any time during the months of December, January, February, March and April, shall take or cause to be taken all necessary steps whether by strawing the trucks into which such potatoes are loaded or otherwise to protect such potatoes from frost, damp or other damage.

6. (*a*) No bag which is or has been sold or supplied by or on behalf of the Food Controller for use as a potato bag shall be sold or otherwise disposed of by any person at a price exceeding 6d.

(*b*) In any proceedings it shall be presumed until the contrary is proved that

a bag marked "M.F." is a bag which has been sold or supplied by or on behalf of the Food Controller for use as a potato bag.

7. (*a*) All growers of potatoes shall, until further notice, furnish within eight days from the first day of each month, beginning with the month of December 1918, monthly returns of:—

(i) Estimated quantity of potatoes in his possession on the first day of the month in which the return falls to be made;

(ii) Quantity of potatoes consumed or delivered in the preceding month; and

(iii) Such other particulars as may be necessary to complete the prescribed forms of return.

(*b*) The returns shall be made on the forms prescribed by the Food Controller and in accordance with the directions stated on such forms. The forms of return when completed are to be returned in accordance with the directions stated on such forms.

(*c*) A grower shall not be required to make a return under this Order if his total acreage under potatoes in Scotland in the year 1918 was less than 1 acre.

8. As respects every crop of potatoes, the grower shall cause the sound ware potatoes to be dressed out so that they may be sold separately. Provided that nothing in this clause shall prevent the grower from dressing out seed potatoes.

9. A grower may sell his potatoes in the ground by auction or otherwise, but in every such case the buyer of the potatoes so sold shall be deemed for all the purposes of this Order to be the grower thereof.

PART II.—REGISTRATION OF DEALERS.

10. (*a*) Except a grower selling his own potatoes, a person shall not sell potatoes wholesale, either on his own account or as agent on commission, unless he holds a certificate of registration as a wholesale dealer for the time being in force granted by or under the authority of the Food Controller, or sell potatoes by retail unless he holds a certificate of registration as a retail dealer for the time being in force granted by a Food Committee. Provided that this clause shall not prevent a wholesale dealer from selling direct to consumers in quantities of not less than 1 cwt.

(*b*) Except a grower selling his own potatoes, a person shall not sell potatoes as or for seed unless he holds a certificate of registration as a dealer in seed potatoes.

11. A person registered as a wholesale dealer or a retail dealer shall not sell any potatoes in contravention of the conditions, if any, endorsed on his certificate.

12. (*a*) A retail dealer (unless registered as a hawker or costermonger) shall not sell potatoes by retail except at a place in respect of which he holds a certificate of registration as a retail dealer, but this shall not prevent a retail dealer from selling from his cart in the ordinary course of his business. A retail dealer registered as a hawker or costermonger shall sell only from his cart, stall or barrow and at such other place, if any, as may be named in his certificate.

(*b*) A retail dealer who carries on his business (including the selling of potatoes by retail) at more than one shop or place may receive a separate certificate of registration in respect of each such shop or place.

(*c*) A hawker or costermonger shall be so described in his certificate.

13. Applications for certificate of registration as a wholesale dealer are to be made to the Food Controller, and may be granted and revoked in such circumstances as he shall think fit.

14. Applications for certificate of registration as a retail dealer are to be made in the case of a retail dealer (other than a hawker or costermonger), to the Food Committee for the area in which his premises are situated (in cases where the retail dealer is applying in respect of premises situated in more than one area separate applications being made in each area in respect of the premises situated therein), and in the case of a hawker or costermonger to the Food Committee for the area in which he resides at the time of such application.

15. A Food Committee may in any case in which in their opinion it is desir-

able so to do in the interest of the public within their area, with the consent of the Food Controller, grant to any person a certificate of registration as a retail dealer in respect of any premises within their area or as a costermonger or hawker, and unless they see any good reason to the contrary they shall without any such consent grant an appropriate certificate to every applicant who has served in the Forces of the Crown during the present war and before so serving was carrying on business as a retail potato dealer within their area.

16. Every application for a certificate of registration shall be made on a form to be prescribed by the Food Controller, and every applicant shall furnish upon such form a true statement of the particulars required for completing the form, which statement shall be signed by the applicant or his duly authorised agent.

17. Every certificate of registration shall be in the form prescribed by the Food Controller.

18. (*a*) The Food Committee may, with the consent of the Food Controller, revoke any certificate of registration granted by them if they are satisfied that any of the provisions of an Order or regulation or direction made or given by or under the authority of the Food Controller relating to potatoes, or to any other article which the holder is entitled to sell by reason of his being the holder of the certificate, has not been observed by the holder of such certificate or any of his servants or agents, and shall revoke such certificate if required so to do by the Food Controller.

(*b*) The Food Controller may revoke any such certificate in such circumstances as he shall think fit.

19. The Food Committee shall keep a register of the persons to whom, and the premises in respect of which certificates of registration have been granted by them under this Order.

20. In the event of the transfer of any business in connection with which a certificate of registration is held, or in the event of the death of the holder of a certificate of registration, it shall be lawful for the transferee or other person claiming in right of the holder of such certificate, on making an application for a certificate of registration, to sell and deal in potatoes from the date of such application until the decision thereon is intimated by the Food Controller, in the same manner and subject to the same conditions as the holder of such certificate was entitled to deal by virtue thereof.

21. The holder of any certificate of registration, his servants and agents, shall give to the Food Committee such information, reports and returns relating to his stocks of potatoes and dealings in potatoes as the Food Controller or Food Committee may from time to time require, and shall produce all books, documents and accounts relating thereto for inspection on lawful demand.

22. Every certificate of registration as a wholesale dealer shall be kept by the holder at his only or principal place of business, and every certificate of registration of a retail dealer shall be kept at the premises to which the same relates, or in the case of a hawker or costermonger shall be carried with him wherever engaged in selling potatoes, and every certificate shall be produced by the holder on lawful demand.

23. Retail certificates granted under the Potatoes Order, 1917, and wholesale certificates granted under the Potatoes (Registration of Wholesale Dealers) Order, 1918, and now in force shall be deemed to have been granted under this Order.

PART III.—PROVISIONS APPLICABLE TO METHODS OF SALE AND PRICES.

24. No potatoes shall pass through the hands of more than two wholesale dealers, between the grower and the retail dealer, and all persons concerned shall observe the rules in relation to wholesale dealings contained in the First Schedule.

25. The maximum price at which potatoes of the 1918 crop, other than seed potatoes, may be sold by the grower thereof shall be the prescribed grower's price. Except that a grower of potatoes may sell quantities of less than 1 cwt. to consumers at a price not exceeding 1d. per lb.

Until further notice the prescribed grower's price shall be at the rate of £6, 15s. per ton.

26. The prescribed grower's price is fixed on the basis :—

(i) that the potatoes are either loaded by the seller into trucks at the seller's railway station, or (at the buyer's option) into a ship or barge not less convenient to the seller than the seller's railway station ;

(ii) that bags (if required) are supplied by the buyer ; and

(iii) that no commission is paid.

If the potatoes are delivered otherwise than as above, a corresponding variation shall be made in the prescribed grower's price and in particular if bags are supplied by the grower, the maximum price shall be increased by a sum of 10s., whether the bags are returnable or not, and if any commission is paid by the grower to a wholesale dealer not exceeding the rate authorised under clause (29 (*b*)) the maximum price shall be increased by the amount of the commission.

27. Upon a sale of his own potatoes by a grower, it may be made a condition of the sale that the buyer supplies any labour required for lifting or otherwise handling the potatoes, or undertaking the carriage of the potatoes from the seller's premises to station, ship, barge or other place of delivery. Provided that by the contract of sale a fair value is based upon the services so agreed to be rendered by the buyer, and in any such case the value so agreed shall be deemed, for the purposes of this Order, to form part of the price paid by the buyer for the potatoes.

28. The foregoing provisions in relation to sales by a grower are subject to the special provisions contained in the First Schedule hereto in cases where the grower is also a wholesale dealer, and such provisions shall be observed by all persons concerned accordingly.

29. (*a*) No wholesale dealer shall, in the four-weekly period ending the 30th November 1918, or in any succeeding four-weekly period, sell—

(i) potatoes acquired by him from a grower, and sold to another wholesale dealer, except at such prices as secure that the aggregate of the prices charged for potatoes so sold during the four-weekly period in question does not exceed the cost to him of such potatoes by more than an amount representing 3s. 6d. for every ton of potatoes so sold ; or

(ii) potatoes acquired by him from a grower or another wholesale dealer and sold to a retail dealer or consumer, except at such prices as secure that such aggregate does not exceed such cost by more than an amount representing 7s. 6d. for every ton of potatoes so sold.

(*b*) No wholesale dealer shall sell potatoes as agent on commission at a commission exceeding, where the sale is to a wholesale dealer, 3s. 6d. per ton, or where the sale is to a retail dealer or consumer 7s. 6d. per ton.

30. The cost of potatoes to a wholesale dealer for the purpose of the preceding clause shall be reckoned as including the following items and no more, viz. :—

(*a*) The price actually paid or payable or, by virtue of clause 27, deemed to have been paid by him for the potatoes, including the authorised charge for bags where the potatoes are bought by him already bagged.

(*b*) A sum not exceeding 10s. per ton for bags where the potatoes are bought by him unbagged and bags (whether returnable or not) are supplied by him ;

(*c*) Any reasonable costs of transportation (including marine insurance) or cartage borne by him in respect of the potatoes ; and

(*d*) Any market charges or port dues paid or payable by him in respect of the potatoes.

31. The maximum prices which may be charged by a retail dealer on a sale of potatoes shall vary according to the prices actually paid for the potatoes by the retail dealer and shall be in accordance with the scale set out in the Second Schedule.

32. The cost of potatoes to a retail dealer for the purpose of the preceding clause shall be reckoned as including the following items and no more, viz. :—

(*a*) The actual price paid for the potatoes by the retail dealer ;

(*b*) any sums actually paid or payable for the carriage of the potatoes by

the retail dealer except the carriage of the potatoes from the place at which in the ordinary course of business potatoes would be delivered to him.

33. A retail dealer if he is ready and willing to sell potatoes over the counter at prices not exceeding the maximum prices applicable under this Order may in addition to the foregoing prices make such charges as may be agreed between him and the purchaser, for the delivery of potatoes ordered for delivery at the purchaser's premises, not exceeding 2d. for any quantity not exceeding one stone with a further penny for each further half stone or part of a half stone so delivered. No charge may be made for packing, packages or giving credit.

34. Where potatoes of which the cost to the retailer is different are mixed for sale, the scale of maximum prices for the mixture shall be the scale applicable to the potatoes the cost of which is lowest.

PART IV.—UNDERSIZED AND DAMAGED POTATOES.

35. The following provisions shall apply to all undersized potatoes and to all potatoes sold as damaged potatoes :—

(*a*) The maximum prices at which such potatoes may be sold by any person shall be at the rate of £3, 10s. per ton, delivered free on rail, ship or barge, and such charges may be made in respect of bags, if supplied by the seller, as are under the order applicable in the case of a sale of ware potatoes : Provided that a retail dealer may sell any such potatoes in lots not exceeding 14 lbs. at a rate not exceeding ½d. per lb.

(*b*) The potatoes shall be expressly sold and invoiced as "undersized potatoes" or as "damaged potatoes" or as "undersized and damaged potatoes" with the addition (if the parties think proper) of any further particulars of the damage, and any such potatoes shall not be sold either by a wholesale dealer or by a retail dealer except under the same description with or without any such addition as aforesaid, and any retail dealer who exposes any such potatoes for sale shall show by a notice prominently displayed in connection with such potatoes the description of such potatoes as above.

(*c*) No such potatoes shall be mixed for purposes of sale with any other potatoes.

PART V.—SUBSIDIARY AND MISCELLANEOUS.

36 Every wholesale dealer shall keep accurate records containing such particulars as may be necessary for showing whether or not he is complying with the foregoing provisions of this Order and shall make such returns as to his wholesale trade in potatoes as may from time to time be required by the Food Controller or by the Food Committee for any area in which he has a place of business. All such records and relevant documents shall be produced by the dealer on lawful demand.

37. Every retail dealer shall so long as he shall have any potatoes on sale display prominently at the shop or other place of sale (including his cart, stall or barrow if he is a hawker or costermonger) a statement or statements showing the prices at which he is selling the potatoes at such shop or place, and when he is selling different potatoes at different prices the statement or statements shall be in such a form or shall be so displayed as to show clearly which are the prices for each lot.

38. Every retail dealer shall keep an account in which he shall regularly and punctually and at the earliest practicable time enter the particulars of all his purchases of potatoes showing the description of potatoes purchased, the quantity purchased, the price paid or payable for the potatoes, and all sums (if any) paid or payable for the carriage of the potatoes, and he shall in the same account enter the prices per stone, per half stone, and per lb. at which he has sold the potatoes or is offering them for sale, and he shall preserve for not less than three months all invoices, bills, receipts, and other documents relating to his purchases of potatoes, and he shall on lawful demand produce such account and all such invoices, bills, receipts, and other documents for inspection, and point out which entries in his account and which of the invoices, bills, receipts,

or other documents relate to the potatoes which he has on sale at the time of the demand, and give such other information as to his dealings in potatoes as the person making such demand shall reasonably require.

39. Wherever upon any sale of potatoes the seller supplies and is entitled to charge for bags, he may require a deposit to be paid by the buyer of not exceeding 1s. for each bag, in addition to the sum charged for the use of the bag, which deposit shall be refunded upon the return of the bag in such condition as is reasonable having regard to its condition when supplied and to ordinary wear and tear in use. Where a buyer is a wholesale dealer he may on re-sale of the potatoes require the amount, if any, of the deposit paid in relation thereto to be re-imbursed to him by the buyer of the potatoes, who shall in that event have the like right as his vendor would have had to repayment of the deposit upon a return of the bags.

40. Nothing contained in this Order shall prevent accommodation sales from one retail dealer to another retail dealer but the purchasing dealer shall not sell potatoes so purchased by him at prices higher than those at which the selling dealer might have sold them and the purchasing dealer shall upon every such accommodation sale take from the selling dealer a note of the transaction showing the scale of highest prices at which the selling dealer might have sold.

41. On every sale of potatoes except to consumers the seller shall furnish the buyer with documents, invoices and receipts giving full particulars of the quantities sold and the prices paid or payable.

42. A person shall not sell or offer or expose for sale or buy or offer to buy any potatoes at prices exceeding the prices applicable under this Order or in connection with the sale or disposal of any potatoes enter or offer to enter into any fictitious or artificial transaction.

43. Whenever in this Order or any Schedule hereto any person is required to produce any documents or class of documents, or give any information on lawful demand, he shall produce or give the same at all reasonable times and places on demand of any officer or constable of police, or any person authorised by the Food Controller or Food Committee to make such demand either particularly or as holding any office or position, and either generally or in the particular case.

44. For the purpose of this Order

"A wholesale dealer" means the person who is the holder of a certificate of registration as a wholesale dealer in potatoes for the time being in force granted under the authority of the Food Controller.

"A retail dealer" means the person who is the holder of a certificate of registration as a retail dealer in potatoes for the time being in force granted under the authority of the Food Controller.

"A Food Committee" means a Food Control Committee constituted by or under the authority of the Food Controller.

"Ware potatoes" means potatoes which will not pass through a riddle having 1⅝-inch mesh, or such other mesh as may in any particular case be determined under the authority of the Food Controller.

"Undersized potatoes" means any potatoes other than "ware potatoes."

"His own potatoes" with reference to a grower of potatoes mean the potatoes grown by such grower.

45. Infringements of this Order are summary offences against the Defence of the Realm Regulations.

46. This Order shall not (except clause 3 hereof) apply to cooked, dried or evaporated potatoes.

47. Parts I. and II. of this Order shall apply to all potatoes, but otherwise this Order shall not apply to—

(*a*) potatoes of the varieties mentioned in the Third Schedule sold as or for seed; or

(*b*) seed potatoes sold as or for seed.

48. (*a*) This Order may be cited as the Potatoes (Scotland) Order, 1918.

(*b*) This Order shall apply only to Scotland.

By Order of the Food Controller.

FIRST SCHEDULE.

Rules for restricting wholesale dealings and adjusting the terms of the Order to the case of wholesale dealers who are also growers or retail dealers.

1. In this Schedule :—

"Grower-dealer" means a grower of potatoes who is also a wholesale dealer.

"Wholesale and Retail Dealer" means a person who is a wholesale dealer and also a retail dealer.

2. A wholesale dealer shall not re-sell to or through the agency of another wholesale dealer (whether or not such other dealer is also a retail dealer) any potatoes which he has himself bought or agreed to buy from a wholesale dealer or from a grower-dealer selling either as a wholesale dealer or through a wholesale dealer on commission.

3. Every wholesale dealer shall keep the potatoes which he is at liberty to re-sell to a wholesale dealer separate from those which he is not at liberty so to re-sell, and shall keep separate accounts in relation to the two classes of potatoes and also in relation to the potatoes in respect of which his maximum profit is to be calculated at the rate of 7s. 6d. per ton from those in respect of which his maximum profit is to be calculated at the rate of 3s. 6d. per ton, and shall cause his accounts to be kept in such a form as to show clearly from which class the potatoes delivered upon each sale made by him have been taken.

4. A wholesale and retail dealer may as respects any potatoes bought by him treat the purchase (and enter the same in his books) as made by him for the account of his retail trade, or transfer any part of a purchase at cost price to the account of his retail trade. In every such case the potatoes so dealt with shall be disregarded in applying the provisions of clause 29 of this Order, and the transaction shall be dealt with in the account relating to the dealer's retail trade as if he had not been also a wholesale dealer.

5. A wholesale and retail dealer may also and in the alternative treat any potatoes as sold by his wholesale business or department to his retail business or department at any price and on any terms which would have been permissible under this Order as between him and a retail dealer buying such potatoes from him and in that case :—

(*a*) In the application of clauses 29 and 36 of this Order the potatoes shall be treated as having been sold by the dealer at that price and on those terms in the course of his wholesale business ; and

(*b*) in determining the maximum prices that may be charged for the potatoes on the sale thereof by retail such potatoes shall be treated as having been purchased by the dealer at that price and on those terms in the course of his retail business.

6. Where a grower-dealer sells his own potatoes as grower the sale shall be subject to the provisions applicable under this Order to a sale by a grower.

7. Where a grower-dealer sells his own potatoes as a wholesale dealer the sale shall be subject as respects price and conditions of sale to the provisions applicable under this Order to a sale by a grower except that the maximum price shall be increased by the sum of 7s. 6d. per ton in the case of a sale to a retail dealer or consumer and 3s. 6d. per ton in the case of a sale to a wholesale dealer, with the addition in either case of any reasonable costs of transportation (including marine insurance) or cartage, and the amount of the market charges and port dues (if any) incurred by the vendor in relation to the potatoes sold over and above the charges which would have been included in the maximum prices applicable if the sale had been made by him as a grower.

8. Sales of his own potatoes made by a grower-dealer as a wholesale dealer shall in his account be kept separate from any other sales made by him, and shall not be taken into account for the purpose of clause 29 of this Order.

9. For the purpose of this schedule every sale of potatoes in excess of one ton to a single purchaser not being a public institution or body or otherwise known to be a large consumer shall be deemed to be a sale to a wholesale dealer unless it is proved that in fact—

(*a*) the purchaser is not a wholesale dealer ; and

(*b*) the purchaser is either a retail dealer or purchases the potatoes for his own consumption.

SECOND SCHEDULE.

SCALE OF MAXIMUM RETAIL PRICES.

Retailers buying price per cwt. for Potatoes delivered at the place at which he ordinarily takes delivery.	Highest authorised Retail Selling Price over the Counter.			
	Rate per cwt. for quantities of 1 cwt. or more.	Rate per stone for quantities of 14 lbs. or more, but less than 1 cwt.	Rate per 7 lbs. for lot 7 lbs. or more, but less than 14 lbs.	Rate per lb. for lots of less than 7 lbs.
s. d.	*s. d.*	*s. d.*	*d.*	*d.*
Any price up to and including 6 7	7 6	1 0	6	1
Exceeding 6s. 7d. but not exceeding 7 2	8 0	1 1	6½	1
Exceeding 7s. 2d. but not exceeding 7 6	8 6	1 2	7	1
s. d	*s. d.*	*s. d.*	*d.*	*d.*
Exceeding 7s. 6d. but not exceeding 8 2	9 1	1 3	7½	1¼
Exceeding 8s. 2d. but not exceeding 8 10	9 8	1 4	8	1¼
Any price exceeding ... 8 10	10 3	1 5	8½	1¼

Note.—On sales of 1 cwt. and upwards the deposit of 1s. per bag supplied is returnable on return of the bag.

THIRD SCHEDULE.

VARIETY.

Myatt's Ashleaf Kidney.
Sharp's Victor.
Ringleader.
Snowdrop.
Early Puritan.
Duke of York or Midlothian Early.
Sharp's Express.
May Queen.
Ninetyfold.
Eclipse or Sir John Llewelyn.
Beauty of Hebron.
Dunnotar Castle.
Harbinger.
Early Rose.
Epicure.

Any other variety which may be determined to be a first early variety by the Board of Agriculture for Scotland.

The above Order prescribes only a maximum price for ware potatoes. In the months of November and December it was £6, 15s. per ton, and recently the Food Controller announced an increase of 10s., making the price for January and February £7, 5s. The Board understand that further increases will be given as the season advances. The amounts quoted represent the prices chargeable by growers, and have been fixed on the basis that the potatoes are either loaded by the seller into railway trucks or (at the buyer's option) into a ship or barge not less convenient to the seller; that bags, if required, are supplied by the buyer; and that no commission is paid. For bags supplied by

the grower, whether returnable or not, an additional 10s. per ton may be added, and if any commission be paid by the grower to a wholesale dealer the maximum price is to be increased by the amount of the commission.

It will be noted from Clause 2 that the export of potatoes (excluding seed potatoes) from Scotland is prohibited except under licence; but the Food Controller has given a guarantee that he will purchase all ware potatoes for which a market cannot be found in Scotland. The price paid for potatoes taken over in this way during the months of November and December was £6 per ton, and a price of £6, 10s. has been announced for January and February.

The Food Controller has constituted a Committee known as the Scottish Central Allocation Authority for the purpose of regulating in Scotland all matters relating to potatoes. This body is at the moment dealing only with "ware" potatoes and their address is 22 Grosvenor Street, Edinburgh. The Order under which the Allocation Authority was constituted reads as follows :—

The Potatoes (Scottish Central Allocation Authority) Order, 1918 (*No.* 1437):— In exercise of the powers conferred upon him by the Defence of the Realm Regulations and of all other powers enabling him in that behalf, the Food Controller hereby orders as follows :—

1. There shall for the purpose of regulating in Scotland matters relating to potatoes and matters incidental thereto, be constituted a Committee for Scotland which shall be known as the "Scottish Central Allocation Authority" (hereinafter called "The Authority").

2. The powers and duties of the Authority shall be such as may from time to time be assigned to them by or under the authority of the Food Controller, and the Authority shall in the exercise of those powers and the performance of those duties comply with such directions as may from time to time be given by or under the authority of the Food Controller.

3. The Authority shall consist of such number of members as the Food Controller shall determine, and the members shall be appointed in the first instance by or under the authority of the Food Controller.

4. The quorum necessary for the transaction of business by the Authority shall be such number as may be fixed by the Authority but shall not be less than six.

5. The Authority may, subject to the approval of the Food Controller, appoint a person as Secretary and Clerk, who shall hold office during the pleasure of the Authority.

6. The Chairman of the Authority shall be the Food Commissioner for the Edinburgh Division, and the Deputy Chairman shall be the Deputy Food Commissioner for the Edinburgh Division, and if at any meeting of the Authority the Chairman is absent the Deputy Chairman shall act as Chairman, and if both the Chairman and the Deputy Chairman are absent, the members present shall choose one of their number to act as Chairman for that meeting.

7. The Authority may, subject to the approval of the Food Controller, or of any person authorised by him in that behalf, provide such offices and appoint such clerks and servants as may from time to time be requisite for carrying out the duties entrusted to them.

8. If any vacancy shall occur on the Authority by death, resignation or otherwise among the members thereof, the Authority shall at their next meeting notify the Food Controller of such vacancy and shall recommend the appointment of a person to fill such vacancy, and the Food Controller shall, if he approves, appoint him to fill the vacancy.

9. The Authority may, subject to the provisions of this Order and to any directions which may from time to time be given by or under the Authority of the Food Controller, meet together for the despatch of business, adjourn and otherwise regulate their proceedings and the right of voting at their meetings as they may think fit.

10. Every question at a meeting of the Authority shall be determined by a majority of the votes of the members present and voting on the question, and in the case of an equality of votes the Chairman or acting Chairman shall have a second or casting vote.

11. Any member of the Authority may resign from the same by sending to the Secretary or Chairman of the Authority notice of his desire to do so.

12. Any Potato Inspector or Transport Officer appointed as a member of the Authority shall not be entitled to vote at any meeting of the Authority.

13. The Food Controller may at any time revoke the appointment of any member of the Authority, and thereupon such member shall cease to be a member of the Authority.

14. The Food Controller or any person empowered by him in that behalf may at any time revoke the appointment of any officer, clerk or servant of the Authority, and thereupon such officer, clerk or servant shall cease to be employed by the Authority.

15. The proceedings of the Authority shall not be invalidated by any vacancy in their number or by any defect in the appointment of any member of the Authority.

16. The Food Controller or any person empowered by him in that behalf may appoint such and so many Sub-Committees, whether consisting of members of the Authority or not, as the Food Controller or such person may determine, and the Authority may appoint such Sub-Committees as they may think fit, but the Chairman of the Authority shall *ex officio* be a member of every such Sub-Committee.

Except so far as the Food Controller or any person empowered by him may otherwise direct, the Authority may delegate, subject to such conditions as they think fit, to any such Sub-Committee any powers and duties of the Authority.

17. The provisions of this Order relating to the proceedings of the Authority shall apply to a Sub-Committee as they apply to the Authority with the necessary modifications.

18. The Food Controller or any person empowered by him may appoint the Chairman of any Sub-Committee, but failing such appointment the Sub-Committee, shall appoint some member of their body to be their Chairman, and the person so appointed shall, if he so long remains a member of the Sub-Committee, hold office as Chairman for such period as may be specified in the resolution of the Sub-Committee by which he is so appointed or until he resigns the office, and shall act as Chairman of every meeting.

19. Minutes of the proceedings of every meeting of the Authority or any Sub-Committee shall be kept in a proper book, and shall be signed by the Chairman of the next ensuing meeting, and when so signed shall be *prima facie* evidence of the proceedings at that meeting.

Copies of all minutes of a Sub-Committee shall immediately after the meeting to which they relate be forwarded to the Chairman of the Authority, and copies of all minutes of the Authority and of all Sub-Committees shall with all possible despatch be forwarded to the Food Controller.

20. The Food Controller shall have the power to veto or suspend the proceedings of any meeting and the acts and resolutions of the Authority or of any Sub-Committee.

21. The Authority shall furnish such reports, returns and information as may from time to time be required by the Food Controller.

22. The Authority shall cause to be kept full and true accounts of all moneys received and paid by them. The accounts shall be open to the inspection of any person authorised in that behalf by the Food Controller, and shall be audited as the Food Controller may direct.

The Authority shall account for and pay any moneys in their hands, or standing to their credit, to any bank or person the Food Controller or any person authorised by him, may direct.

23. All expenses incurred by the Authority shall be defrayed in such manner as the Food Controller may from time to time determine, and the Food Controller may, if he thinks fit, prescribe different methods for defraying different classes of such expenses.

24. If any difficulties arise with respect to the constitution of the Authority or otherwise in relation to the foregoing provisions of this Order, the Food Controller may do anything which appears to him necessary or desirable for the establishment of the Authority or otherwise for ensuring the full operation of this Order or of any subsequent Order relating to the constitution, powers and duties of the Authority.

25. The Food Controller may at any time if he thinks fit discharge the

Authority constituted by virtue of this Order and appoint another Authority or body of persons or person to exercise and perform all or any of the powers and duties which may have been entrusted to the Authority so discharged.

26. This Order may be cited as the Potatoes (Scottish Central Allocation Authority) Order, 1918.

Seed Potatoes:—An Order relating to the sale of seed potatoes has also been issued by the Food Controller. This Order does not prescribe maximum prices to be paid to the grower, rates of commission on sales by merchants or retailers, or the size of riddle to be used in dressing potatoes for sale as or for seed. The seller must, however, furnish to the buyer a declaration stating the class, variety and dressing of the potatoes sold, and in cases where the potatoes have been taken from immune crops certified during the growing season by this Board as reasonably free from "rogues," the declaration must also state the serial number of the certificate. For the purposes of the Order seed potatoes are divided into four classes, Class I. representing those that have been grown in Scotland. The full text of the Order is given below :—

The Seed Potatoes Order, 1918 (*No.* 1604) :—In exercise of the powers conferred upon him by the Defence of the Realm Regulations and of all other powers enabling him in that behalf the Food Controller hereby orders that except under the authority of the Food Controller or of any other Government Department nominated by him for the purpose, the following regulations shall be observed by all persons concerned :—

1. It shall be the duty of a person on the occasion of a sale of potatoes as or for seed—

(*a*) to furnish to the buyer on or before delivery of the potatoes a declaration, either in the relative invoice or in some other written document, correctly stating the class, variety and dressing of the potatoes sold. In cases where seed potatoes are sold from crops immune from Wart Disease which were inspected when growing in 1918 and certified as reasonably free from rogues by the Board of Agriculture and Fisheries as regards potatoes grown in England or Wales, or by the Board of Agriculture for Scotland as regards potatoes grown in Scotland, the declaration shall also correctly state the serial number of the relative certificate ;

(*b*) to deliver only such potatoes as correspond with the declaration.

2. It shall be a defence to any proceedings in respect of any false statement in the declaration referred to in Clause 1 if the person charged prove that he did not know and could not reasonably have ascertained that the statement was false.

3. For the purposes of this Order the classes of potatoes sold as or for seed shall be :—

Class I. (Scotch).
Class I. (Irish).
Class II. (once grown).
Class III.

The class "Class I. (Scotch)" shall include only potatoes grown in Scotland.

The class "Class I. (Irish)" shall include only potatoes grown in Ireland.

The class "Class II. (once grown)" shall include only potatoes grown in England or Wales in respect of which documentary evidence can be produced showing that they were grown in the year 1918 from seed grown in Scotland or Ireland in the year 1917.

The class "Class III." shall include all potatoes other than those comprised in the other classes.

4. Infringements of this Order are summary offences against the Defence of the Realm Regulations.

5. (*a*) This Order may be cited as the Seed Potatoes Order, 1918.

(*b*) This Order shall not apply to sales in Ireland of potatoes sold for planting in Ireland.

(*c*) This Order shall come into force on the 16th December 1918.

Feeding Stuffs.

Reference was made in the last issue of the JOURNAL to the introduction by the Ministry of Food of a scheme for the organised distribution of feeding stuffs upon the basis of definite rations for various classes of live stock. This scheme came into operation on 17th November, and at that date supplies of concentrated feeding stuffs could only be obtained by persons in possession of certificates granted by the Live Stock Commissioners for their districts.

The Order giving effect to this scheme reads as follows :—

The Cattle Feeding Stuffs (Distribution) Order, 1918 (*No.* 1308) :—In exercise of the powers conferred upon him by the Defence of the Realm Regulations and of all other powers enabling him in that behalf the Food Controller hereby orders that, except under the authority of the Food Controller, the following regulations shall be observed by all persons concerned :—

1. A person shall not on or after the 17th November 1918 obtain or attempt to obtain Cattle Feeding Stuffs from any person or supply or attempt to supply any Cattle Feeding Stuffs to any person except under and in accordance with the provisions of this Order.

2. A person named as a supplier, in a certificate granted under this Order, may supply to the person therein named or referred to as the buyer, Cattle Feeding Stuffs of the class or classes and up to the quantity and subject to the conditions mentioned in, or applicable under such certificate.

3. A person named or referred to as a buyer in a certificate granted under this Order may obtain from the person named therein as the supplier, Cattle Feeding Stuffs of the class or classes and up to the quantity and subject to the conditions mentioned in or applicable under such certificate.

4. A person shall not use or permit to be used any Cattle Feeding Stuffs obtained under a certificate granted under this Order except in accordance with the terms and conditions mentioned in or applicable under such certificate.

5. (*a*) A producer or maker of or a dealer in Cattle Feeding Stuffs shall not on or after the 17th November 1918 (except under and in accordance with the provisions of this Order or of any directions given thereunder), use any Cattle Feeding Stuffs produced, acquired or obtained by him in the course of his occupation, trade or business for the purpose of feeding his live stock.

(*b*) Nothing in this clause shall prevent :—

(i) a person who has made an application for a certificate under this Order from using for the purpose of feeding to his live stock any Cattle Feeding Stuffs mentioned in such application as being in hand at the date thereof ; or

(ii) a person from using for the purpose of feeding his live stock any Cattle Feeding Stuffs which he might lawfully have obtained and fed to such live stock otherwise than under a certificate.

6. The Food Controller or any person authorised by him may grant certificates under this Order on such terms and conditions as he may from time to time determine and may revoke any certificate, and may from time to time by general or special notice vary the quantity or class of Cattle Feeding Stuffs obtainable under any certificate or any class of certificate.

7. (*a*) Certificates granted under this Order may be graded by or under the authority of the Food Controller so as to give priority to any class of live stock over any other class of live stock, and for this purpose any class of live stock may be sub-divided.

(*b*) Where certificates have been graded, a person shall in the disposition of any Cattle Feeding Stuffs held by him have regard to the grades of the certificates upon which he is named as supplier and shall not dispose of any Cattle Feeding Stuffs to the holder of a certificate of a lower grade, until all orders for Cattle Feeding Stuffs properly demanded upon a certificate of a higher grade have been filled by him.

8. Every application for a certificate shall be made in such a manner or on such form as may from time to time be prescribed by or under the authority of the Food Controller.

9. (*a*) Directions may from time to time be given by or under the authority of the Food Controller relating to :—

(i) Records to be kept and returns to be made by any person who deals

in Cattle Feeding Stuffs or who has obtained any Cattle Feeding Stuffs upon a certificate granted under this Order.

(ii) The endorsement on certificates of particulars of the class and quantity of Cattle Feeding Stuffs supplied thereon, and

(iii) any other matter in connection with the trade or business of any person dealing in Cattle Feeding Stuffs.

(*b*) All persons concerned shall comply with any directions given by or under the authority of the Food Controller, and shall permit any person authorised by the Food Controller to inspect any records directed to be kept under this clause.

10. (*a*) Nothing in this Order shall prevent the sale and purchase without a certificate of maize or maize products (other than gluten feed, Paisley meal, maize germ meal and hominy chop) or of any horse mixture where the purchaser declares that he is buying for the purpose of feeding the same to any stallion used exclusively for stud purposes or to any horse to which the Horses (Rationing) Order, 1918, or any other Order made by the Food Controller restricting the amount of cereal Foodstuffs to be fed to horses applies; provided that the purchaser shall use the same for the purpose of feeding a horse or horses of the classes specified above.

(*b*) Nothing in this Order shall prevent the sale and purchase without a certificate of any Poultry Mixture where the purchaser declares that he is buying for the purpose of feeding the same to any poultry, provided that the purchaser shall use the same for the purpose of feeding poultry.

(*c*) The Food Controller may at any time by notice under this Order direct that any declaration to be made for the purpose of either of the foregoing sub-clauses of this clause shall be made in writing.

11. Nothing in this Order shall be taken to authorise any cereal foodstuffs to be fed to horses in contravention of the provisions of the Horses (Rationing) Order, 1918, or any other Order of the Food Controller restricting the amount of cereal foodstuffs to be fed to horses.

12. A person shall not—

(*a*) make or connive at the making of any false statement on any application or return made in connection with or for any of the purposes of this Order, or make or connive at the making of any false statement for the purpose of obtaining any Cattle Feeding Stuffs, or obtain or attempt to obtain any Cattle Feeding Stuffs, where any false statement has been made on the relative application; or

(*b*) without lawful authority alter or attempt to alter or forge any entry upon a certificate; or

(*c*) make or connive at the making of any false entry or endorsement on a certificate; or

(*d*) fail, neglect or connive at any failure or neglect to make any entry or endorsement on any certificate in manner directed thereon or required under this Order; or

(*e*) assign or attempt to assign any certificate or any Cattle Feeding Stuffs obtained thereunder; or

(*f*) falsely represent himself to be a person to whom any such certificate applies or has been issued.

13. For the purposes of this Order:—

The expression "Horse" shall include mare, gelding, filly, pony, ass and mule.

The expression "Cattle Feeding Stuffs" shall mean oil cakes and meals and other cattle feeding cakes and cattle feeding meals of every variety, millers' offals, millers' screenings, barley offals, oat offals, malt culms, brewers' grains, distillers' grains, maize, gluten feed, Paisley meal, maize germ meal, hominy chop and other maize products, molassed foods and mixtures containing any of the foregoing articles, but does not include dog biscuits or any of the foregoing articles which are suitable for human food.

14. This Order shall not apply to:—

(*a*) the making or obtaining of a supply of Cattle Feeding Stuffs proved to have been made to a person buying for the purpose of resale pursuant to this Order; or

(*b*) the making or obtaining of a supply of Cattle Feeding Stuffs for the purpose of being fed to any horse owned by the Admiralty, Army Council or Air Council.

(*c*) Sales of Cattle Feeding Stuffs in quantities not exceeding 7 lbs. in one week to or for the benefit of any person, except in so far as the Food Controller may direct that it shall apply; or

(*d*) Dealings in Cattle Feeding Stuffs in Ireland for delivery in Ireland.

15. The Cattle Feeding Stuffs (Priority Supply) Order, 1918, is hereby revoked as at the 17th November 1918, without prejudice to any proceedings in respect of any infringement thereof.

16. Infringements of this Order or of any directions given thereunder are summary offences against the Defence of the Realm Regulations.

17. This Order may be cited as the Cattle Feeding Stuffs (Distribution) Order, 1918.

When the above Order was issued certificates entitling the holders to purchase the feeding stuffs mentioned in the Order were granted only in respect of the following classes of animals, viz., cows in milk, calves under six months, bulls over six months kept for breeding, agricultural horses and other horses entitled to rations under the Horses Rationing Order, breeding sows and boars, and store pigs. The recent increase in the supplies of millers' offals and the release of greater quantities of grain for feeding purposes have rendered it unnecessary to make special provision for horses. The following are the arrangements made by the Ministry of Food for the next three months (26th January to 27th April), and in this connection the arrangements for supplying cake and cake meals for ewes should be carefully noted by sheep farmers:—

"With a view to ensuring a minimum supply of concentrated cattle feeding stuffs to certain classes of live stock after 25th January 1919, the following arrangements are being made. If at any time more supplies become available than are required under these arrangements, farmers will be able to purchase limited additional quantities without certificates. A preference will be given in purchasing these additional supplies to dairy stock owners:—

"1. *Cake and Cake Meals*:—Certificates will be issued to applicants for *Dairy Cattle*, *Calves* under six months old, *Bulls* kept for breeding, *Ewes in Lamb* and *Nursing Ewes*.

"2. *Millers' Offals*, *i.e.* Bran, Pollards, Middlings, Paisley Meal, Barley Dust, etc., and *Brewers' and Distillers' Grains* may be purchased *without certificates*.

Note.—Livestock owners (including horse owners) unable to obtain supplies of Millers' Offals should write to the Live Stock Commissioner for a special form.

"3. *Grist Meals* of Cereals and Pulse may be obtained from the usual sources without certificates.

"4. *Pig Meals.*—Pig owners who desire to feed their pigs with compound meal instead of, or as well as, with Millers' Offals and Grist Meals should fill up the form provided for the purpose.

"*Note.*—A certificate will be issued, but no guarantee can be given that supplies of Pig Meals will be provided, and applicants may have to confine their feeding to Millers' Offals or Grist Meals."

All communications regarding these arrangements should be addressed to the Live Stock Commissioner for the area in which the farmer resides.

While the supply of cake and cake meals is still limited other kinds of feeding stuffs have become more plentiful, and the following changes made by the Ministry of Food in the existing regulations should be noted:—

General Licence under the Dredge Corn Order, 1917:—Notwithstanding the provisions of the above-named Order, the Food Controller hereby authorises as from 1st December 1918 until further notice every producer of such dredge corn as consists of a mixture of cereals grown together containing more than

one cereal as a main constituent, to use such dredge corn for the purpose of feeding his live stock.

Barley.—It has been decided that, on application to a grain officer, a farmer may obtain the release for feeding purposes of 20 per cent. of his threshing of barley, or the whole of his damaged barley, tailings, screenings and dressings, whichever is the greater, on condition that the balance is sold either to a licensed manufacturer or to a recognised grain dealer.

Millers' Offals.—Recent changes in the milling regulations have led to an improvement both in the quantity and quality of Millers' Offals. These articles may now be obtained without certificate, but as their value has increased owing to the recent decision to reduce the extraction of flour from grain milled for human consumption the maximum price has been raised from £13 to £14, 10s. per ton.

The Horses Rationing, No. 2, *Order*, 1918 (*No.* 1331):—The following Order amending a previous Order on the same subject has been issued by the Food Controller. It should be noted, however, that among the classes of horses excluded from the operation of the Order are those maintained and used exclusively for agricultural purposes. The Order reads as follows:—

In exercise of the powers conferred upon him by the Defence of the Realm Regulations, and of all other powers enabling him in that behalf, the Food Controller hereby orders that except under the authority of the Food Controller the following regulations shall be observed by all persons concerned:—

1. No person shall feed any horse or permit any horse to be fed with cereal foodstuffs except as provided in this Order, or under the authority of the Food Controller.

2. This Order shall not apply to horses falling within the classes mentioned in the First Schedule.

3. Horses falling within the classes mentioned in the Second and Third Schedules may not on any day be fed with more than the quantity of cereal foodstuffs prescribed for such horses in the Schedules, or in such other Schedules as may from time to time be prescribed by the Food Controller for the purposes of this Order.

4. The maximum quantity of cereal foodstuffs which may be fed on any one day is prescribed in the Schedules in terms of oats, but other cereal foodstuffs may be used in lieu of oats, and if so used they shall be deemed for the purpose of this Order to be the equivalent of oats in the following proportions:—

7½	lbs.	maize = 10 lbs. oats.
9	„	beans = 10 lb. oats.
9	„	peas = 10 lbs. oats.
12	„	brewer's grains = 10 lbs. oats.
13	„	bran or other miller's offals = 10 lbs. oats.
12	„	any horse mixture not containing hay or straw chaff = 10 lbs. oats.
10	„	any other cereal foodstuffs which may lawfully be fed to a horse = 10 lbs. oats.

The allowance for brewer's grains is for dry grains—4 lbs. of brewer's grains obtained wet may be used in lieu of 1 lb. of dry brewer's grains.

5. Horses falling within the classes mentioned in the Fourth Schedule may not be fed with any cereal foodstuffs.

6. Any person or persons in possession of a horse or horses to which this Order applies shall keep a record in writing in sufficient detail to show (1) the number of horses kept by him in each class referred to in Schedules II. and III.; (2) the total maximum rations authorised by this Order; (3) the description and quantities of the cereal foodstuffs fed to such horses per week; and (4) the description and quantities of all cereal foodstuffs purchased and the date of such purchase: such records shall at all reasonable times be open to inspection by an officer or constable of police or any person authorised by the Food Controller or the Controller of Horse Transport.

7. For the purpose of this Order:—

"Horse" shall include mare, gelding, colt, filly, pony, mule and ass.

"Cereal foodstuffs" shall include all grains, and beans and peas, and products thereof, and mixtures containing any such articles.

8. The Horses (Rationing) Order, 1918, is hereby revoked as at the 21st October 1918, without prejudice to any proceedings in respect of any contravention thereof or to any exemptions granted thereunder.

9. Infringements of this Order are summary offences against the Defence of the Realm Regulations.

10. (*a*) This Order may be cited as the Horses (Rationing) No. 2 Order, 1918.

(*b*) This Order shall come into force on the 21st October 1918.

Note.—The amount of hay which may be fed to horses in Great Britain is restricted by an Order of the Board of Trade called the Hay and Straw Order No. 3, 1918 (S.R. & O. No. 1216 of 1918). No restriction is placed by this Order or by the Board of Trade Order on the use for feeding purposes of straw or roots.

SCHEDULE I.

Horses excluded from the operation of this Order :—

(*a*) Horses owned by the Admiralty, the Army Council or the Air Council.

(*b*) Horses maintained and used exclusively for agricultural purposes.

(*c*) Stallions used exclusively for stud purposes.

SCHEDULE II.

Horses solely or mainly used for trade or business purposes to be rationed :—

Class of Horse.	Maximum Daily Ration in terms of Oats.	
	When in hard and Continuous Work.	When not in hard and Continuous Work.
	Lbs.	Lbs.
(*a*) Heavy dray and cart horses and heavy trotting vanners ...	16	12
(*b*) Light dray and cart horses and light trotting vanners... ...	14	10
(*c*) Other light horses and cobs ...	12	9
(*d*) Ponies 14 hands and under ...	7	5

Notes.

(1) The jobbing out of horses is not in itself a trade or business purpose within the meaning of this Order.

(2) Pit ponies, working in the pits or at the pit mouth, may be given 4 lbs. extra per day.

(3) Pit horses, working in the pits or at the pit mouth, may be given 2 lbs. extra per day.

(4) Horses regularly engaged in work at a slow pace, not involving heavy loads and allowing of frequent intervals of standing, should be regarded as not in hard and continuous work.

SCHEDULE III.

Horses not used for trade or business purposes to be rationed :—

Class of Horse.	*Maximum daily ration in terms of Oats.*
(*a*) Brood Mares	7 lbs.
(*b*) Weaned Foals	6 „
(*c*) Yearlings :—	
1st January to 31st May	6 „
1st June to 31st August	3 „
1st September to 31st December	6 „

	Maximum daily ration in terms of Oats.
(*d*) Two- and Three-year-olds :—	
1st January to 30th April	7 lbs.
1st May to 31st October	3 „
1st November to 31st December	7 „
(*e*) Entire thoroughbreds, two years old and upwards, not used for stud purposes	7 „
(*f*) Hunters, not less than 14·3 hands, between the ages of 4 and 12 years (both inclusive), regularly hunted, sound, and suitable for military service as (*a*) officers' chargers, (*b*) cavalry troop horses, or (*c*) artillery riding horses ; such horses being the property of (1) the Master or Committee of a recognised pack of hounds, or of (2) recognised followers living within the limits of the Hunt. The horses to be registered by the Master or his authorised deputy, who shall notify the owners of the horses and the Controller of Horse Transport, 7 Whitehall Gardens, S.W. 1, of such registration. Horses so registered are liable to be called up by the Army Remount Department at any moment.	6 lbs. from 1st Oct. to 31st Oct. ; 10 lbs. from 1st Nov. till end of season.
(*g*) Racehorses registered with the Controller of Horse Transport, 7 Whitehall Gardens, S.W. 1, for the purposes of the limited racing scheme	13 lbs.

Note.—The age of a horse is to be reckoned as beginning on the 1st January of the year in which the horse was foaled.

SCHEDULE IV.

Horses not to receive any cereal foodstuffs :—

Horses not falling within any of the classes mentioned in Schedules I., II., III., including :—

(*a*) Racehorses, hunters and thoroughbreds other than those specified in Schedules I. and III.

(*b*) Carriage horses, hacks, char-a-banc horses, polo ponies, including all horses let out on hire for these purposes, and horses used in entertainments.

(*c*) Horses mainly used for other than business or trade purposes including all horses let out on hire for other than these purposes.

Note.—Correspondence with respect to this Order should be addressed to :—

The Controller of Horse Transport,

7 Whitehall Gardens, S.W. 1.

In view of the better position in regard to cereal feeding stuffs the following licence has been issued by the Ministry of Food, allowing increased rations to the classes of horses mentioned in the Fourth Schedule of the above Order :—

1. The Food Controller hereby authorises the feeding of horses falling within the Fourth Schedule to the Horses (Rationing) No. 2 Order, 1918, with cereal foodstuffs at the following rates :—

Class of Horses.	*Maximum Daily Ration in terms of Oats.*
Horses, 15 hands and over	7 lb.
Horses, 14 hands and under 15 hands	6 lb.
Horses, under 14 hands...	4 lb.

Provided that as regards such horses the records mentioned in Clause 6 of the Order are kept and are open to inspection as provided by that Clause.

2. For the purposes of this licence cereal foodstuffs other than oats may be used in the proportions mentioned in Clause 4 of the Order.

Live Stock.

Prices.—In view of the importance of maintaining an even supply of fat cattle and sheep for consumption, and in order to meet the extra expenses incurred by farmers in holding back stock, the Food Controller has announced the following revised scale of prices :—

BULLS, BULLOCKS AND HEIFERS.

1919.	*First Grade.*	*Second Grade.*	*Third Grade.*	*Fourth Grade.*
	Per cwt.	Per cwt.	Per cwt.	Per cwt.
Jan. ...	78/-	73/-	68/-	55/-
Feb. ...	80/-	74/-	69/-	55/-
Mar. ...	81/-	75/-	70/-	55/-
Apr. ...	83/-	75/-	70/-	55/-
May ...	85/-	75/-	70/-	55/-
June ...	85/-	75/-	70/-	55/-
July ...	82/-	70/-	65/-	55/-
Aug. ...	79/-	70/-	65/-	55/-
Sept. ...	75/-	70/-	65/-	55/-
		COWS.		
Jan. ...	73/-	65/-	56/-	45/-
Feb. ...	75/-	66/-	57/-	45/-
Mar. ...	76/-	67/-	58/-	45/-
Apr. ...	78/-	67/-	58/-	45/-
May ...	80/-	67/-	58/-	45/-
June ...	80/-	67/-	58/-	45/-
July ...	77/-	62/-	53/-	45/-
Aug. ...	74/-	62/-	53/-	45/-

Note.—If in the opinion of the person grading a beast it is likely to yield an unusually small or large proportion of bone, the above prices may (except in the case of Fourth Grade Cattle), be varied by 1s., 2s. or 3s. more or less, but in no case shall the price for the first grades be exceeded by more than 1s. per cwt. for Bulls, Bullocks, Heifers and Cows, in excess of the maximum prices in force for the time being.

(It is understood that at the moment all Fourth Grade beasts are being sold on the dead weight basis).

Sheep.—Increases per head on sheep of good marketable quality as compared with the present prices are as follows :—

Variations according to Estimated Deadweight.

1919.		1919.	
Jan. ...	From 1/6d. to 5/-	June ...	From 4/- to 13/4d.
Feb. ...	„ 2/6d. „ 8/4d.	July ...	„ 2/- „ 6/8d.
Mar. ...	„ 3/- „ 10/-	Aug. ...	*Nil.*
Apr. ...	„ 4/- „ 13/4d.	Sept. ...	*Nil.*
May ...	„ 5/- „ 16/8d.		

The prices originally fixed for both cattle and sheep are stated in the Schedule to the Live Stock (Sales) Order, 1918, which was printed in full in the July issue of this JOURNAL.

The Calves (Sales) Order :—The full text of this Order was published in the last issue, and in connection with the administration of the Order the Ministry of Food make the following announcement :—

"There is some ground for thinking that all farmers are not conversant with their rights under this Order.

"Where a calf is offered by auction in a market, the farmer may, if he is not satisfied with the price offered, take the animal away again. It is also open to him to sell to the Government buyer in the market at the maximum price of 20s. per calf, or to send his calf to a Government authorised slaughter-house for sale on the dead-weight basis."

Pigs.—The following announcement is made by the Ministry of Food :—

"The Pig (Sales) Order, 1918, is revoked. The effect is to remove most of the restrictions on the slaughter and sale of pigs, including the obligation to sell pigs in markets. It is, however, proposed to retain the maximum prices of pigs for slaughter, namely 21s. per score live-weight and 28s. per score dead-weight including all offal, or 26s. 9d. per score without offal. Wholesale and retail meat dealers and bacon curers will continue to buy pigs on permits.

"All per head charges are removed, and the maximum retail prices for pork are reduced by 2d. per lb.

The Poultry and Game (Prices) Order, 1918 :—The full text of this Order was given in the October issue of the JOURNAL. The following amending Order has been issued :—

In exercise of the powers conferred upon him by the Defence of the Realm Regulations and of all other powers enabling him in that behalf, the Food Controller hereby orders that the Poultry and Game (Prices) Order, 1918, as amended (hereinafter called the Principal Order) shall as from the 11th November 1918 be amended as follows :—

1. (*a*) The following shall be inserted as the first item in the Schedule to the Principal Order :—

	First Column.		Second Column.	
	Price at the rate per lb.	Price for the bird.	Price at the rate per lb.	Price for the bird.
		s. d.		*s. d.*
Cockerel weighing not less than 6 ozs. and not more than 1 lb.	—	2 2	—	2 8

(*b*) The words "Cockerel, Pullet, Cock or Hen" in the Schedule to the Principal Order shall be deleted and the following words substituted :—

"Any other cockerel and any pullet, cock or hen."

2. Copies of the Principal Order hereafter to be printed under the authority of His Majesty's Stationery Office shall be printed with the insertion and substitution provided for by this Order and the Principal Order shall as from the 11th November 1918 take effect as hereby amended.

The Milk (Distribution) Order, 1918 (*No.* 1246) :—In exercise of the powers conferred upon him by the Defence of the Realm Regulations and of all other powers enabling him in that behalf, the Food Controller hereby orders that except under the authority of the Food Controller the following regulations shall be observed by all persons concerned :—

Milk.

1. (*a*) The Food Controller or any person authorised by him in that behalf may from time to time issue directions relating to the collection, allocation, distribution or treatment of milk, and in particular may :—

(i) fix the proportion or amount of milk which may be retained by a producer for the purpose of his wholesale or retail trade or for any other purpose ;

(ii) fix the maximum quantity of milk which may be acquired by any person in any period and the persons from whom milk may be acquired by him ;

(iii) direct that any producer or dealer in milk shall sell or deliver the whole or any part of his milk to any person or place ;

(iv) restrict or regulate the sale or delivery of milk by any person to any other person or to any place ; and

(*v*) fix the maximum amount of liquid milk which any person may use in any period for any manufacturing purpose.

(*b*) Directions given under this clause may be given so as to apply generally or so as to apply to any special locality, or so as to apply to any special producer, dealer or person or class of producers, dealers or persons, and shall have effect notwithstanding any contract entered into by the person to whom the directions are given. Where any such directions have been given it shall be the duty of all persons concerned to comply therewith, and a person shall not sell, use or dispose of any milk to which such directions apply except in accordance with such directions.

2. For the purposes of this Order "Milk" shall include condensed milk, dried milk, milk preparations and butter-milk.

3. Infringements of this Order or of any directions given thereunder are summary offences against the Defence of the Realm Regulations.

4. (*a*) This Order may be cited as the Milk (Distribution) Order, 1918.

(*b*) This Order does not apply to Ireland.

Butter.

The Butter Order, 1918 (*No.* 976):—The full text of this Order was given in the October issue of the JOURNAL. In connection with the issue of an amending Order the Ministry of Food make the following announcement:—

"The Food Controller has raised the retail price of British made butter from 2s. 4d. per lb. to 2s. 6d. per lb. The producer may charge the retailer 2s. 3d. per lb. for butter in bulk and 2s. 3½d. per lb. for butter in rolls, etc., of 1 lb. in weight or less. Where the producer sells to a wholesaler or blender the maximum price he may charge is 2s. 1¾d. per lb. for butter in bulk and 2s. 2¼d. per lb. for butter in rolls, etc., of 1 lb. in weight or less.

"The retail price of British made butter thus becomes the same as that in force for Government butter."

Eggs.

The Egg (Prices) Order, 1918 (*No.* 1486):—In exercise of the powers conferred upon him by the Defence of the Realm Regulations, and of all other powers enabling him in that behalf, the Food Controller hereby orders that except under the authority of the Food Controller the following regulations shall be observed by all persons concerned:—

1. For the purposes of this Order:—

The expression "eggs" shall include the eggs of any bird, except plovers' eggs and gulls' eggs.

The expression "fresh eggs" shall mean eggs produced in the United Kingdom, each weighing 1½ ounces or more, and not having been preserved either by pickling or by being held in cold store, or otherwise.

The expression "imported fresh eggs" shall mean eggs imported into the United Kingdom each weighing 1½ ounces or more and not having been preserved either by pickling or being held in cold store or otherwise.

The expression "preserved eggs" shall mean eggs each weighing 1½ ounces or more, which have been preserved either by pickling or by being held in cold store or otherwise.

The expression "small eggs" shall mean all eggs weighing less than 1½ ounces.

The expression "Food Committee" shall mean a Food Control Committee constituted in any part of the United Kingdom under the authority of the Food Controller.

2. A person shall not sell or offer or expose for sale, or buy or offer to buy any eggs at prices exceeding the maximum prices for the time being applicable under this Order.

3. (*a*) Until further notice on the occasion of a sale, other than a sale by retail, of any eggs of a description mentioned in the Schedule to this Order, the maximum price shall be the price applicable according to the First Column of such Schedule.

(*b*) The foregoing maximum price is fixed on the basis of the following terms and conditions being applicable to the transactions:—

(i) Payment to be nett cash within 7 days of delivery and moneys then

unpaid thereafter to carry interest not exceeding a rate of 5 per cent. per annum or bank rate whichever shall be the higher.

(ii) Delivery to be at the seller's railway station or at the seller's warehouse at the option of the buyer, and the buyer to assume liability for breakages occurring after such delivery.

(iii) Where any eggs are sold by wholesale in less quantities than full trade packages, the seller to be entitled to make an additional charge for counting out such less quantities, not exceeding a sum at the rate of 9d. per long hundred of 120 eggs in respect of the eggs so counted out.

(iv) No charge to be made for packing, packages or any service incidental thereto; except that the seller may where the package contains proper internal sub-divisions for separating the eggs therein contained, make a charge not exceeding the usual trade charge for the cost of such a package, provided that the sum charged shall be repaid by the seller to the buyer on return of such package to the seller's railway station, in such condition as is reasonable having regard to its condition when supplied and to ordinary wear and tear.

Where the contract is made on terms and conditions other than the above, a corresponding adjustment shall be made in the maximum price.

4. (*a*) Until further notice, on the occasion of a sale by retail of any eggs of a description mentioned in the Schedule to this Order, the maximum price shall be the price applicable according to the Second Column of such Schedule.

(*b*) No additional charge shall be made for making delivery or for packing, packages or giving credit except that:—

(i) The seller may, where the package contains proper internal sub-divisions for separating the eggs therein contained, make a charge not exceeding the usual trade charge for such a package provided that the sum charged shall be repaid by the seller to the buyer on return of such package to the seller in such condition as is reasonable having regard to its condition when supplied and ordinary wear and tear; and

(ii) where any eggs are delivered at the request of the buyer otherwise than at the seller's premises, an additional charge may be made in respect of such delivery, not exceeding a sum at the rate of ½d. per half-dozen, or any larger sum properly and actually paid by the seller for carriage.

5. A person selling eggs by retail shall not:—

(*a*) sell any eggs by retail except specifically under the description of "fresh eggs," "imported fresh eggs," "preserved eggs" or "small eggs" (as the case may be), with such further description (if any) as may be desired by the seller; or

(*b*) expose for sale eggs of any description mixed with eggs of any other description.

(*c*) falsely represent or misdescribe for the purpose of sale, eggs of one description as eggs of any other description.

6. (*a*) A person selling eggs by retail shall, so long as he shall have any eggs on sale, display in a conspicuous position at his shop (or other place of sale) a notice or notices showing in plain words or figures the maximum price for eggs for the time being in force under this Order, and the notice or notices shall be so displayed as to indicate clearly in respect of any eggs exposed for sale, their description and maximum price.

(*b*) A person who sells otherwise than at a shop or stall eggs laid by his own birds and whose total stock of live poultry does not for the time being exceed 100 head, shall not be required to display any notice under the provisions of this clause in respect of such eggs, at the place at which he sells the same by retail.

7. The Food Controller may from time to time by notice under this Order prescribe further or other prices for eggs.

8. A Food Committee may from time to time by resolution vary the maximum price applicable on a sale of eggs by retail within their area or any part of their area, but

(*a*) every such resolution shall be reported to the Food Controller within

5 days, and in the case of a resolution increasing the maximum price, shall not take effect until the same has been sanctioned by the Food Controller, and until such resolution has been published by the Food Committee; and

(*b*) every resolution by a Food Committee under this Clause shall be subject at any time to review by the Food Controller and shall be withdrawn or varied as he may direct.

9. Where the Food Controller is of opinion that having regard to the provisions of this Order any contract subsisting at the date of this Order for the sale of any eggs, ought to be cancelled or modified, he may, if he thinks fit, cancel such contract or may modify the same in such a manner as he shall think just.

10. A person shall not, in connection with the sale or proposed sale or disposition of any eggs, enter or offer to enter into any fictitious or artificial transaction or make or demand any unreasonable charge

11. Nothing in this Order shall apply to—

(*a*) the sale or purchase of canned, dried or desiccated eggs;

(*b*) the sale or purchase of eggs cooked or otherwise prepared for sale as part of a meal by a caterer in the ordinary course of his catering business; or

(*c*) the sale and purchase of any eggs for breeding purposes provided that:—

(i) the purchaser declares in writing that the purchase is made for such purpose, and, unless a Food Committee gives permission to the contrary, uses eggs for that purpose; and

(ii) in any proceedings against a person for selling or purchasing any eggs at a price exceeding the maximum price permitted by this Order, the burden of proving that such eggs were sold and purchased for breeding purposes shall be on the person charged.

12. Infringements of this Order are summary offences against the Defence of the Realm Regulations.

13. (*a*) This Order may be cited as the Eggs (Prices) Order, 1918.

(*b*) This Order shall come into force on the 2nd December 1918.

THE SCHEDULE.

MAXIMUM PRICES FOR EGGS.

Description of Eggs.	First Column. At a rate of per doz.	Second Column. At a rate of per doz.
	s. d.	*s. d.*
Fresh Eggs	5 0	5 6
Imported Fresh Eggs... ...	5 0	5 6
Preserved Eggs	4 0	4 6
Small Eggs	2 8	3 0

The Board have issued the following memorandum explaining the chief provisions of the Wart Disease Order which came into operation on 1st October 1918.

The Wart Disease of Potatoes (Scotland) Order of 1918.

The Board of Agriculture for Scotland have issued this Order solely for the purpose of ensuring a more effective control of the disease known as "Black Scab" or "Wart Disease of Potatoes." At this date it is perhaps unnecessary to enlarge on the serious nature of this disease beyond saying that in the interests of food production and of the important trade in Scottish grown potatoes, it had become urgently necessary to adopt more effective measures for preventing an extension of the area in which "Black Scab" had made its appearance. This area covers roughly the central industrial district of Scotland, and, within this area as elsewhere, the disease

has, for the most part, been confined to private gardens. These two facts are reflected in the Order inasmuch as the areas scheduled are situated mainly in the centre of Scotland, and the chief restrictive provisions of the Order apply only to holdings, not exceeding half an acre in extent, within the scheduled areas.

Up to the present no means of eradicating the disease from infected soil has been discovered, and the only method of checking its spread is the planting of varieties of potatoes that resist attacks by the fungus. The Order therefore provides that so far as the scheduled "infected areas" are concerned no potatoes other than those of approved immune varieties may be planted in any garden or holding of half an acre or less in extent.

The following notes indicate briefly the extent to which all persons in Scotland who grow, sell or buy potatoes are affected by the Order:—

Infected Areas.

The districts which have been scheduled as "infected areas" are as follows:—

(1) An area comprising (*a*) the administrative County of Kinross; (*b*) the administrative County of Clackmannan; (*c*) the civil parishes of Logie, Stirling, St. Ninian, Airth, Larbert, Grangemouth, Muiravonside, Slamannan, Falkirk, Dunipace, Denny, Kilsyth, Campsie, Baldernock and Strathblane, all in the administrative County of Stirling, and the municipal Burghs of Stirling and Falkirk; (*d*) the civil parishes of Borrowstounness and Carriden and Linlithgow in the administrative County of Linlithgow, and the municipal Burgh of Linlithgow; (*e*) the civil parishes of Cumbernauld, Kirkintilloch, New Kilpatrick, Old Kilpatrick, Dumbarton, Bonhill and Cardross in the administrative County of Dumbarton, and the municipal Burgh of Dumbarton; and (*f*) the civil parishes of Inchinnan, Renfrew and Abbey (Paisley) in the administrative County of Renfrew, and the municipal Burghs of Renfrew and Paisley.

(2) An area comprising (*a*) the civil parishes of Largs, Kilbirnie, Dalry, West Kilbride, Ardrossan, Stevenston, Irvine, Kilwinning, Beith, Dunlop, Stewarton, Fenwick, Loudoun, Kilmarnock, Kilmaurs, Dreghorn, Dundonald, Symington, Riccarton, Craigie, Galston, Sorn, Muirkirk, Auchinleck, Mauchline, Tarbolton, Monkton and Prestwick, Ayr, Dalrymple, Coylton, Stair, Ochiltree, Old Cumnock, New Cumnock and Dalmellington, all in the administrative County o Ayr, and the municipal Burghs of Ayr, Irvine and Kilmarnock; and (*b*) the civil parishes of Kirkconnel, Sanquhar, Penpont and Morton, all in the administrative County of Dumfries, and the municipal Burgh of Sanquhar.

(3) An area comprising the civil parishes of Caerlaverock, Dumfries and Torthorwald in the administrative County of Dumfries, and the municipal Burgh of Dumfries.

(4) An area comprising (*a*) the civil parishes of Langholm and Ewes in the administrative County of Dumfries; and (*b*) the civil parish of Castleton in the administrative County of Roxburgh.

(5) An area comprising the civil parishes of Colinton, Liberton, Newton and Inveresk in the administrative County of Edinburgh, and the municipal Burgh of Musselburgh.

NOTE.—*Other districts will be added to the above Schedule if the prevalence of Wart Disease within them should make such a course necessary.*

Planting of Potatoes in an Infected Area.—The only varieties of potatoes which may be planted in an "infected area" are those which are approved by the Board as immune from Wart Disease. This restriction does not apply to holdings of more than half an acre in extent although such holdings may be situated in the "infected area."

Sale of Potatoes grown in an "Infected Area."—No potatoes that have been grown in gardens or holdings of half an acre or less in extent situated in an "infected area" may be sold for planting in any land which is *not* in an "infected area." Potatoes which have been grown on holdings exceeding half an acre, even if the holdings are in an "infected area," are not subject to the above restriction.

NOTE.—*The two preceding paragraphs must be read in conjunction with the following paragraph dealing with the restrictions imposed on*

holdings of whatever size and wherever situated which have been declared to be "infected premises" because of outbreaks of Wart Disease.

Holdings previously Scheduled as Infected Premises.

The above restrictions apply to all holdings (farms, gardens, etc.) of whatever extent or wherever situated which prior to the date of the Order were declared to be "infected premises" under any previous Order issued by the Board.

(1) No farmer or other grower may plant any but immune varieties in any scheduled land in his occupation.
(2) No farmer or other grower may use for planting in non-scheduled land in his occupation any potatoes that have been grown in scheduled land.
(3) No farmer or other grower may sell potatoes grown in scheduled land for planting in ground that has not been scheduled.
(4) A farmer or other grower may sell potatoes grown in scheduled land for planting in scheduled land on another farm or garden, or he may sell such potatoes to occupiers of holdings of half an acre or less in extent situated in "infected areas."
(5) Crops of potatoes grown in infected soil must not be used or disposed of for any purpose except under the authority of a licence granted by the Board.

Approved Immune Varieties of Potatoes.

Definition.—The Order defines "an approved immune variety" as "a variety approved for the time being by the Board as being immune from Wart Disease." The official list of these varieties may be obtained on application to the Board.

Sale of Immune Varieties.—The Order prohibits the sale of approved immune varieties for planting purposes except under licence granted by the Board; but this restriction applies only to sales to persons who themselves intend to use the potatoes for planting. Sales by growers to merchants or by merchants to retailers are not affected, but all persons selling potatoes of these varieties to the actual planter must be licensed.

The object of this restriction is to give the Board a certain control over the distribution of seed potatoes of the immune varieties so that the necessary steps may be taken to divert supplies to the infected areas where occupiers of gardens, allotments, etc. are prohibited from planting any other varieties.

Notification of Disease.

Notification of the presence of Wart Disease must be made to the Board by

(1) The occupiers or other persons in charge of land on which Wart Disease exists or appears to exist;
(2) All persons having in their possession potatoes that are affected with Wart Disease.

The effect of this provision is, that all growers, wholesale merchants, auctioneers, dealers, retail merchants and all buyers of potatoes, including those who buy merely for domestic purposes, are put under an obligation to report any appearance of Wart Disease that may come to their notice.

It should also be noted that occupiers of land on which Wart Disease has occurred must report any outbreak that may occur in subsequent years.

Copies of the Order may be obtained, price 1½d. each, post free, from H.M. Stationery Office, 23 Forth Street, Edinburgh.

STATISTICS.

PRICES of AGRICULTURAL PRODUCE and FEEDING STUFFS in October, November, and December 1918.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	OCTOBER.			NOVEMBER.			DECEMBER.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l w s. d.	per cwt. l.w. s. d.	per cwt. l w s. d.	per cwt. l.w. s d.
Aberdeen-Angus ...	75 10	70 8	65 0	75 10	70 10	65 0	77 5	71 11	66 1
Shorthorn	75 11	70 5	65 0	76 0	70 8	65 0	77 4	71 10	65 11
Galloway	76 0	70 0	65 0	75 0	70 0	65 0	77 6	72 0	66 6
Ayrshire	74 4	67 6	59 4	75 0	66 11	59 4	75 6	67 6	57 6
Cross-bred	75 7	70 3	64 5	75 5	70 3	64 7	77 1	71 8	65 8
Blue Grey	76 0	70 0	65 0	75 0	70 0	65 0	78 0	72 0	67 0
Highland	75 8	70 0	...	76 0	70 0	65 0	78 0	72 0	...
VEAL CALVES	per lb. d. 13	per lb. d. 10¾	per lb d. 8¾	per lb. d. 13	per lb. d. 9¾	per lb. d. 8¾	per lb. d. ...	per lb. d. 9½	per lb. d. 8½
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d	60 lb. and upw'ds. per lb d.	Ewes per lb. d.
Cheviot	16¼	16	15¾	16½	16¼	16	16¾	16½	16¼
Half-bred .. .	16½	16	15¾	16½	16¼	16	16¾	16¼	16¼
Blackface	16¼	16	15¾	16¼	16	15¾	16½	16	15¾
Greyface	16½	16¼	15¾	16½	16¼	15¾	16¾	16¼	16
Down Crosses ..	16½	16	...	16½	16¼	...	16¾	16½	...
PIGS—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone s. d.
Bacon Pigs	17 8	17 2	15 2	18 1	17 4	16 0	18 0	17 2	16 0
Porkers	17 9	17 4	15 2	18 1	17 8	16 0	18 0	17 5	16 0

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description.	OCTOBER.			NOVEMBER.			DECEMBER.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
STORE STOCK:—									
STORE CATTLE—									
Aberdeen-Angus:	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Yearlings	22 13	17 9	12 16	22 16	17 16	13 3	23 5	17 12	13 11
Two-year olds ...	32 3	26 14	21 2	34 17	27 2	20 19	35 0	28 19	18 15
Shorthorn:									
Yearlings	21 0	15 10	11 10	..	...	...	...	..	...
Two-year-olds ...	33 0	27 0	20 0	...	...	..	...	...	...
Galloway:									
Yearlings	23 13	18 3	15 0	19 10	17 0	14 12	20 0	17 7	14 13
Two-year-olds ..	32 0	26 13	20 10	32 0	25 10	20 0	30 5	26 0	...
Ayrshire:									
Yearlings	16 5	13 0	...	...	13 0	10 0	...	...	..
Two-year-olds ...	21 15	17 8	...	24 10	18 0	14 0	...	...	...
Cross-bred:									
Yearlings	20 18	16 8	12 16	21 11	16 14	13 2	21 2	16 5	12 19
Two-year-olds ...	32 18	26 10	20 9	33 13	26 18	21 13	32 12	26 1	17 18
Blue Grey:									
Yearlings	24 13	19 0	16 6	21 0	17 10	...	...	...	...
Two-year-olds .	33 0	27 13	...	33 15	26 10	...	...	...	...
Highland:									
Yearlings	15 15	13 9	11 3	15 2	12 2	9 10	13 15	11 10	9 0
Two-year-olds ...	24 8	20 14	17 18	22 16	19 5	17 8	23 0	...	...
Three year-olds ...	32 14	27 0	22 9	30 0	25 3	21 0	...	...	..
DAIRY COWS—									
Ayrshire:									
In Milk	53 0	42 0	28 3	55 7	45 0	30 14	54 16	45 0	28 17
Calvers	56 0	41 10	28 5	57 19	44 8	30 16	53 2	42 12	27 16
Shorthorn Crosses:									
In Milk	59 0	45 0	31 8	64 3	48 14	33 17	64 14	49 18	34 2
Calvers	56 11	42 15	31 10	60 19	46 16	34 19	60 2	47 4	34 5
STORE SHEEP—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Cheviot Hoggs ..	56 7	49 8	56 0	...	40 6	...	39 0	...	..
Half bred Hoggs ...	82 10	37 9	. .	58 0	42 6	...	61 2	44 7	28 0
Blackface Hoggs ...	64 5	52 8	46 3	42 0	37 4	30 0	...	...	...
Greyface Hoggs ...	60 6	..	...	...	...	...	...	36 0	...
STORE PIGS—									
(6 to 10 weeks old)	58 6	41 10	...	50 3	35 0	...	43 8	30 6	...

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	OCTOBER.			NOVEMBER.			DECEMBER.		
		Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF :—										
		per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb d.	per lb d.	per lb. d.	per lb. d.
Home-fed—										
Bullock or Heifer ...	1	14¼	14¼	14¼	14¼	14¼	14¼	14¼	14¼	14¼
	2	...	...	..	...	...	...	...	...	...
Bull	1	14¼	14¼	14¼	14¼	14¼	14¼	14¼	14¼	14¼
	2	...	...	...	...	..	...	...	...	...
Cow	1	14¼	14¼	14¼	14¼	14¼	14¼	14¼	14¼	14¼
	2	...	12	12½	12½	12	11⅞	...	11½	12⅝
Irish—										
Bullock or Heifer ...	1	...	...	14¼	..	...	14¼	...	...	14¼
	2	...	...	...	...	...	...	...	..	...
Bull	1	...	...	14¼	...	...	14¼	...	...	14¼
	2	...	...	12⅞	...	...	13½	...	...	12⅝
Argentine Frozen—										
Hind Quarters ...	1	...	15⅝	..	...	...	..	...	...	15⅞
Fore ,, ...	1	...	12½	...	...	...	...	...	...	13⅝
Argentine Chilled—										
Hind Quarters ...	1	...	...	...	...	...	...	..	...	...
Fore ,, ...	1	..	...	...	...	...	...	...	...	...
MUTTON :—										
Hoggs, Blackface ...	under 60 lbs.	15	15	15	15	15	15	15	15	15
	60 lbs. and over.	...	15	...	15	15	13½	15	15	15
,, Cross	under 60 lbs.	15	15	15	15	15	15	15	15	15
	60 lbs. and over.	...	15	...	15	15	13½	15	15	15
Ewes, Cheviot	1	15	15	15	15	15	15	15	15	15
	2	...	...	...	...	...	13	...	...	14
,, Blackface ..	1	15	...	15	15	15	15	15	15	15
	2	...	...	...	...	...	13	...	...	14
,, Cross	1	15	15	15	15	15	15	15	15	15
	2	...	...	...	...	...	13	...	...	14
Argentine Frozen ...	1	...	...	...	...	...	...	...	...	...
LAMB :—										
Home-fed	1	15	15	15	15	15	15	15	...	15
	2	...	...	...	...	...	...	...	...	...
Argentine Frozen ...	1	...	...	...	...	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	...

AVERAGE PRICES OF PROVISIONS AT GLASGOW.

(Compiled from Reports received from the Board's Market Reporter.)

Description.	Quality.	Oct.	Nov.	Dec.
		s. *d.*	*s.* *d.*	*s.* *d.*
BUTTER:				
Irish Creamery ... per cwt.	1	252 0	252 0	252 0
„ „ (Unsalted) „	1	252 0	252 0	252 0
Canadian ... ... „	1	252 0	252 0	252 0
Australian ... ... „	1	252 0	252 0	252 0
„ (Unsalted) ... „	1	252 0	252 0	252 0
New Zealand ... ... „	1	252 0	252 0	252 0
„ (Unsalted) „	1	252 0	252 0	252 0
Argentine ... ... „	1	252 0	252 0	252 0
„ (Unsalted) ... „	1	252 0	252 0	252 0
CHEESE:				
Cheddar ... ... „	1	163 4	163 4	163 4
Cheddar Loaf ... ... „	1	...	...	...
Dunlop ... ... „	1	163 4	163 4	163 4
Canadian ... ... „	1	163 4	163 4	163 4
New Zealand ... ... „	1	163 4	163 4	163 4
BACON:				
Ayrshire (Rolled) ... „	1	222 6	222 6	222 6
Irish (Green) ... ... „	1	...	...	...
„ (Dried or Smoked) „	1	218 0	214 0	214 0
Wiltshire (Green) ... „	1	...	...	...
„ (Dried or Smoked) „	1	...	...	...
American, Long Clear Middles (Green) ... „	1	189 0	189 0	189 0
American, Short Clear Backs ... ... „	1	150 0	150 0	150 0

Description.	Quality.	Oct.	Nov.	Dec.
		s. *d.*	*s.* *d.*	*s.* *d.*
BACON *(continued)*:				
American, Bellies... per cwt.	1	150 0	150 0	150 0
„ Sides ... „	1	176 6	176 6	176 6
„ Cumberland Cut „	1	174 0	174 0	174 0
Canadian, Sides ... „	1	176 6	176 6	176 6
„ Cumberland Cut „	1	174 0	174 0	174 0
Danish, Sides ... „	1	...	...	...
HAMS:				
Irish (Smoked) ... „	1	...	...	...
American, Long Cut (Green) ... ... „	1	170 0	170 0	170 0
American, Short Cut „	1	170 0	170 0	170 0
Canadian, Long Cut „	1	170 0	170 0	170 0
EGGS:				
Country ... ... per doz.	1	5 11	6 7	*50 0
	2	5 8	6 5	...
Irish... ... ... per 120	1	54 11	65 0	*50 0
	2	52 10	63 0	...
„ (Cold Stored) „	1	49 0	*40 0	...
	2	48 0	...	...
„ (Pickled) ... „	1	*40 0	*40 0	*39 6
	2	...	...	...
American ... ... „	1	...	*40 0	*40 0
	2	...	...	...
Danish (Pickled) ... „	1	*40 0	*40 0	*40 0
	2	...	...	...

* Controlled price per 120.

AVERAGE PRICES OF POTATOES AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

MARKETS.	Quality.	Second Earlies.	Late Varieties.			
			Red Soils.		Other Soils.	
		British Queen.	Langworthy.	Other.	Langworthy.	Other.
		per ton. £ s. d.	per ton £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
OCTOBER.						
Dundee	First ...	...	...	...	...	...
	Second ...	...	...	...	...	...
Edinburgh... ...	First ...	7 10 0	...	...	...	...
	Second ...	...	...	...	...	...
Glasgow	First ...	6 17 6	...	...	...	...
	Second ...	...	...	...	...	...
NOVEMBER.						
Dundee	First ...	...	...	...	...	7 0 0
	Second ...	...	...	...	...	...
Edinburgh... ...	First ...	7 10 0	...	...	8 10 0	...
	Second ...	...	...	...	...	...
Glasgow	First ...	7 0 0	...	...	7 5 0	...
	Second ...	...	..	...	...	...
DECEMBER.						
Dundee	First ...	...	...	...	...	7 0 0
	Second ...	...	...	...	...	...
Edinburgh... ...	First ...	7 15 0	...	8 15 0	8 15 0	8 12 6
	Second ...	...	...	...	...	...
Glasgow	First ...	...	...	...	...	7 10 0
	Second ...	...	...	...	...	...

AVERAGE PRICES OF ROOTS, HAY, STRAW AND MOSS LITTER AT DUNDEE, EDINBURGH AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Markets.	Quality.	Roots.			Hay.		Straw.			Moss Litter.
		Carrots.	Yellow Turnips.	Swedes.	Ryegrass and Clover.	Timothy.	Wheat.	Barley.	Oat.	
OCTOBER.		per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.
Dundee ...	1	...	44 6	...	...	...	...	...	...	54 8
	2	...	40 0	...	...	...	...	...	...	...
Edinburgh	1	...	...	...	168 0	...	78 0	80 0	81 0	48 0
	2	...	...	...	140 0	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	47 6
	2	...	...	...	...	...	...	...	...	...
NOVEMBER.										
Dundee ...	1	...	45 4	70 0	...	...	...	...	...	57 9
	2	...	42 0	55 0	...	...	...	...	...	...
Edinburgh	1	...	...	60 0	170 0	...	80 0	...	86 3	50 0
	2	...	...	...	141 3	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	50 0
	2	...	...	...	...	...	...	...	...	...
DECEMBER.										
Dundee ...	1	...	45 6	60 0	...	...	...	...	...	56 3
	2	...	..	56 0	...	...	...	...	...	...
Edinburgh	1	...	..	52 6	171 3	...	79 5	...	85 0	50 0
	2	...	...	...	142 6	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	50 0
	2	...	...	...	...	...	...	...	...	...

AVERAGE PRICES OF FEEDING STUFFS AT GLASGOW AND LEITH.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	OCTOBER.		NOVEMBER.		DECEMBER.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton. £ s. d	per ton £ s. d	per ton. £ s. d.	per ton. £ s. d.	per ton £ s. d	per ton. £ s. d.
Linseed Cake—						
Home	...	...	...	...	...	19 0 0
Foreign	...	...	. .	...	...	...
Soya Bean Cake ...	...	...	...	.	...	. .
Decorticated Cotton Cake	...	...	...		...	...
Undecorticated Cotton Cake—						
Bombay ...	...	...	...	...	...	...
Egyptian	**14 15 0	14 15 0	**14 15 0	14 15 0	**14 15 0	14 15 0
Coconut Cake .	...	. .	...	...	...	...
*Palmnut Kernel Cake	...	.	.		...	...
Groundnut Cake (Decorticated) ..	...	.	...	.	...	...
†Beans (Brazilian)...	30 15 0	. .	30 15 0	...	..	. .
‡ „ „ ...	...	...	37 10 0	. .	37 10 0	...
Maize Meal ...	...	...	...	...	...	..
Rice Meal	...	...	...	.	...	...
Paisley Meal ...	...	. .	23 10 0	..	23 10 0	...
Distillery Meal ...	...	...	32 10 0	.	..	...
††Beans (English) .	...	. .	4 16 6	. .	3 18 9	...
††Peas (English) ...	...	...	4 18 4	...	4 3 2	...
Locust Bean Meal	...	...	...	. .	...	40 0 0
Maize	...	...	...	...	...	...
Oats	...	16 10 0	. .	16 10 0	..	16 10 0
Flour Millers' Offal	...	...	...	...	**16 5 0	...
Malt Culms ...	...	. .	...	...	...	13 0 0
*Distillery Mixed Grains—						
Dried	18 10 0	...	18 10 0	...	18 10 0	...
Brewers' Grains—						
Dried	...	...	...	...	..	...
Wet	...	...	...	...	...	...
Distillery Mixed Grains—						
Wet	...	...	...	...	...	...
*Wheat—						
Middlings (Fine Thirds or Parings)	...	...	...	...	...	14 10 0
Sharps (Common Thirds)... . .	...	...	...	...	...	14 10 0
Bran (Medium) ..	...	...	...	..	...	14 10 0
Bran (Broad) ...	...	.	...	...	...	...
Feeding Treacle ...	...	...	...	...	...	22 0 0
*Crushed Linseed ...	...	...	...	...	...	...
*Fish Meal	24 0 0	25 0 0	27 0 0	25 0 0	27 10 0	26 17 6

* Fixed price excluding price of bags and authorised transport charges.
† Ex-Store Liverpool. ‡ Ex-Bristol.
** Free on rail. †† Price per 252 lbs.

Printed under the authority of His Majesty's Stationery Office
By J. SKINNER & CO., LTD., 57 THISTLE STREET, EDINBURGH.
(11131.) 7997/189. 3000. 1/19.—J.S.&Co.Ltd. (E.)

The Scottish Journal of Agriculture.

VOL. II.—No. 2.] APRIL 1919. PRICE 6d.

THE AGRICULTURAL ADMINISTRATOR IN THE TROPICS.

JAMES CURRIE, C.M.G.

IN accepting the invitation to contribute a note to the JOURNAL on the duties of an Agricultural Administrator in the Tropics, I would at once disclaim capacity to write from the technical or specialised standpoint. Any weight which may attach to the opinions I express is due to the fact that I put in some sixteen years as a Civil Servant in the Anglo-Egyptian Sudan, a country of unbounded potential resources from the agricultural standpoint, and of but little account from any other. It was my duty, however, as a senior official, to put forward various schemes for organising agricultural work. I was therefore compelled to consider not only the nature of the problem, but also the type of man most likely to tackle it successfully, and the general administrative system subject to which the men available could reasonably be expected to do their best work.

What is the problem and the scope of the duties of the agricultural administrator in the tropics? I shall attempt to sketch the scope of his duties, and the department of work he will have to organise in whatever part of the tropical world he may be placed.

After he has assumed the reins he will presumably make a general study of the prevailing conditions. His range of observation must necessarily be a wide one, for political and administrative considerations can hardly be excluded from it. He will, needless to say, have to form a definite opinion as to the merits or otherwise of the system of land tenure that generally obtains, at all events from the point of view of its effects on agricultural production. These questions will inevitably bring him into close contact with colleagues concerned with the administration of other departments of Government, *e.g.* Finance and Law. The more successful he is in inspiring confidence and in securing sympathetic consideration for his own particular departmental point of view, the smoother his path will be.

Having obtained his general point of view he will have to come down to detail. His immediate objects can probably be divided under two main heads. His first object will be, by a series of measures, to do what he can to ensure increased production. His second object, subsidiary but essential to the carrying out of the

first, will be the institution of an adequate system of crop statistics and records.

In order to attain the first objective he will, without prejudice to any subsequent aims, assuredly have to establish the following scientific sections, namely :—

(1) Botanical—including plant breeding, variety testing and experiment stations ;
(2) Entomological—to study and work out remedial measures connected with insect pests, and to formulate the necessary legislation ;
(3) Chemical—for the study of soils, manures and analyses of plants and products ;
(4) Mycological—this will need to be independent of the botanical section, which will inevitably concern itself with improvement in plants and purification of varieties.

There is, however, no valid reason against grouping together under one branch the entomological and mycological sections.

To attain his second objective he will have to institute a second main branch of administration to include commercial, statistical and publication sections.

There remains the thorny subject of agricultural education, which may or may not come under his direction, but with which, in any event, he is bound to establish the closest possible contact. In a backward country, it will be found in practice that the best results are obtained by making agricultural education an integral part of the Department of Agriculture, and it will be the duty of the administrator to see that proper relations are established between the departments of research and any schools of agriculture that may be established. Should he fail to set-up such connection, the result will inevitably be reflected in the lack of vitality and the dry rot that will pervade his schools.

Quite apart from schools, a very large proportion of the work of the Department must necessarily be educational. There is little use, at all events amongst backward, suspicious people, in expecting that they will consent to learn from what they see on State Demonstration Farms. Their criticism invariably is (and we may as well admit its validity) that Government can obtain all the facilities which are denied them, and that, therefore, the deductions to be drawn are worthless. Fortunately, there is a more excellent way. Demonstrations can be carried out by cultivators themselves, at their own expense, under the direction of officers of the administration, with the cultivator secured against financial loss so long as he consents to be advised and directed. I have not seen this means of propaganda fail whenever it has been tried. Provided the executive officers are of the right stamp, and the initial experiments are not dogged by persistent ill-luck, the results are frequently highly encouraging, and arouse wide-spread criticism and interest. For propaganda purposes, I have never seen Government farms of the slightest use—their function ought to be limited to research and experiment.

If the above description of the functions of the officer in charge of agricultural administration be accepted as in any way correct—

it is certainly abbreviated and perfunctory—it will be seen how wide is the sphere of his duties, and what a combination of qualities is required if such a post is to be adequately filled.

Should any reader be sufficiently interested to pursue the subject further, I would refer him to two papers delivered by Mr. Gerald Dudgeon to the Third Intermediate Congress of Tropical Agriculture on the "Organisation of Agricultural Departments in relation to Research Work," and "Technical Education in Tropical Agriculture"[1]; I may also quote by way of supplement a letter I have just received from a very old friend who has spent the best part of his life in grappling with these problems.

> "1. As you know I have had the privilege during the past twenty years of serving as agriculturist and forester under a chartered company in Rhodesia, a farmers' government in Natal, a typical Latin administration in Portuguese East Africa, and a quasi-military system obtaining in a British Protectorate. The following opinions are based on an analysis of factors common to all, as, I take it, you do not require a comparative study of the influence of political systems on agricultural development, though the subject is one of no little interest.
>
> "2. I would first urge, as a considered and constantly confirmed opinion, that the functions of a Colonial Agricultural Administrator cannot be associated profitably with the work of technical research, though a technical training is a necessary qualification. Ground between the upper and nether millstones, he cannot hope to bring to scientific work the detachment of mind and concentration of thought which are essential to satisfactory results.
>
> "His task in life is to dream dreams, to test them waking by strictly practical standards, and to impose the results as an agricultural policy on the apostles of *laissez faire*. He must be prepared to fight in a crowded arena for every penny of his financial resources, and take half a loaf without discouragement. He must induce such centrifugal bodies as government and farmer to meet, cushion the shock and absorb the friction of their passage through a common orbit. He must gain the confidence of both by infinite tact, patience and a technical grasp of local problems and the applicability of local research. To early success he must add a level-headed dealing with the recurring crises of agricultural development in a new country. He must be prepared to deal with native cultivators through the medium of their own language. And, finally, he must inspire team work in his staff, which will inevitably have skeletal proportions, and by careful definition of functions, with a well devised system of liaisons, secure balance and co-operation between research, administration and education, and a maximum efficiency in the whole.
>
> "3. It would thus appear that the colonial agricultural administrator should be a visionary and an economist, a

[1] Transactions, Third International Congress of Tropical Agriculture, Vol. I. Published by John Bale & Son.

fighting politician and a suave diplomatist, a native linguist, an expert agriculturist and a business organiser. The catalogue is based on a middle-aged consciousness of one's own shortcomings. What such a man might mean to the agricultural industry has been brought home to us during the past six years, where a decapitated agricultural department, divested of all real authority, has been supplemented by numerous other official and semi-official, headless and soulless bodies, boards and syndicates, without co-ordinating machinery or organic connection. The results have inevitably been overlapping and waste of effort, lack of discipline, wirepulling, unfair competition for men and money, the absence of any articulate policy or adequate representation of agricultural interests, and, briefly, chaos.

"4. The agricultural expert, who is to engage successfully in technical research in the colonies, should be caught young, and need extrication from no rut of specialisation. Pioneer research is an attack on an indefinitely wide front against an unlimited number and nature of problems with the object of occupying scattered points, which shall serve to orientate the efforts of those who follow. The investigator must consequently be prepared to work on incomplete or imperfect evidence, for time presses, while maintaining unimpaired his scientific conscience Capacity to abandon preconceived ideas, based on conditions for which no parallel will be found, is essential. Cause for a majority of failures may be sought in attempts to put new wine into old bottles. To cite a single example, soil which has been brought for any length of time under the influence of well conducted farm operations, ceases to bear any close resemblance to its original character, and becomes an artificial substance. The pioneer chemist, dealing with 'the raw and naked lands,' can apply principles based on soil studies in, say, Scotland, only with the greatest possible reserve, and would preferably clean the slate and start anew. Tropical soil temperatures and biological interactions afford results which may only be confused by interpretations in terms of British farming.

"5. A second, and no less important, qualification in the pioneer expert is ability to communicate his results in intelligible form He must personally breach the gap between research and education if his work is to have any practical value. He must be prepared to close his laboratory or leave his station and use the spoken rather than the written word. The ordinary channels of communication in more highly civilised countries may not be available. The lecturing tour, the agricultural show and the demonstration plot should supplement the work of a residential school. Personal intercourse with the cultivator, with the colonist or native, is the secret of success. The pioneer farmer has neither the time nor the inclination for technical reports, though a popular agricultural journal, if well illustrated, may be employed as an additional avenue of approach. He is always, however, glad to discuss possible improvements in farm practice if the

expert be prepared to recognise the probability of mutual education.

"6. A pioneer investigator must be prepared to adopt the view that in human affairs science has little significance except for practical purposes. The temptation is ever present to look rather to Royal Societies than to the often 'difficult' farmer for audience, but it is 'simple service simply given' which is asked, 'to his own kind in their common need.'"

If we accept this description as a reasonable and accurate one, it is obvious that such a public servant, if he can be obtained at all, is of priceless value to the country that is in possession of his services. It is equally certain that men with these qualities are, in the nature of things, few and far between, and represent a combination of qualities that are obviously too uncommon. No academic records, however brilliant, will guarantee them. They certainly do not appertain to any specialist in virtue of any specialist training known to me. Up to the present a perplexed Government frankly accepts the problem as insoluble and, starting from that standpoint, has in general made a stupendous muddle of the whole problem. It has accepted as a starting premise that the super-man I have attempted to describe cannot be found among the ranks of agriculturists. A non-technical officer, euphemistically termed an all-round administrator, has in general been put in charge of the Department. He has been the channel of communication between the Department and the financial and administrative authorities who in practice control its destinies. It may be confidently said that this procedure has not succeeded; at all events I have not seen anything but failure result. The technical head of the agricultural department must be placed in such a position that he himself can discuss the problems he has to take up with the financial and other authorities with whom the last word must necessarily rest. In practice such a position is seldom assigned to him, and this is one of the main reasons why progress has been so disappointingly slow. Further, no one can direct or carry on the executive work unless he is fully competent to understand the scientific side. To the ordinary mind, the standpoint here taken up must appear so obvious that the question naturally arises why the opposite state of things should obtain. Vested interests, administrative prejudices, or the presence in the seats of the mighty of men trained in the classical tradition so detested by Mr. Wells, do not furnish a complete explanation. It must be admitted that the difficulty of obtaining technical experts who have had the right type of training and experience is very great. And though the technical expert, if he is the right type, will produce by far the best results if put in charge, the "all-round administrator" will in all probability do better than the narrow specialist both in relation to the outside world and to his own staff.

The question then that arises is, what kind of training and experience gives the best opportunity for the evolution of the administrator of the type I have suggested is necessary? If the description of his functions I have given be accepted as in any degree reasonable or accurate, it is obvious that the possession of

a corps of public servants fitted to fulfil them under the right kind of chief, would be a priceless asset to any Government, and an incalculable factor in the economic development of any country. It is equally certain that men with such qualifications must always be difficult to obtain. But, so far as they can be procured by any system of training, let us consider what that training must necessarily be. We had some reason to believe, in 1913, that the Colonial Office had made up its mind to establish in the Tropics two well-equipped centres at which post-graduate tropical research work would be possible. It is much to be hoped that the project will be revived. The demand for raw material induced by the war has so substantially enriched all our tropical dependencies, that they are well able to shoulder the financial burden on a large and liberal scale. Till these facilities are provided for agricultural students, I believe that the search for adequate staff to undertake work abroad will continue to be the heart-breaking task that it at present is. For the present, however, leaving such facilities out of the question, let us consider the type of man who will be best qualified to profit by them when they are provided, and provided I am convinced they inevitably must be. It will be apparent that, so far as the requisite qualities can be obtained by education and training, a man's best chance of acquiring them lies in the possession of a liberal education of a University type. The University will give him the opportunity of coming into contact with men of all kinds and classes, qualifying for every variety of profession. It goes without saying that he will specialise in his own professional subjects, but, if he makes full use of his opportunities, he will obtain a point of view that will enable him to employ his specialist knowledge as a means to greater ends. Unless he become touched with that spirit, it might almost be called the "University spirit," he can never rise to the level of the opportunities that agricultural administration among backward people presents. If only technically well qualified, he will be able to render useful service, but it must inevitably be subordinate service, and if, by reason of the possession of pedestrian virtues, he is promoted beyond the level of his capacity, his deficiencies will soon become apparent. As Mr. Morley finely said in his address to the students of Manchester University, "The hall mark of the University spirit is the capacity to 'weave the strands of knowledge into the web of social service,'" and that is pre-eminently the task of the agricultural administrator in backward parts of the world. Writing as a Scotsman, and in the main these remarks will be read by Scotsmen, one is tempted to ask the question if agricultural education of the type I have attempted to describe is available to Scottish students? Speaking with but little knowledge of actual conditions, but merely from observation of men and of work as I saw them abroad, I am disposed to think that adequate facilities do not exist. As a plantation manager, as a practical agriculturist dealing with known conditions and known data, the Scot occupied a foremost place. But if a type of man was required who gave promise of the qualities I have attempted to describe, and his training had been acquired in the British Isles, he had well nigh invariably been at Cambridge.

It is not conceivable that one University can be able to turn out sufficient of such men. It is quite certain that they are not forthcoming in anything like sufficient numbers at present, and that in a world starving for raw material the demand for them is clearly not going to diminish. My object in writing this note will have been fully attained if it causes any one to consider whether, my description of the type of man and of work being correct, Scotland, which leads in all other forms of administrative activity abroad, ought not to bestir herself to meet the demand.

I am in no sense qualified to dogmatise on the measures that ought to be taken. I am fully convinced, however, that if those who control Scottish agricultural destinies were persuaded that the provision of such facilities is really called for, they could be relied on to do what is necessary to meet the need.

BARLEY-GROWING IN SCOTLAND.

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IN 1900 the area under barley in Scotland, according to the returns of the Board of Agriculture, was 240,000 acres, in 1912 the area had fallen to 180,000 acres, and in 1918 to 153,000 acres. This last decrease was to a considerable extent due to the recommendations of the Government to farmers to specialise wherever suitable in oat and wheat growing, instead of barley growing. Most of the area under this crop is found along the East Coast where the rainfall is, on the average, a little under 30″. We find, however, a considerable area under bere in the much wetter Western part, *e.g.* Harris and Lewis.

The most suitable soils for barley are fine, free working, warm loams, with a sufficiency of lime. We may get quite a satisfactory yield from clay and peaty soils, but the grain is usually of poor quality. Although a dry, warm climate is more favourable than a wet one for the production of good barley, it should be cool rather than hot, especially in the autumn during the filling and ripening period, otherwise the grain will be thin and flinty. This fact accounts for the eastern counties being more suitable for the growing of this cereal than the more inland parts, which are more liable to extremes of heat and cold.

The uses to which barley are put in this country are many and varied, the chief being (1) malting, (2) the production of meal, (3) the production of pot and pearl barley, and (4) feeding stock. As the highest price is given for good malting barley, the farmer should aim at the production of grain suitable for this purpose, for even although the yield is only moderate, he will usually get a much better monetary return than where the yield is higher but the quality poorer and fit only for feeding purposes.

The first essential for grain of good quality is that the sample should be fresh and free from all mouldiness and mustiness. When handled in bulk, a good sample of barley ought to be firm and hard, and should run through the hand easily. The grains should be

plump, well filled and broad at the germ end, and have a fine, thin, wrinkled skin of a pale yellowish colour, entirely free from any greyish or blackish discoloration. All this will show that the grain has ripened and been harvested under favourable weather conditions, and that it has kept well in stook, stack and granary. It should be of one variety, and the grains should be as uniform in size as possible, in order to secure regularity of germination. A cross section of a grain should have a fine white, floury appearance, as this indicates a high starch content, on which the amount of the extract required by the brewer or distiller will mainly depend. On the other hand, a hard flinty cross section indicates a high nitrogen content, a characteristic which considerably reduces its value for malting purposes, although valuable in a barley which is to be used for feeding stock. The sample should be entirely free from broken or partially skinned grains, as these are readily attacked by moulds, which spread to the other grains. Thus we see that for malting purposes it is a high starch content that the farmer should aim at, but when the grains are used for feeding purposes, whether in the form of meal or pot barley, high starch content is not so essential, as the value of a food depends very largely on its nitrogenous as well as on its carbohydrate content.

Place in Rotation.—As barley is a comparatively shallow-rooted crop it is less able to withstand competition with weeds than the other corn crops. The land on which it is grown must accordingly be thoroughly cleaned if the best results are to be obtained. It is usual, therefore, in this country to take it after a root crop, and on the lighter classes of soil it usually does best at this point in the rotation. On the better classes of land, however, there are disadvantages in growing barley after a root crop, especially if the roots have been eaten off by sheep, because the land then tends to be too rich in nitrogenous matter, which encourages the growth of straw to so great an extent that the crop is later in ripening, apt to lodge, and thus to produce an inferior quality of grain.

Further, it is customary to sow grass and clover seeds with the grain crop after roots, and they often come up very luxuriantly, especially in a wet season, their presence thereby making it very difficult to get the cereal crop into a fit condition for stacking. The longer exposure in the stook leads to great discoloration of the grain, and a large mass of grass and clover in the stack also prevents that thorough ventilation which is so necessary if heating and sweating are to be avoided. Generally, therefore, on the richer soils a better sample is got where the barley is taken as a second crop after oats or wheat. By this means the fertility of the soil is reduced, and although the yield may not be so heavy the grain is of better quality, and as the grass and clover seeds are not sown along with the barley at this time, there is less difficulty in getting the crop harvested in good condition.

At whatever stage in the rotation the crop is taken it is of the greatest importance that a fine, mellow seed-bed should be secured, as upon this more than on anything else an even germination of the seed and the regular development and ripening of the crop will

depend. The land should be ploughed as early as possible, for land ploughed late in the season will rarely give a satisfactory seed-bed. When sheep are folded on the turnip land (a practice which is not advocated except on the lighest soils if the best quality of barley is desired), the plough should follow the folds closely. If this is not done, and the soil is at all of a heavy nature, the surface will dry out into a hard, caked condition, and it will afterwards be found difficult, if not impossible, to get it broken down into a sufficiently fine state. If turnips are left on the land until late into spring, and are allowed to grow again, they will dry out the soil too much, and the barley crop will afterwards suffer for lack of moisture. Stubble land, on the other hand, can always be ploughed early in the autumn, and a fine surface tilth is then got through the action of the winter frosts. In some districts, to enable the necessary fine tilth to be obtained, the practice of double ploughing, once in autumn and once in spring, is followed. This tends to give the whole surface a more even and deeper tilth, and helps in obtaining a more even distribution of the soil moisture, thus lessening to a large extent the patchiness which is often so apparent when a sufficiently fine tilth has not been obtained. As barley is a shallow-rooted crop deep ploughing is not essential, but a firm seed-bed is absolutely necessary. What should be aimed at, therefore, is a fine, shallow, surface tilth, resting on a firm seed-bed. Ploughing for barley should never be more than 4 inches deep. In cases where work has fallen behind so that there is not sufficient time to have the land properly ploughed, and thus give the grain the advantage of being early sown, cultivators are often used. In this case, however, although we get a very fine tilth, we fail to get the desired firmness of seed-bed which is so essential. This fact accounts for the failure which in many cases follows the use of the cultivator. Therefore, wherever it is considered expedient or necessary to use the cultivator, the soil must be well consolidated by rolling before the seed is sown. This is done by following the cultivator or spring toothed harrows by a heavy roller, which in turn is followed by a light harrow when the seed is to be broadcasted. Unless the surface is free from all lumpiness we cannot expect to get an even braird, so that rolling is essential. These operations should not be carried out on stiffish soils if at all wet, because such soils tend to become not only cloddy, but also puddled, and so prevent the free percolation of water from the surface, thus creating a sour condition of the soil which is detrimental to plant growth.

Manuring.—Owing to its shallow-rooted habit of growth, and its comparatively short growing season, barley is benefited by the application of manures in readily available forms. As the result of a large amount of experimental work carried out throughout the country, the influence of the different manurial ingredients, both on the yield and on the quality of the crop, is fairly accurately known.

The yield will depend largely on the supply of available nitrogen. Where, however, nitrogen is used in excess, or is applied to soils in high condition, it stimulates unduly the growth of straw,

which therefore tends to become soft and apt to lodge. As it prolongs the growing period it affects adversely the quality of the grain. It is best applied in the form of sulphate of ammonia, since, although nitrate of soda gives a bigger crop, the use of this manure results in a softer straw.

The functions of phosphates are (1) to develop the rooting system of the seedling plants, and (2) to assist in the formation of the flower and the ripening of the grain. Where there is a sufficiency of phosphates an even and more rapid braird is obtained, the crop is earlier and there is a better quality of grain. Superphosphate is the best form in which to apply phosphate.

Potash, on the other hand, is chiefly concerned with the formation of carbohydrates and fibre, and greatly influences, therefore, the plumpness of the grain. The straw is also strengthened by the presence of potash, but when it is used in excess it has the disadvantage of discolouring the grain. All potassic manures are soluble, and any of them may be used in medium soils. If used on the heavier soils it is best applied in the form of muriate of potash or sulphate of potash, and in the lighter soils in the form of kainit.

When the soil is in high condition, or when the turnips have been eaten off by sheep, no nitrogen should be used. 3 cwts. superphosphate and ½ cwt. muriate of potash should be applied to prevent lodging, to bring about an earlier ripening, and to improve the quality of the grain. Where the turnips have been entirely removed from the land, or where the barley has been taken after oats or wheat, or on soils not in a particularly high condition, a complete manure should be used. The following mixture may be expected to give good results under average conditions :—¾–1 cwt. sulphate of ammonia, 3 cwts. superphosphate, and 2 cwts. kainit. These manures should be applied before harrowing is commenced, in preparing the seed bed, for when applied at this time they are better mixed with the soil than if applied later and only lightly harrowed in.

Rate of Seeding.—It is very difficult to lay down any definite figure for the quantities of seed to be sown, as there are so many circumstances which have to be taken into consideration, *e.g.* the character of the soil, the climate, the time of sowing, the variety, the size and germination of the seed, and the method of sowing.

Of these, the first is the most important, for where the soil is in good heart and the tilth fine, the condition is conducive to a high and even germination and to an increase in the tillering power of the plants, which will mean a smaller amount of seed. On the other hand, on poor, cloddy or dirty soils a larger seeding will be required. Again, on soils which are naturally too wet or too dry a heavier seeding is required, as many seeds will in the former case rot, and in the latter never form healthy plants.

In a warm, genial climate a smaller seeding is required ; thus the quantity of seed used in Norfolk and Suffolk is much less than in Central Banffshire. The seeding in the later districts should always be thicker, as there will then be less vegetative growth and the crop will ripen earlier. On the other hand, the seeding should not be too

thick, otherwise the straw will be very soft and apt to lodge. The time of sowing will also influence the quantity of seed to be used. As a rule, early sowing will require less seed than later sowing. Too thin a seeding, however, especially if early, may have the effect of reducing the size of the final crop, due partly to the growth of weeds, if there is a spell of cold, inclement weather in spring.

As to the effect of the variety on this question, it is found that late varieties generally tiller more than early varieties, therefore less seed is required.

The size of seed is an important factor in deciding what quantities are to be sown. It has been found that 1000 seeds of Common Barley will weigh about 35 grammes, whereas the same number of seeds of Maltster will weigh about 50 grammes, or in other words, 3½ bushels of Common Barley may be sufficient when 5 bushels of Maltster may not be too much.

We have to consider also the germination of the seed, for when we have a sample of high germinating power less seed is required than where the germination is low.

Another factor in determining the amount of seed to be sown is the method of sowing. When the seed is drilled, less is required, as the seeds are placed at a more uniform depth and slightly deeper. When broadcasted more seed is sown, because many of the grains are left on the surface, and are either removed by birds or fail to germinate through lack of moisture. It is found that, on an average, the best results are got when the seeds are sown at a depth of about 2 inches. On drier soils, however, the depth should be increased.

The drill machines used in this country have the disadvantages, however, of having their spouts too wide apart, with the result that, if the land is at all dirty, weeds are encouraged, and also that the channels made for the reception of the seed are too "V" shaped, with the result that the seeds are heaped on the top of each other. It would therefore be a considerable boon to farmers if the manufacturers were to adjust their drills in such a way that the spouts were closer and the channels more spread. The slowness of the makers of these machines in realising the necessity for such improvements has done much to keep these machines from becoming so popular as they might otherwise be.

Time of Seeding.—As regards the time of seeding, it has been found, both by experience and experiment, that, other things being equal, barley when sown early will give both a higher yield and a better quality than when sown later. The early sown barley, being better established before dry weather sets in, suffers less from protracted periods of drought, and has also a chance of more sunshine during the ripening season. The time of sowing is more a matter of the condition of the soil than the actual climate, and it cannot be sown too early if the soil has the necessary texture and tilth. In the south of Scotland in some years February is not too early, but in the north the usual months are March and April, and occasionally May. Sowing during this last month is often due to the fact that the turnips have not been lifted sufficiently early to get the soil into suitable condition; this practice is not to be recom-

mended, because both the quantity and the quality of the barley crop are affected adversely.

If the seed is sown by hand or broadcast machine the soil is harrowed after the crop is sown, but in the case of the drill machine the land is harrowed first, once or twice, then the seed is sown and the surface again harrowed. In both cases the roller follows the harrows to compact the soil, thus warming it and making a more even germination by bringing the seeds in closer contact with the soil particles.

In the case of light, dry soils it is an advantage to break the surface by light harrows after the rolling to provide a mulch and so prevent the loss of soil moisture by evaporation.

Harvesting.—Barley should not be cut until it is dead ripe. With barleys of the erect-eared, or short broad type, there is a tendency for the ears to break off at the neck during harvesting, and these should be cut earlier than those of the nodding-eared, or long narrow type. A very heavy crop of any variety should be cut a little earlier than a medium crop, because in the event of rough weather there is more danger of the former being damaged, and at the same time it ripens more in the stook. In all cases, however, cutting should not be commenced until the grain is quite firm and the skin has begun to wrinkle.

As the colour of the grain depends upon the amount of sunshine, the crop should be made into comparatively small sheaves, and these should be set up in stooks of not more than eight sheaves, facing north and south, or as some advocate in the North, facing the 1 o'clock sun, so that both sides of the stook may get equal amounts of heat. It is well also that the stooks should be turned once or twice, so that every sheaf and every part of the sheaf may be exposed well to the light for some time at least.

Another practice in the south of England is to make a "cole" or "huick" consisting of about 30 sheaves, arranged in such a way that the heads are in the centre with the last sheaf on the top with bottom up. It is claimed for this practice that, as only the top sheaf can get wet, there can be no discoloration of the grain. It takes more time than stooking, but this is made up for in leading.

Even although the crop is in a perfectly dry condition when put into the stack, a certain amount of sweating will take place, and this will eventually lead to discoloration of the grain unless the stack is thoroughly ventilated Under all circumstances, therefore, the crop should be built around "bosses" or "kilns," which will ensure thorough ventilation of the stacks, and although they entail a little extra labour it will be more than repaid by the better coloured grain that will result. Even under the best conditions of harvesting a certain number of heads will always be found on the outside of the stack, and these should be either picked out by hand or beaten out, otherwise they will become darkened by exposure during the winter and afterwards spoil very considerably the appearance and value of the sample.

Threshing.—As already pointed out, the presence of the broken or partly shelled grains in a sample very materially lowers its value for malting purposes, and it is undoubted that more damage

is done to the grain through carelessness in the threshing than from any other cause. Close dressing the grain in order to secure high bushel weight is a very great mistake. Maltsters prefer grain of moderate weight, about 55 lb. per bushel, to heavier samples, say 58 lb. or upwards, especially so if there are signs that the latter weight has been obtained by too close dressing. No attempt should be made to remove entirely the awn from the grain. This cannot be done without taking part of the husk along with it. Close dressing will also injure the grains at the germ end, and as the germinating power of the sample will thus be lowered, it will necessarily be of less value for either malting or seed purposes. The grains, therefore, should be very closely watched during the process of threshing, and if there are the least signs of any chipping, the drums, the concave and the awner should be immediately readjusted. Care should also be taken in the feeding. This should be done very regularly, and too much should not be rushed through in one day, otherwise the machine becomes choked up and chipping of the grain is inevitable. A good deal will depend, of course, on the machine itself. If it is new, the flanges of the beaters, not being worn off, will do a certain amount of damage. On the other hand, when the machine is old the centre of the beaters is usually more worn than the ends. When, therefore, the mill is set to suit the middle part of the beaters the ends are brought too close together, and again damage is done. It is therefore important that in mills used for threshing barley the beaters should be frequently changed. As there are considerable differences in the size of the grains of different varieties and strains, care should be taken to see that the different parts of the machine are adjusted to suit each of these. It is also very important that the machine should be thoroughly cleaned out before commencing to thresh a new variety, as a mixture of varieties is not suitable for either seeding or malting. For the same reason grain bags should also be clean.

As barley is easily spoiled if kept in a loft it should not be threshed until it is required, either for seed or for the market. If it is necessary to keep it in a loft for some time, the loft should be well ventilated, and the grain should be spread thin and frequently turned. Whether for sale or seed it should be cleaned and sized.

Varieties.—The varieties of barley which are sown in this country may all be classified into two groups, viz. six-rowed and two-rowed. The first group may be sub-divided into two classes—(*a*) where the rows are arranged at equal intervals around the stalk, *e.g.* winter barleys, which by experiment have been shown to have inferior cropping powers, so that there is no advantage in sowing them for their grain ; (*b*) where two pairs of the rows opposite each other are so closely arranged that they give the appearance of being one row each, instead of actually two, so that the whole ear appears at first sight to be four-rowed. Close examination, however, will really show that it is six-rowed. Bere belongs to this class, although it is often referred to as belonging to a four-rowed class, which does not exist. It is grown in the Western Isles, in Orkney and Shetland, and in some of the late districts of the north

of Scotland, and is very early and capable of producing a fair crop on the poorer classes of soils, where the better cereals could not be grown profitably. It is also very useful on clay soils, which, by their very nature, are more difficult to get into suitable condition sufficiently early in the season to grow more valuable cereals. It is mainly used for bere meal and feeding purposes, although to a small extent it is still used for distilling purposes.

The second group may also be sub-divided into two classes:—(*a*) Those with long and narrow ears — called "nodding-eared barleys," from the fact that when they become ripe they bend over. The weakness of this class generally lies in the fact that the straw is not so strong as in the second class, and therefore these varieties are not suited to the best soils, with the exception of Archer, which, in addition to having stronger straw, has also less tendency to "neck," due to the fact that the top leaf is very close to the base of the ear. It is claimed for Garton's latest production, "1917," that the stalk below the ear is so much thicker and stronger than that of other varieties that it is also free from the disadvantage of "necking."

(*b*) Those with short and broad ears — called "erect-eared barleys," as they remain erect when ripe. The grains are large and plump, and the straw of most of the varieties of this class is strong; thus the crop is not so liable to lodge, and therefore such varieties are suited to better soils.

GROUP I.

(*a*) Zero and Squarehead Winter, which are winter barleys; Eclipse and O.A.C. 21.

(*b*) Bere.

GROUP II.

(*a*) *Narrow-Eared or Nodding-Eared, e.g.* Archer, Chevalier, Common, Hannchen, Princess, Gold and 1917.

(*b*) *Broad-Eared or Erect-Eared, e.g.* Brewers' Favourite, Goldfinder, Maltster, Invincible, Plumage, Goldthorpe, Swan Neck and Binder.

As many of these varieties of barley have been in cultivation for a considerable number of years, while others have been under observation only for a very limited time, it is impossible to lay down any very definite rules regarding what should be grown under all circumstances, but from experiment and experience it is possible to state in a very general way what varieties suit best certain soils and climates, and from such observations growers may get a little guidance in selecting varieties for further trial under their own special conditions. Much work is being done on producing varieties in this country, in America and in Sweden, both by crossing and selection, and much remains still to be done.

We may classify these varieties in two ways—(1) as to their earliness, and (2) as to the suitability to different soils and climates.

CLASS I.

Early.—Standwell, Swan Neck, Hannchen, Gold, Common and Bere.

Medium. — Maltster, Invincible, Goldthorpe, Plumage, Chevalier and Binder.
Late.—Archer.

CLASS II.
Good Soils and Good Climate.—Maltster, Standwell, Invincible, Goldthorpe, Plumage, Archer and Binder.
Not so Good Soils and Good Climate.—Chevalier and Gold.
Moderately Good Soils—More Northerly, Later Districts.—Common, Swan Neck and Hannchen.
Poor Soils and Later Districts.—Bere.

Choice of Seed.—A change of seed is not so essential in the case of barley as it is for other cereals. Once a variety or strain has been proved suitable for any particular locality it should be grown until some other variety has proved its merit to take its place. It is not advisable to rush after new varieties until local trials have been made. Such trials, when made, should cover a number of years, and the average should be taken before any definite conclusion is arrived at. Changes may be necessary in very late districts or in very late seasons, and in such cases seed should be procured from earlier districts.

We deprecate the practice, which is only too common in many districts, of using inferior grain for seed simply because it is cheap. No greater mistake could be made, because there is not only a smaller crop of both grain and straw of inferior quality, but also a plentiful harvest of weeds. The farmer should therefore use the very best seed, of uniform size and of high germination. If he is using his own seed he should have it tested, and if he buys it then he is entitled to get from the seller under "The Testing of Seeds Order" a statement of its germination.

In conclusion, a word may be said on "smut," which frequently attacks the barley crop, injuriously affecting the appearance and value of the grain. As a preventive it is recommended to treat the grain with a weak solution of formalin, which should be mixed up in the proportion of about 1 pint to 20 gallons of water. The grain may either be steeped in the solution for about ten minutes and then spread out to dry, or the solution may be sprayed at the rate of 1 gallon for 4 bushels on the heap, which must be turned so that every grain gets its share. It is covered with bags for a few hours and then dried.

THE INTERCROSSING OF SHEEP AND THE EVOLUTION OF NEW VARIETIES OF WOOL.

J. COSSAR EWART.

Introductory.—During recent years some progress has been made in identifying the wild ancestors of the sheep now living under domestication. On the other hand little progress has yet

been made in ascertaining which of the ancient primitive breeds contributed most to the making of improved modern breeds. Further, owing to the absence of records, it is impossible to say definitely by what methods Bakewell and others formed the British foundation breeds. But as there are few economic characters in domestic animals which have not resulted from blending, it may be assumed that intercrossing played a more important part than selection in improving old strains as well as in the making of new ones. This view is supported by what is taking place at the present day. The Sarts or Chantos of Eastern Bokhara periodically cross their long established fat-rumped breeds with the wild *Ovis ammon poli*, the natives of Ferghana cross their ewes with Littledale's ammon as well as with *Ovis poli*, the people of Little Tibet have often specimens of *Ovis ammon hodgsoni* running with their tame sheep; in the Punjab hybrids between the Urial (*Ovis vignei*) and domestic ewes are occasionally met with, and for centuries Umbers—hybrids between the Mouflon and tame sheep—have been bred in Italy.

Recently the Merino has been used to improve the native sheep of East Africa, and in Australia Merino ewes are being crossed with Lincoln and other breeds with a view to obtaining new strains capable of yielding good mutton as well as fine wool. As it happens the only approach to a new breed of sheep in Britain during recent years is the cross obtained by breeding Cheviot ewes with Border-Leicester rams. Intercrossing is widely and extensively carried on, but for years no serious attempt has been made in Britain to blend into one breed the desirable traits of two or more breeds, *e.g.*, to make a Blackface strain which should yield fine wool as well as excellent mutton. A modern would-be maker of new breeds of sheep knows no more about the causes of variation than the creators of the Leicester and Southdown breeds, but, thanks to Mendel, he knows what is likely to happen when long established breeds are crossed. More important still, he is beginning to concern himself more with the contents of the germ cells than with the points of either sire or dam, and to realise that though the contents of the germ cells may be almost identical in the members of wild races, they are hardly ever identical in the members of domestic breeds. Further, instead of concentrating his attention on first crosses, he is beginning to realise that, apart from their economic value, the chief rôle of first crosses is to produce, when inter-bred, material for the making of new strains.

Notwithstanding all that has been written about Mendelism, many breeders still fail to realise (1) that when hybrids (first crosses) are mated with a pure-bred member of the breed to which their sire belongs, 50 per cent. of the offspring may be as pure or nearly as pure as their sire; (2) that only those offspring of first crosses likely to produce the type aimed at should be preserved; and (3) that though the inter-breeding of first crosses is supposed to yield only three kinds of offspring, it frequently results in an epidemic of variation. When Blue Andalusian fowls (hybrids or first crosses between a black strain and a white strain) are inter-bred, the offspring on an average consists of 25 per cent. of birds like the black grandparent, 25 per cent. like the white grandparent,

and 50 per cent. like the blue hybrid parents. This being the case it follows that the most economic way of breeding Blue Andalusians is to cross white and black strains—by doing this the breeder obtains 100 per cent. of blue birds.

To improve rapidly the wool of a breed of sheep or the milk yield of a herd of cows, intercrossing must be accompanied by rigid elimination. Given a ram known to transmit the kind of wool desired, or a bull which with 1000 gallon cows always begets good milkers, herds with the desired traits can best be rapidly established if, in the one case, only those second crosses with fine wool are preserved, and if, in the other, only those second crosses yielding a good supply of rich milk are added to the herd. It is, however, especially important for breeders to bear in mind that intercrossing often leads to reversion and to the appearance of new blends, and occasionally to absolutely new pure-breeding varieties. That pure-breeding new types sometimes suddenly appear was demonstrated by the late Mr. A. D. Darbishire by interbreeding first crosses between tame and waltzing mice. The first crosses (hybrids) between white albino mice and pink-eyed skewbald Japanese waltzing mice, as Darbishire's striking experiments showed, are always in make, colour and behaviour like wild mice. The first crosses when interbred instead of yielding (like Blue Andalusians) three kinds of offspring, some like themselves, some like the albino grandparent, and some like the pink-eyed skewbald waltzing grandparent, produced waltzing mice of seven different colours, viz.:—albino waltzers, pink-eyed fawn, skewbald-fawn, and skewbald-lilac waltzers, and black-eyed grey, skewbald-grey, and black waltzers. More interesting still, several of the new varieties bred true.

The question now arises, do hybrid sheep (first crosses between well established breeds living under domestication) behave when interbred like Blue Andalusian fowls or like the grey hybrids obtained by crossing albino and Japanese waltzing mice?

There is no evidence that first crosses between British improved breeds of sheep when interbred yield offspring comparable to those obtained from Blue Andalusian fowls. On the other hand the offspring of hybrids between the Border-Leicester and Cheviot breeds are, as a rule, so like their cross-bred parents that Leicester-Cheviot hybrids now rank as a true breed—the so-called Half-Bred.

At the present time Merino crosses are common in Australia, but as far as I can learn, typical Merinos have not thus far been extracted from the first crosses.

Up till a year ago, after interbreeding many different kinds of first crosses, there seemed no escape from the conclusion that sheep do not conform to Mendel's law to the same extent as Andalusian fowls and Shorthorn cattle.

But a lamb dropped on the Edinburgh University Farm during the last week of May 1918 clearly demonstrated that this view was untenable.

In 1914 an Afghan Fat-tail ram imported by the Marquess of Bute was mated with Blackface, Cheviot, Shetland and other ewes. Some of the first crosses were interbred in 1916, but no definite results were obtained. Again in 1917 several Fat-tail hybrid ewes

were mated with a Fat-tail-Blackface hybrid ram. In due time one of the hybrid ewes—a first cross between the imported Afghan ram and a Cheviot gimmer—produced a ram lamb, which even at birth had all the points one expected to find in a young pure bred Fat-tail. As Fig. 1 shews, this lamb has drooping ears—the stamp, as Darwin said, of long domestication—and the characteristic tip-tilted tail. In its coat, gait, behaviour and temperament it has from the first forcibly reminded one of its imported grandsire.

From the results obtained by interbreeding Fat-tail hybrids taken along with similar results obtained in America with Karakule sheep, it may hence be inferred that the first crosses of long-established pure breeds when intercrossed now and again approach in their behaviour to Blue Andalusians. Nevertheless it is well to bear in mind that the interbreeding of hybrid British sheep is more likely to lead to variation, or to reversion to a remote ancestor, than to the exact restoration of one or both of the grandparents.

Partly in order to learn something about the origin and history of the sheep living under domestication, and partly to determine to what extent sheep when crossed conform to Mendel's law, a number of breeding experiments with primitive and improved breeds were started some fifteen years ago. The time has come when the results of some of the experiments may with advantage be published.

Experiments with Southdown and Soay Sheep.—During the eighteenth century attempts were made to improve Southdown sheep by means of the Leicester and Merino, but for a century and more the improvements made in the Southdown have been mainly, if not entirely, effected by selection—hence the Southdown may well be one of the purest of modern English breeds.

Of all the sheep now living in the British Islands the sheep marooned on the small uninhabited and rarely visited island of Soay are the most primitive—they probably closely resemble two breeds of sheep introduced into Britain about 2000 B.C., viz. a breed (the ewes of which had goat-like horns) probably descended from the Urial (*Ovis vignei*) still found in Central Asia, and a breed (the ewes of which are hornless) probably descended from the Mouflon still found wild in Sardinia. As the Soay sheep consist of two distinct types which refuse to blend, they are not likely to be as prepotent or exclusive as the Southdown. In both varieties of Soay sheep the wool is very short and fine, but so close that they are as hardy as the Highland Blackface. Further, Soay sheep are long lived, easily kept and very prolific—a ewe brought from Soay in 1893 died in 1914 after rearing her 32nd lamb. Like the Moorit sheep of Shetland, Soay sheep have never acquired the habit of accumulating fat in the subcutaneous tissues—hence they are classed with breeds deficient in mutton characters. In having large horns, long ears and a throat fringe, a narrow arched back and low narrow shoulders, long slender limbs and a somewhat low set-on tail, Soay rams profoundly differ from plump comfortable looking Southdown rams, obvious products of intensive artificial selection. The head of a Soay ram is given in Fig. 2, and the head of a Soay ewe with goat-like horns in Fig. 3.

Though first crosses interest hardly at all the experimental breeder, they may nevertheless be of considerable economic importance. It may therefore be stated that Southdown-Soay hybrids (as first crosses are styled by Mendelians) combine the good mutton characters of Down breeds with not a little of the hardiness and deer-like activity of the Soay. In make, coat, colour and behaviour they approach the Southdown. Further, like the Southdown, they mature early and fetch good prices as lambs and hoggs. A Southdown-Soay hybrid is represented in Fig. 7.

Of the lambs obtained by interbreeding the first crosses, about 70 per cent. were white and belonged to the Down type, but only 2 per cent. resembled the Soay ancestors in coat and colour; the remainder alike in make and colour differed from all the known ancestors.

The white Down-like second crosses when interbred produced, in addition to lambs in make and coat like the first crosses, a number of coloured lambs. One ewe had a white, a brown and a black lamb, another had a piebald lamb, and the lamb of a third ewe was fawn and white.

The experiments hitherto made with Southdown-Soay sheep indicate (1) that it will be possible to establish a breed having the chief characteristics of the first crosses; (2) that by mating the first crosses with a Southdown ram, material could be at once obtained to start a new and vigorous strain of Southdowns; and (3) that interbreeding first crosses by the same sire leads at once to a decided loss in size and vigour, and to a decided reduction in the market value.

Southdown-Soay Wool.—In a report made some years ago on the wool of the Southdown-Soay hybrids, the late Mr. Harry Sanderson of the Tweed Mill, Galashiels, states that Southdown-Soay crosses "produce a wool which is superior in every respect to that of their parents. The staple is of good length, and the quality more nearly approaches the Australian Come-back than anything else. The colour is pure white. It is a wool admirably suited for the manufacture of high-class cloths, and could always be relied on to fetch a high price in the market." This opinion was amply justified by cloth subsequently woven at Galashiels out of Southdown-Soay wool.

A number of new wools grown on the University farm have recently been examined, tested and woven into cloth in the splendidly equipped Textile Department of the University of Leeds. Professor Barker, M.Sc., the head of this department, in a report on the new wools points out that the Southdown-Soay variety is remarkable for its strength and quality and that when woven it makes the finest woollen cloth and the softest worsted cloth of the wools experimented with. Evidence of its resisting power we have in the fact that the breaking strain of the warp is 384 lbs.—the strength of the Southdown-Blackface warp is only 303 lbs. Professor Barker also points out that the time is coming when there will be a demand for fine wools which it will be difficult to meet, that this demand could be partially met by drastic changes in sheep-breeding in the British Islands, and he urges that steps be

at once taken to produce in quantity wool of the Southdown-Soay type.

The breaking strains of several worsted yarns and cloths are given in the following table :—

Southdown-Soay worsted yarn	...	...	20·6 oz.
Southdown-Soay worsted cloth	...	...	384 lb.
Siberian-Shetland worsted cloth	...	...	332 lb.
Southdown-Blackface worsted yarn	...	...	18·2 oz.
Southdown Blackface worsted cloth		...	303 lb.

Professor Barker, when referring recently to the remarkable strength of the Southdown-Soay wool, pointed out that "it is conceivable that this type of wool might fulfil a special purpose," and that as the yield is 55 per cent. it pretty well corresponds with the Botany level.

Experiments with Southdown-Blackface Sheep.—Some years ago the late Mr. A. D. Darbishire wished to determine how far the inheritance of the characters of the wool of sheep conforms to the Mendelian scheme. Seeing that the fleece of the Southdown differs profoundly from the fleece of the Highland Blackface, and that Southdown-Blackface crosses yield good wool as well as good mutton,[1] it was decided to cross a number of Blackface ewes with the Southdown ram used for the Southdown-Soay experiments.

As intercrossing usually leads to reversion, it is important to know as much as possible about the history of breeds used in crossing experiments. From the available records it is evident that in olden times all the strains of the Scotch Blackface differed profoundly from the "improved" variety seen during recent years at Agricultural Shows. Though at the end of the eighteenth century there were several distinct strains of Blackface sheep, a strain characterised by a coat of coarse wool reaching almost to the ground had not yet been evolved. Even in the seventies of last century the wool of Blackface sheep in many parts of the Scottish Highlands was often of a soft texture, and only 4 or 5 inches in length. But during recent years, breeders by rigid and intensive selection have so increased the staple that the fleece now consists mainly of wool 4 or 5 times longer than in the wild *Ovis ammon poli*, which frequents valleys "on the roof of the world," 18,000 to 20,000 feet above the level of the sea, and at least twice the length of that of the woolly Mammoths, which spent their summers in Siberia during the Great Ice Age. At the same time the quality of the fleece has been so reduced that it now consists mainly of wool almost as coarse as the hair forming the outer coat of wild sheep. Moreover the inner coat, instead of consisting as in wild sheep of very fine wool of a nearly uniform length, is composed of wool of various lengths and of four or more qualities. The hair and wool of a wild sheep is represented in Fig. 6.

Even in the sheep of the less fashionable Blackface herds with a relatively short coat, the wool as a rule varies greatly both in

[1] It has long been the practice on some farms in the south of Scotland to cross Blackface ewes with a Southdown ram in order to obtain for home use a very superior kind of mutton.

length and quality. As a matter of fact during recent years Blackface breeders have paid very little attention to the quality of the wool, with the result that it has been largely exported at a very low price to America for the making of carpets.

The first crosses between a Southdown ram and Blackface ewes vary considerably. As might have been anticipated, the wool is of a considerable length and of poor quality in some individuals, but fine and of a nearly uniform staple in others.

A Southdown-Blackface hybrid ewe in which the Southdown sire predominates is represented in Fig. 8. The wool from the shoulder of the Southdown ram used in the experiments, varying in length from 4 to 5·5 inches, was longer than the wool forming the undercoat of the wild Urial but not so fine, Fig. 6. Some of the wool from the shoulder of the Blackface dams of the hybrids measured 14 inches, but the wool from the shoulder of the hybrid represented in Fig. 8 measured only from 6 to 8·5 inches, but varied more in quality than that of the Southdown sire. As in the sire, the wool of the hybrid was free of kemp.[1]

It may be mentioned that some of the Southdown-Blackface hybrid rams eventually developed large horns of the type one associates with *Ovis ammon typica* of the Great Altai mountains, a species which sometimes measures over 50 inches at the withers. This resemblance suggests that the Scotch Blackface and other British breeds with large more or less "nipped in" spiral horns may bear the same relation to the Altai Ammon—the "Father of all sheep," that the Fat-rumped sheep of Eastern Bokhara bears to Marco Polo's sheep, in which the horns form an open spiral.

The second crosses obtained by interbreeding the Southdown-Blackface hybrids varied nearly as much as the Southdown-Soay second crosses. Several forcibly suggested Southdowns in make and gait as well as in wool; others in colour, make and horns resembled the Blackface grandsire, but failed to acquire the long coat of the modern Blackface—doubtless because recently acquired characteristics are so imperfectly fixed that they are apt to be lost when intercrossing is resorted to. In the case of the Southdown-Blackface, as in the case of the Southdown-Soay experiments, interbreeding the first crosses got by the same sire led immediately to reduction in size and vigour and to retarded development.

From the results already obtained it may be safely asserted that if large numbers of Southdown-Blackface hybrids are bred, it will be possible by judicious selection to form a hornless strain characterised by the make and vigour of the Blackface, but provided with a coat closely approaching that of the Southdown.

In improving scrub cattle and mongrel herds of sheep, the plan usually followed is to make five successive crosses by pure bred sires. But in the case of pure-bred cattle and sheep which conform to Mendel's law, selection should begin with the second crosses. In other words, only the second crosses that breed true, that produce to a pure-bred sire offspring of the kind desired, should be preserved—the remainder should be ruthlessly eliminated.

[1] The kemp so common in some Blackface herds closely resembles and probably in part corresponds to the coarse hairs which form the outer coat of wild sheep. (Fig. 6.)

Economic Results.—Southdown-Blackface crosses mature so rapidly and yield mutton of so superior a quality that they readily fetch in the open market double the price obtained for pure-bred Blackface wether lambs of the same age. Further, though the wool of the Southdown-Blackface cross is only about half the length of pure Blackface wool, the coat is so compact and the quality of the wool so good that before the war the fleece of a hybrid Southdown-Blackface fetched as much as three fleeces of pure-bred Blackface sheep of a like age.

The great value of Southdown-Blackface wool has been demonstrated in the Textile Department of the University of Leeds. Professor Barker, the head of this department, has recently pointed out that the resisting strength of the warp of this hybrid wool is over 300 lbs., that the wool uncombed forms a most attractive worsted cloth, and that when woollen spun it forms a soft semi-merino fabric.

The cloths manufactured in the Textile Department of the University of Leeds differ so profoundly from fabrics made out of pure Blackface wool that had they not been produced under the personal supervision of Professor Barker, one would be inclined to think fine imported yarn had been accidentally substituted for the yarn from the Southdown-Blackface fleeces.[1] That semi-merino fabrics have been obtained from the wool of half-bred Blackface sheep is, however, not surprising. The explanation is not that the Southdown proved dominant, but rather that intercrossing gave the more or less remote fine woolled ancestors of the Blackface more influence in forming the coat of the hybrids than the fashionable but coarse woolled more recent ancestors. When one handles the cloth made from the wool of the Southdown-Blackface crosses one is not surprised that Professor Barker is anxious that steps should be taken to have Southdown-Blackface wool produced in large quantities.

Experiments with "Siberian" Sheep.—At the end of the Bronze Age herds of the Urial-Soay and Mouflon-Soay sheep and of "four-horned" sheep occurred in most parts of Europe. Remnants of these prehistoric varieties still survived in many parts of the Continent during the first half of the 19th century,[2] but by the end of the century the primitive breeds had been supplanted in most areas by improved breeds. At the present day piebald and other varieties of "four-horned" sheep are still preserved in private parks, but herds of Neolithic and Bronze Age sheep of the Urial and Mouflon type are now rarely met with except in outlying or isolated areas such as the Faroes and Iceland, Shetland, Soay and the Isle of Man, Brittany and D'Ouessant (a small island off the coast of Brittany), the Auvergne, the Alpes Maritimes, the Ardennes, and certain parts of Russia and Western Siberia.

The members of the herds in all these areas vary in make, coat and colour, but with few exceptions are characterised by a short

[1] Samples of cloth manufactured from the Southdown-Blackface, Southdown-Soay and from other wools can be seen at the Offices of the Board of Agriculture for Scotland, St. Andrew Square, Edinburgh.

[2] Evidence of this we have in a paper on sheep published in "The Isis of Oken" in 1841.

tail (Fig. 5), fine limbs, and an almost complete absence of mutton characters, *i.e.* of the power of storing up fat in the subcutaneous tissues. In the most typical members of the herds, the coat usually consists of fine wool, which varies in colour from fawn to reddish brown—because of the reddish colour of the fleece, such coloured sheep are often known as moorit sheep. The fine reddish short wool forming the fleece of some of the better bred moorit sheep corresponds to the fine white wool forming the inner coat of wild sheep (Fig. 6). We may assume that as the coarse hair inherited from the wild ancestors was gradually eliminated, the fine wool forming the inner coat gradually became pigmented. If we assume further that the least conspicuous individuals had the best chance of eluding eagles, ravens and other enemies, we can understand why so many primitive "peat" or "heath" sheep are of a fawn or brown colour. It may be mentioned that the loss of the coarse hair forming the outer coat was due more to changes in the environment than to selection by the ancient herdsman.

The wool of moorit sheep (produced in considerable quantity in Shetland) is so soft and fine and easily stretched that it is better adapted for knitting than for weaving. One reason why Shetland moorit wool is not well adapted for making into fabrics is deficiency of strength, another is lack of lustre.

Some years ago I received samples of wool from Petrograd which made it evident that some of the primitive breeds with a fine brown lustrous coat still flourished in one or more parts of the Russian Empire. Later I succeeded in obtaining a few sheep (said by their importer to be Siberian Mouflon) with a brown coat of a very unusual type. In a report on the wool of this so-called Siberian Mouflon, Mr. Harry Sanderson of Galashiels wrote in 1912, "It is of a rich brown colour, and has something of the soft silky handle which one associates with alpaca or cashmere. There is an undercoat of very fine quality about 3 inches long, and a stronger wool of about twice the length of the undercoat coming through it. Treated like alpaca this wool would give a valuable noil." A Siberian Mouflon ram is represented in Fig. 9.

In 1912 a number of white Wensleydale ewes and fawn coloured Shetland ewes were crossed with a dark brown "Siberian Mouflon" ram, and at the same time Soay ewes, and dark brown Shetland and Manx ewes, Cheviot and Blackface ewes were crossed with a somewhat lighter Siberian ram. The lambs obtained from these ewes varied greatly in make and colour. In 1914 a number of the first crosses were interbred. Seeing that Wensleydale sheep have lustrous wool, and that pure bred Wensleydale lambs are often black, it was hoped that some of the Wensleydale second crosses would have a fine brown lustrous coat.[1] But as it happens, sheep with a moorit coat have not yet been obtained from the Wensleydale crosses. All the Cheviot first crosses were white, but when bred with a pure Siberian ram they produced moorit offspring. When the brown second cross ewes were crossed with a Siberian ram a pure breeding moorit variety was obtained, with wool which Professor Barker reports is identical with good moorit Shetland.

[1] Probably owing to reversion the wool of Siberian-Wensleydale first and second crosses is very coarse and straight.

As this new variety in the head and other respects approaches the Cheviot breed, it may reproduce a phase in the evolution of the Cheviot—one of the remote dun-faced ancestors with fine brown wool—just as many members of the Half-bred (Leicester-Cheviot crosses) probably reproduce a more recent ancestor to which both the Border-Leicester and the Cheviot are intimately related.

As the descendants of the Cheviots with three crosses of Siberian blood had wool of the moorit Shetland type, it may be assumed that a herd of moorit sheep with certain well-marked Cheviot characteristics could be rapidly evolved.

The wool of Siberian-Blackface second crosses differed from that of the Blackface grandparent only in being more lustrous. As in Shetland cross-bred sheep with long moorit wool of the Blackface type are sometimes met with, it may be assumed that it would be as easy to create a moorit variety of the Blackface as a moorit variety of the Cheviot.

The wool of the Siberian-Shropshire crosses was so deficient in quality and lustre and varied so much in length that no second crosses were bred. On the other hand, Siberian-Shetland hybrids produced to a Southdown ram lambs bearing wool which Professor Barker describes as most beautiful, curly and lustrous.

The Siberian-Soay first crosses in make, wool and colour approached Soay ewes of the hornless or Mouflon type, and thus in a sense justified the dealers' name of "Siberian Mouflon." The Siberian-Shetland first crosses were nearly intermediate in their characters, but some of the second crosses had as fine an outer coat of long dark brown lustrous wool as their grandsire. When these second crosses with Siberian characteristics were mated with a pure Siberian ram, offspring were obtained which with rare exceptions have an outer coat consisting of long lustrous wool and an inner coat which yields a valuable short noil, and also a long noil which Professor Barker removed and had spun into a valuable woollen yarn. A Siberian-Shetland ewe is represented in Fig. 10.

Though the breaking strain of the warp of Siberian-Shetland wool (worsted spun) did not reach the remarkable level of the Southdown-Soay wool, it was higher than in any of the other wools experimented with, and decidedly higher than in pure moorit Shetland. To considerable strength (332 lbs.) it added quality and uniformity, as well as the soft silky handle and lustre one associates with alpaca, and when combed and woven it is reported to yield "smart fine fabrics" and to be capable of producing rugs superior to the famous Austrian rugs. In addition to forming a substitute for alpaca, Siberian-Shetland wool is said to be superior for knitting to the fine soft moorit wool grown in Shetland.

Some years ago a Siberian-Shetland ram was lent to Mr. Gordon of Windhouse, Mid Yell, Shetland. Of this ram Mr. Gordon reported in 1915 that he had "imparted not a little vigour to his descendants."

In 1917 a pure bred Siberian ram was sent to Mid Yell. In a note in *The Shetland News* of February 27th, 1919, Mr. Gordon says that from this lustrous-wooled ram he had "obtained excellent results in the improvement of wool," and had "given away to crofters a good few of his ram lambs."



FIG. 1A —Head of a 21 days' old extracted Fat-tail ram lamb (Fig. 1) In the ears, form of head and colour of muzzle, this lamb agrees with a typical Afghan Fat tail, but it may never have as large a tail as the grandsire



FIG. 1 —A 14-weeks'-old Fat-tail ram lamb Sire, a Fat-tail Blackface dam, a Fat tail Cheviot; grandsire an imported Afghan Fat-tail.



FIG 2.—Head of a Soay ram with horns of the Urial type. Soay rams with the tips turned in approach the Mouflon type



FIG 3.—Head of a Soay ewe with goat-like horns, as in all wild sheep except the Mouflon. Soay ewes without horns closely resemble the wild Mouflon of Sardinia.



FIG. 4.—Head of a moorit Shetland with goat-like horns. Shetland ewes with goat-like horns are now rare.



FIG. 5.—Ram of an extinct short-tailed Orkney race which resembled Urial hybrids, now occasionally seen in the Punjab. After a drawing in the Low Collection in the University of Edinburgh.

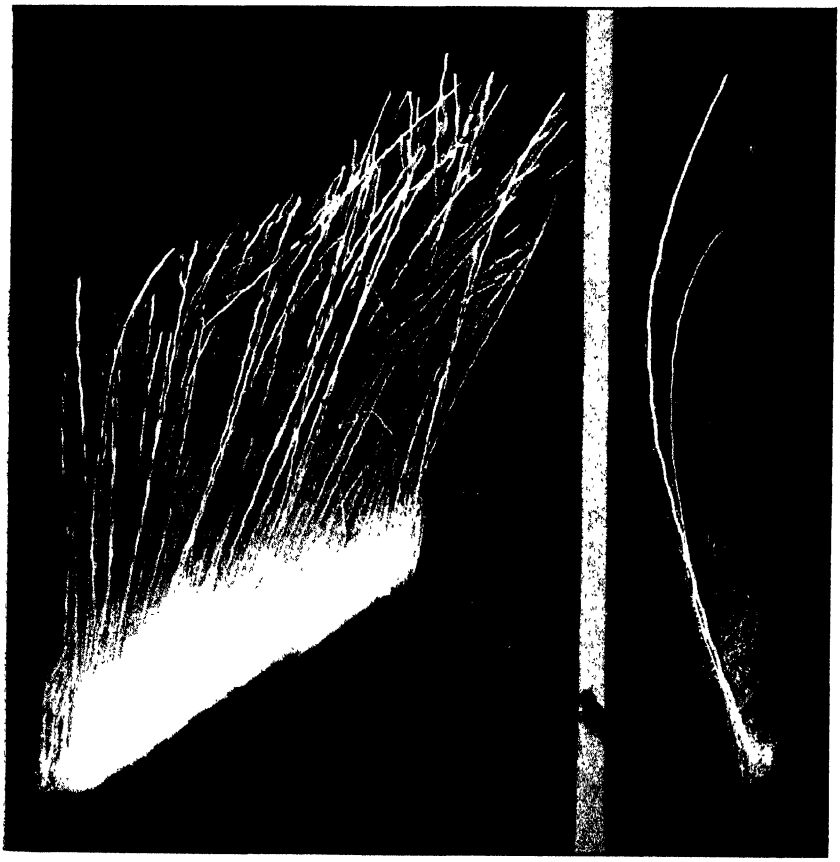


FIG. 6.—Portion of the coat of a wild Urial shed in March. It consists of coarse hairs mostly of a brown colour, and of a thick inner coat of very fine pure white wool.

FIG. 6A.—Two of the coarse hairs forming the outer coat and the fine wool of the inner coat associated with them. The wool when straightened is nearly as long as the hair × 2·5.

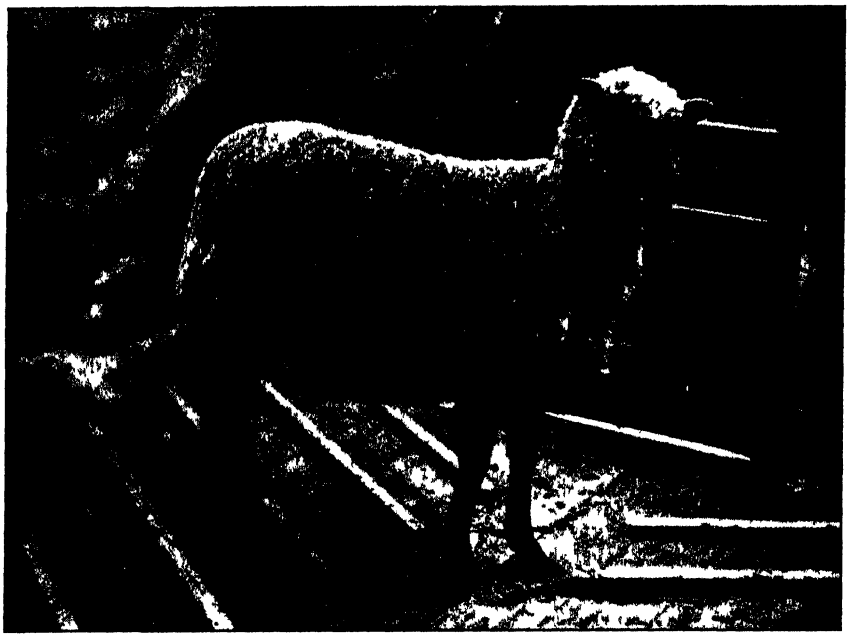


FIG. 7 —A Southdown Soay hybrid ewe In this first cross the coat consists almost entirely of fine wool, which in quality approaches the wool forming the inner coat of the wild Urial

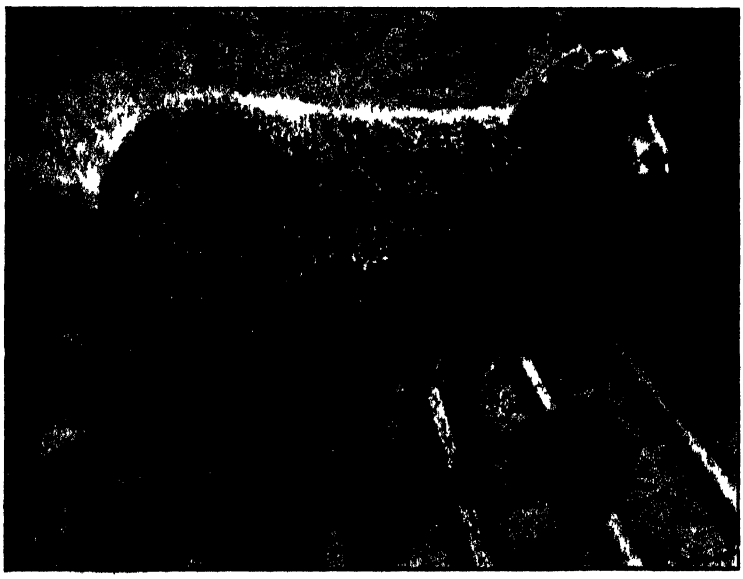


FIG 8 —A Southdown Blackface hybrid ewe In this first cross the quality of the wool varies, the coarser fibres probably represent the outer coat of the remote wild ancestors.



FIG. 9.—A "Siberian-Mouflon" ram. The fleece consists of an outer coat of fine brown alpaca like lustrous wool, and of an inner coat of still finer brown wool which yields a valuable noil



FIG. 10.—A Siberian-Shetland ewe with a coat consisting of rich brown soft lustrous wool, with a breaking strain of over 330 lb. This wool, when woven undyed, yields "smart fine fabrics", further, it is superior for knitting to the best moorit wool grown in Shetland.

That the native sheep of Shetland are wanting in vigour will be admitted when it is mentioned that in some years over 30 per cent. of the Scattald ewes perish, and that the demand for moorit wool is greater than the supply may be inferred from the fact that the price per pound was half-a-crown before the war and is now 4s. Figs. 2 and 5 are from a paper in the Transactions of the Highland and Agricultural Society of Scotland, 1913, and Figs. 3 and 4 are from the Journal of the Leeds University Textile Association, July 1918.

BEEKEEPING.

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The Value of Honey as Food.—When the food value of honey is reduced to figures after the fashion that has become all too familiar to us in recent years, we are surprised to find that a pound section of honey (about 14 ozs. net) contains as many calories as 20 eggs! Honey is classed among the carbohydrate foods, and is a source of heat and energy. The food value of cane sugar, another carbohydrate, has long been recognised, but it is not so generally understood that sugar requires digestion or "inversion" before it can be absorbed into the system. Cane sugar is a di-saccharide, and must be split into two mono-saccharides called grape sugar and fruit sugar before it becomes available as food. When it is known that honey contains very little cane sugar and consists mainly of grape sugar and fruit sugar, it will be realized that honey is a pre-digested food directly available for the production of heat and energy. This explains why honey is unsurpassed for relief of fatigue, and enables us to understand why Jonathan, wearied in the long pursuit of the Philistines, was so immediately refreshed by a little honey.

But honey is not merely a carbohydrate, and the production of heat and energy does not exhaust the value of this food substance. Nitrogenous matter occurs in the form of pollen grains always present as an accidental mixture, and there is nitrogen also in the albumen supplied by the bees in the elaboration of the honey. The nitrogen content, though very small in amount, is probably far from negligible, since it is present in a form that is readily available. It has recently been shown that honey also contains those mysterious substances known as vitamines, in the absence of which an animal will lose weight although supplied with a food ration that is otherwise adequate.

The time was when honey was our only sweet, and mead or honey ale was the principal drink. In those days practically everybody kept bees, and sugar was unknown in the land. The disappearance of the beehive from the cottage garden has been particularly hard on the children, for the little ones have natural tastes as yet unspoilt by tobacco, alcohol and sauces, and they have a craving for sweets. In modern times this is commonly met by the products of the confectioner, most of which are injurious to

both teeth and digestion. Honey remains the most wholesome of sweets, and wise are those parents who supply it to their children.

The Demand for Honey.—During the war the scarcity of sugar and preserves produced a phenomenal demand for honey, and home production was sensibly increased in spite of many discouraging circumstances. The price rose from about 9d. per clover section in normal times to about 3s. in 1918, and heather honey was in demand at still higher prices. Even at such inflated rates the supply fell far short of the demand, and the imports of foreign honey were enormously increased in spite of shipping restrictions. The following figures were supplied by the Statistical Office, H.M. Customs :—

Value of Honey imported into Britain.

Average for 13 years ended December	1914	...	£36,457
Imported in the year ended December	1915	...	92,619
Do.	1916	...	187,272
Do.	1917	...	825,737
Do.	1918	...	2,702,734

The value of the honey imports for 1918 is thus 75 times the average for the 13 years preceding the war. Even assuming that the honey cost the importer three times as much, and this would be about right, we have still the astounding fact that we bought in 1918 25 times as much foreign honey as we were in the habit of getting before the war.

The value of the honey produced in Britain is not so easily estimated. The number of professional beekeepers in our country is negligible, there being only one or two who depend for a living entirely upon bees. Beekeeping in Britain is a side-line, and the yield per hive is much less than could be produced by a specialist who gave his whole time and energy to his apiary. Yet the aggregate amount of honey produced in Britain is by no means negligible, and the quality of British honey is generally excellent. We moderns have had no opportunity of sampling the classical honey gathered by the bees of Hybla and Hymettus from the blossoms of the wild thyme, and our recent close relations with our Gallic neighbour have not yet made us familiar with the rosemary honey of Narbonne ; but our Scottish heather honey will take a lot of beating, and is easily the most highly prized honey in the world. During 1918 clover honey sold at 3s. 6d. per pound and heather as high as 4s. 6d., yet one grocer in Aberdeen states that he sold 4000 sections, and was unable to meet the demand for the home product. He handled also two tons of foreign honey, but derived little satisfaction from the experience, and was worried by fermentation in the unripe imported product.

The demand for honey could be increased indefinitely if only supplies were adequate, and why should not honey be as common on our tables as butter, eggs or jam? These are produced by the sacrifice of food-materials, some of which are directly available in simpler forms. But honey production is a real case of salvage, for nectar is lost if not gathered, and the fields are all the richer for the

visits of the bees. We must use the extractor more. We want a supply of honey in every home, in a pot, a jar or a tin, which can be drawn upon for sweetening tea, for use with porridge or with milk puddings, and the wax of comb honey would be a nuisance in such cases. Notwithstanding the figures already quoted, it is to be noted that the supply of honey in Britain is still so restricted that nearly the whole of the product is consumed in what one might call the raw condition. We have forgotten how to use honey in cookery, confections, and in the making of beverages. At the Paris Honey Show of 1874 Hunter mentions that there were staged as honey products: honey bread, spiced bread, fruits preserved in honey, jellies, sweetmeats, cakes, bonbons, pastilles and chocolates. There was *eau-de-vie* made from both honey and wax! Other preparations included hydromel or metheglin, champagne, red and white wines, liqueurs, fruit syrups, vinegar and fruit cordials. Scones or other tea bread baked with honey will keep soft and moist much longer than if made with sugar. For this reason American bakers use car loads of the less finely flavoured and therefore less expensive honeys. Honey vinegar is a much finer article than weak acetic acid, produced by distillation of sawdust and tinted to make "pure malt vinegar."

Scottish Beekeeping in the Past.—Beekeepers of to-day have forgotten or are perhaps unaware of the important contributions made by Scottish beemasters of past generations to our knowledge of bees and beekeeping. James Bonner kept his bees in a garret in Glasgow, and learnt so much about them that he published in 1795 a quaint old-world treatise on bees. William Dunbar, minister of Applegarth, produced a beautiful bee-book in 1840, and did not put his name on the title-page, so it is only by an oversight of the engraver that we can identify this most modest of writers on the bee. Dunbar corrected in the most kindly way some of the erroneous statements of Huber—for whom he had the greatest admiration—but modern writers still go on reproducing Huber's mistakes. The great Langstroth, the father of American beekeeping, writing in 1853, is content to quote with acknowledgment Dunbar's account of the way in which the queen bee deposits her eggs. Later came Pettigrew, born at Carluke, who very clearly demonstrated that the greater yields of honey obtained in Scotland were due to the use of larger hives. The Pettigrew skep with a capacity of over 3000 cubic inches did much to increase the honey yield in England and to improve the race of bees. But the British Beekeepers' Association was unwise enough to adopt as a standard the frame hive devised by Woodbury about 1860, and this is still the standard size in Britain. The restriction of the brood to a chamber 42 per cent. smaller than a Pettigrew skep has in 60 years produced a marked degeneration in the British bee, and disease was only to be expected. In other countries, and particularly in America, an enlightened policy has led to progressive enlargement of the hive, and this has been accompanied by a very definite improvement in the American bee.

Scottish beekeepers invented the tiering-up system, and led the way in the production of comb-honey of the finest quality. About

1819 Robert Kerr of Stewarton in Ayrshire invented the Stewarton Hive, which later, by the powerful advocacy of M'Phedran, was widely adopted in England and even in America. M'Phedran, writing as "A Renfrewshire Beekeeper," was well known to readers of periodical bee literature, and was a man far in advance of his time. Miss Macdonell of Glengarry, describing a visit to M'Phedran in 1878, writes: "We saw his Scotch-made embossed wax machine, which he told us was stereotyped from the original German sheets long before the American rollers were invented, or the words "Comb Foundation" coined. His apiary consisted chiefly of storified colonies, cultivated with success in Scotland centuries before the word "Tiering" was invented in America. All the combs in his hives were movable, in frames or in bars, and in the shallow supers as well. His very beautiful watering device we admired much, as well as his original rotating Observatory Hive, which had great attractions for us."

The comb-honey produced in Stewarton supers has never been surpassed, and was a revelation to English beekeepers when first exhibited at the Crystal Palace in 1874. C. N. Abbot, founder and first editor of the *British Bee Journal*, reviewing the Show in his October issue writes: "The pride of the Show came from Ayrshire, in Octagon Stewarton supers of about 4 inches in depth; and truly it was a pleasure to look at them, a treat in itself to see how the art of the master could induce the bees to build their combs so beautifully straight, so symmetrical and even on both sides, and so perfectly finished, that one could have declared that they were cast in a mould to a pattern. and who could fail to admire the perfection acquired in the art of packing by the Ayrshire gentlemen, who brought their immense harvest over 400 miles of railway almost without breaking a single honey-cell, and certainly without destroying a single comb?" It is not surprising after this to find John Hunter, Secretary of the British Beekeepers' Association, admitting in his Manual of Beekeeping, written in 1875, that "the cottagers of Scotland far exceed the English in the ability they display in beekeeping."

Present Neglect of Beekeeping in Scotland.—During the years of war Britain has been visited by beekeepers from America, Canada and Australia, and all have been amazed at the neglect in the old country of abundant opportunities of securing honey. They are astonished at our tiny hives, stereotyped in capacity since 1860, at the degeneracy of our bees, at our blind faith in the efficacy of drugs. Here is an extract from a letter written from a lumber camp in Scotland to an American Bee Periodical:—"If it were not so rainy this would be the greatest country in the world for bees. There are thousands of acres of heather loaded with nectar. The bumblebees here in a good year will make a pailful of honey, so you can imagine what a good swarm of Italians run on the American plan would do. Most everyone here keeps a few swarms of bees, many of them in the old straw skeps. The heather honey has a strong odour, and a pound cut in an ordinary-size room will perfume it so you would almost think yourself out on the moor among the flowers. The honey also has a strong flavour, but

it is very nice." Some of our own Colonists have been even more emphatic in their opinions about British beekeeping.

Various factors have contributed to induce neglect of an important minor industry. Some writers who have obtained for themselves positions of authority in the British bee world have been moneyed amateurs to whom the production of honey was of no consequence, while refinements in management and complications in apparatus were all-important. A beginner who opens such a book gets the impression that one cannot keep bees without a full outfit of expensive apparatus. While it is not proposed that we should go back to the primitive simplicity of the skep, it is very evident that many manuals on beekeeping and many amateur "authorities" advocate a system of beekeeping that is unnecessarily complicated and expensive. Those same bee-books have diligently fostered the idea that bees cannot be kept without copious feeding on a syrup made from sugar and water. Many of the general public quite erroneously believe that the bees are fed all winter upon sugar, and a great many beekeepers do feed their bees both in spring and in autumn. Bees were profitably kept in Britain many centuries before the introduction of sugar, and the most successful beekeepers of to-day feed as little as possible. The preservation of undesirable bees by the abuse of sugar has been a second main factor in the degeneration of the British bee.

A third and very real cause of the decline of beekeeping has been the prevalence of Isle of Wight Disease. This is a very formidable menace, and measures recommended by thoughtless persons have greatly discouraged actual and prospective beekeepers. Drugs, disinfection and segregation as usually practised are entirely useless for a disease of the adult bee; but a bee resistant to the disease would soon be developed in this country as abroad if the beekeeper would only let Nature have her way.

Localities Suitable for Beekeeping.—It would probably be impossible to find any spot in our country in which bees could not be kept with more or less success, but it is undeniable that some locations are more favourable than others. If there is but one main crop the weather may prevent that from being secured, so the wise beekeeper locates where both clover and heather are within 2 miles of his apiary. It is rare for both sources of nectar to fail in the same season, and not infrequently a harvest may be obtained from both. The ancient practice of shifting skeps to the heather has not been successfully incorporated into the modern system, and the beekeeper whose hives are ordinarily too far from the heather would be better advised to establish an out-apiary to secure heather honey. Very close proximity to the sea certainly reduces somewhat the extent of ground readily accessible to the bees, but many successful apiarists are located almost at the edge of the water. Even the town-dweller is not debarred from the fascinating pursuit of beekeeping. The many gardens, parks and open spaces, now so frequently found in our cities, are important sources of early nectar and pollen, enabling the bees to increase early in the season to such an extent that the city beekeeper can actually supply earlier swarms than are usually obtainable in the

country. If the hives are near the outskirts of the town substantial yields of clover honey may be secured. An enthusiastic Edinburgh beekeeper has successfully maintained for many years an apiary situated 14 miles from his home.

Beekeeping a Skilled Occupation.—While it is generally admitted that a poultry-keeper must know something about hens, and that a gardener should have some acquaintance with fruit and vegetables, it is not infrequently assumed that the possession of a hive and appliances is the main qualification for a beekeeper, and that a knowledge of the bee and its ways is not essential. It is quite otherwise. The beekeeper must have a thorough understanding of the natural history of the bee, and he must learn to look at things from the view-point of the insect. Man has domesticated certain animals and exercises very definite control over their lives; but the bee has never been tamed, and any success in directing its energies has been attained only by close study of its natural instincts. Fortunately for the beekeeper the bee has been studied more closely than any animal except man, and the information gleaned through the ages is available in books. Owing to their independence of human control the bees require less attention than any other livestock, but they require that attention at the proper time, *and from a skilled hand.* In the middle of the clover harvest a producer of comb-honey may require to take a look into each hive every other day, but this "look" need not occupy more than about a minute for each hive

Handling Bees.—Most people have an instinctive fear of bees which is difficult to explain. It is interesting to observe a soldier —perhaps just home from the trenches—fleeing from a bee as if it were a live shell. Most people, however, soon discover that bees are not going about seeking someone to sting, and that a bee never volunteers an attack unless its home is in danger. A bee inside a room is concerned only to get out again, and one at work in a garden attends strictly to the business of the moment. For beginners there are sting-proof veils and gloves, but the gloves are soon discarded and often the veil as well. The essential thing is that a beginner should have a demonstration of how to handle bees, and be shown all the inside features of an occupied hive. The rest is a matter of practice. There are few people of ordinary intelligence who cannot easily and quickly learn to handle bees, and it is encouraging to know that some of the most competent of beemasters began by being dreadfully afraid of the bees.

Beekeeping a Healthy Occupation.—From the insurance point of view beekeepers are probably the very best "lives." People of impaired health who have taken to beekeeping have frequently astonished their friends—and their doctors—by living to a green old age. Langstroth, the American beekeeper mentioned above, had not health enough to be a clergyman—and preaching is one of the healthiest occupations—so he became a beekeeper, and lived to be eighty-five! A. I. Root, the head of the biggest bee business in the world, is now nearly 80 years old, and has been married for about 50 years. There are five children, ten grandchildren, and a

number of the fourth generation. All the descendants live in Medina, Ohio, and all are directly or indirectly connected with the bee industry. No deaths have occurred in the fifty years! Dr. Miller of Marengo, Illinois, the best known beekeeper in the world, was trained for the medical profession, but soon discovered that he had not health enough himself to give it to other people. So he gave up medicine and became a beekeeper, with the result that to-day he is "87 years young," sprightly as a boy, and a regular contributor to bee literature. The reason is not far to seek. The beekeeper is engaged in a pursuit of absorbing interest which takes him into the open air and the sunshine in the finest weather—and only then. There is neither heavy work nor long continued labour, so beekeeping is ideal for ladies, for older people, and for anyone of impaired vitality.

Beekeeping for Small-holders and Ex-service Men.—From what has just been said it will be evident that beekeeping is particularly suitable for ex-service men who are going back to the land. A beekeeper of course is the better of all his limbs, but the loss of one leg would not be a serious handicap, and there are simple devices enabling a one-armed man to perform all ordinary apiarian duties. What could be more ideal for the war-weary than the peaceful country life, the open air, the sunshine, the soothing murmur of the bees?

Beekeeping on a small scale—as a side line—fits in very well with other rural industries. Almost all the work can be done at odd moments, and the total time required is inconsiderable. With the exception of the hiving of swarms, most operations can be carried out in the evenings, in the dinner hour, or at other intervals in the work of the day. Looking after the bees would in most cases be regarded as a form of recreation and not as "work" at all. Last season a city beekeeper had 40 pounds of honey from a stock to which he had given so little attention that he had "scarcely looked over the wall." Another who runs a big farm and does much public work had little leisure for his bees. Yet from four stocks he sold honey to the value of nearly £30, and had a little to spare for the house and for presents.

The following are the records for last season of three very busy men who have full-time occupations and keep bees as a side line. *A* had 7 stocks, which he increased to 14, selling his honey for £30. *B* had 11 stocks and honey to the value of £60. *C* increased his 28 stocks to 32, and received £170 for the honey produced. In the consideration of these results it must be kept in mind that very exceptional prices were obtainable in 1918, and that the bees in each case were handled by men who thoroughly understood bees, and knew just when and how to perform the little operations required.

The small-holder who lives in or near the sporting districts of Scotland has special inducements to keep bees. He is usually within reach of both clover and heather, and there is a special market right on the spot. A crofter in Skye, when asked in pre-war times how he disposed of his honey, replied that he could sell far more than he could produce to the shooting tenants at 1s. 6d.

per pound. Heather honey bought in the Highlands is like hosiery purchased in Shetland. It has a sentimental value and commands a special price.

Advice.—Intending beekeepers should acquire as much bee lore as possible before making an actual beginning with bees. Apiculture is not just a way of coining money, and substantial profits should not be looked for until the necessary skill and experience have been acquired. Beekeepers are to a very large extent dependent on the weather, and there is always the menace of disease. No great loss, however, can be incurred if the beekeeper begins in a small way and extends his apiary by easy stages. Beekeeping is appropriately combined with small-holding, with horticulture, poultry-keeping, or other rural industry. Poultry require special attention in winter when bees require no attention at all. Fruit growing combines particularly well with beekeeping. Fruit-blossom is an important source of early nectar, and the visits of the bees, most methodical of all pollinating insects, will make it reasonably certain that the blossoms will be adequately fertilized.

ISLE OF WIGHT DISEASE IN HIVE BEES.

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IN a former paper issued under the present investigation[1] the failure to produce Isle of Wight disease in hive bees within a working season by means of direct contact with frames and hives and by feeding upon stores of bees suffering from this disease, was established in a limited number of cases.

Further experiments and observations of a like kind have been continued, and in six other instances the result within the time specified was the same, *i.e.* disease did not develop amongst the bees which fed upon the stores and lived upon the frames of sick bees during the whole of the experimental period, which in each case extended over the whole of the working season. It would certainly appear that normally the disease is not readily communicated by such means.

In addition to the foregoing we now desire to record further experiments in which sick worker bees, brood and queens from diseased stocks have been separately utilised.[2]

Experiments in Infection by means of Frames, Stores, and Sick Bees.—SUMMER EXPERIMENTS.—NO. 1. A stock, whose earlier history is given in the communication referred to above, p. 56, wintered (1915-16) successfully. In March flying had commenced

[1] *Proc. Roy. Phys. Soc. Edin*, 1916.

[2] These experiments have been carried out concurrently with an investigation upon the relation of the parasite *Nosema apis* to Isle of Wight disease. This is in course of publication in a separate paper. We conclude that the causal organism of Isle of Wight disease has not yet been found.

The researches have been conducted with the aid of Grants provided by the Development Commissioners through the Board of Agriculture for Scotland.

and pollen was being taken in. During this month an adjacent stock, a swarm of the previous summer, developed very definite signs of Isle of Wight disease, and large numbers of bees crawled when the weather admitted of their coming out. Bees of both stocks were repeatedly examined for *Nosema apis*, and no stage of the parasite was found.

On the 11th April the queen of the diseased stock was removed and the two were united. The union was accomplished with comparatively slight mortality. During May the weather was good and the disease symptoms disappeared. The stock was seen working on every fine day. It now appeared prosperous, and there were large numbers of eggs, larvæ, young and old workers and a good supply of stores.

After a period of prolonged rain the morning of 1st July was bright and sunny. Many of the bees were active and vicious, but large numbers appeared on the alighting board and many clustered on the ground; others crawled around. Drones were turned out. The appearances were characteristic of the Isle of Wight disease. The weather continued to be very wet. On the 10th the stock was examined; there were few dead bees within, but there were some slight indications of dysentery on the alighting board. On the 17th these signs were very much increased, and there were many dead bees, including drones, on the ground all around. At this date the stock was active and working well; it was rather short of stores and syrup was given.

On 29th July the stock was found in the following condition. The bees were active, gathering nectar and pollen. They covered about six frames, and three of these had sealed brood in plenty. Eggs and unsealed larvæ were also present. There was a moderate amount of stores, both honey and pollen, and two new sheets of foundation which had been put in about 12 days previously were well drawn out. Outside the hive there were numerous dead bees. Besides these, there were a few crawling bees—not more than a score or so were seen—some hanging to grasses, others collected in small clusters and remaining motionless, others making short flights—but all were definitely incapacitated. All that were seen were examined. In every case the usual condition associated with the Isle of Wight disease was found present.

The number of affected bees was relatively small, and there did not appear to be many on the floor of the hive within. Generally the impression obtained at this date was that the stock contained only a small number of sick bees and was building up.

On the 5th August the stock was working well, and a large amount of sealed brood covering 3 frames—also eggs and larvæ—were present. The conditions were similar to those observed on 29th July, except that the numbers of eggs and younger larvæ were very much increased. Stores were short and syrup was given. The weather at this time was very warm. Sick bees continued to crawl and climb upon the grass.

It may be regarded as certain that the crawling bees observed in the later weeks of July and in the beginning of August were not the diseased bees introduced upon the 11th April, which were bees

of the previous autumn. The sick bees were hatched in the hive subsequent to the introduction of the disease, and had been in immediate association with diseased inmates of the hive for a longer or shorter period.

A further development of this case is described in the next experiment.

No. 2. About the middle of June 1916 a frame of bees from the aforementioned experimental stock was placed in an observation hive, and to these an Italian queen was successfully introduced. Owing to bad weather there were few opportunities for flying, but when these occurred the bees gathered both nectar and pollen. The observation hive stood near the parent stock, but few losses by return to it could have taken place, as there was no appreciable diminution of bees. On the date that crawling in the parent stock appeared (July 1st) the observation hive was removed to a new situation 22 miles distant. On the 2nd and 3rd, dysentery became very marked in the observation stock, which owing to the bad weather had to be fed continuously. The bees were given both syrup and candy. Very few flew, even when the weather was favourable They fed readily, but mostly did not leave the comb. Crawling bees were in evidence in moderate numbers, and eventually the queen ceased to lay. The mortality within the hive was not excessive, but owing to the crawling losses the numbers steadily dwindled. The fæces of the bees were thin and watery, later they became thicker and ropy looking. The appearance of the bees when out of the hive, crawling, making short hopping flights, as well as the condition of the alimentary canal with congested colons, were not distinguishable from those seen in Isle of Wight disease, and we concluded that the disease was present. After the queen ceased laying, and the numbers had become much reduced, a recovery seemed to take place, the dysentery ceased and the bees ceased to crawl, but they were too few to build up. With warming indoors and feeding, this lot of bees improved in condition and became much more active. The weather also improved at this time, and opportunities were thus given the bees for flight They still crawled, but in fewer numbers, and there was less dysentery. They did not collect pollen, and it is doubtful if any honey was gathered. The flying seemed to be about the hive simply.

The improvement continued, and on the 15th dysentery was absent and only a few crawlers were seen. A greater proportion flew. They fed readily from supplies given, but did not seem to be gathering stores; so far the queen had not recommenced to lay.

The significance of the aforementioned facts lies in the practically simultaneous appearance of disease symptoms in the parent stock and in the bees which had been isolated from it at least a fortnight previously. During the period from the 11th April until 1st July there were no observed indications of the disease, and when it did appear upon the latter date, very large numbers showed the symptoms suddenly. The sudden outbreak in the two lots which lived together for two months, but which had been widely separated for a fortnight, strengthens the view that the disease had a common source in both, and adds to the probability that that source was the diseased element introduced upon the 11th April.

No. 3. On 14th May 1917 a stock of Dutch bees occupying a new hive and with new frames and foundation was found to be actively robbing a small stock rich in stores which was suffering from Isle of Wight disease. Contamination having thus been established, and the robbed stock being reduced to the limits of one frame, it was added with the bulk of its stores to the Dutch stock.

Up till the beginning of July this stock prospered in a normal manner, and no signs of disease ever became apparent. At this date preparations for swarming developed. The bees covered ten frames thickly and there was brood upon nine. We made an artificial swarm, but discovering later that the parent stock was queenless, we re-united the two with the original queen on the 23rd of July, making a stock of over seventeen frames of bees.

During summer the stock continued in good strength, and no sign of disease was ever observed. In September one frame of bees was removed for experimental purpose, and on the 27th a clearing board was introduced and the surplus honey removed, and the bees were made up for winter in the lower box. Two pounds of Bacterol candy were left on the frames. On various occasions throughout the experimental period bees were examined in numbers. *Nosema apis* was not found, and no signs of Isle of Wight disease were ever observed.

No.4. On the 17th August 1918, to a stock of bees[1] covering about six frames and headed by a young queen (Italian bred, mated in Aberdeen) of the current year we added a lot of bees together with brood and stores upon four frames, the remnant of a stock reduced to this condition by Isle of Wight disease. Its previous history is as follows :—One week after swarming, viz. 7th July, indications of Isle of Wight disease were observed, and during that month the stock was repeatedly treated with flavine, notwithstanding which the bees continued to crawl until the stock was reduced to the condition stated upon the date mentioned. The union of the two lots was effected without loss of bees, and the condition of the increased stock was ascertained upon 29th August to be as follows :—The bees covered ten frames fully, and there was brood upon six, including eggs. The queen was seen upon the frames, and there were no signs of disease outside the hive. Stores were short. The weather was changeable, cold to mild.

During the following month the weather was mostly wet, and there were few indications of disease outside the hive. On 20th September it was ascertained that there was brood upon one frame only, and the bees were covering nine frames. No crawling amongst the Italian bees was observed throughout the autumn, and the bees were put up for winter. The mortality up till the end of February was slight. The bees were flying at this date in bright but cold weather. This stock has wintered successfully, and in fine weather the bees have been seen gathering pollen.

WINTER EXPERIMENTS.—No. 5. In the autumn of 1916 a stock of bees which had been showing the usual Isle of Wight

[1] These bees had an earlier history of *Nosema* infection and of contact with brood of Isle of Wight diseased stock.

disease symptoms intermittently over a considerable period was treated with Bacterol both by feeding and spraying. This had no permanent effect.

At the beginning of October crawling was much in evidence. There was sealed brood upon two frames, but the stock was greatly diminished in numbers. In the endeavour to maintain the stock throughout the winter, we added a lot of driven bees obtained in Wales at the beginning of November. The united stock was ascertained a week afterwards to have clustered over six frames. On fine days the bees were flying, and signs of the disease were in abeyance. At the end of December on a fine day bees from this stock were flying and removal of dead was observed. Again on 22nd January 1917 we observed dead bees being carried out. February 23rd was sunny and warm; the bees were active, and large numbers flew on this date. During March the bees flew on every fine day. Pollen gathering and cleaning up was in evidence.

The stock continued normally throughout the spring and summer, and it is clear that the driven bees added in November did not contract the disease, although sick and healthy had been in close association throughout the winter.

The disease re-appeared in this stock in the following July.

In addition to the foregoing experiment, four other cases of stocks affected with the disease were united in the autumn with lots of healthy bees. These healthy bees in each case covered from five to six frames. In two instances the queens of the healthy stocks were retained, and in the remaining two the queens of the diseased stocks were left to head the combined colonies. All the stocks were wintered with ample stores. In the following spring it was found that two of these united stocks had succumbed, whilst two survive. Of the survivors, one is headed by a healthy queen and the other by a queen of a diseased stock.

In another apiary nine stocks suffering from Isle of Wight disease were strengthened by giving them driven bees in September. The majority succumbed in December and January, and only one remains alive. In these cases failure was not due to shortage of healthy bees, as in each case the numbers used were sufficient in themselves for wintering.

In the following record further illustrations of the readiness with which sick bees may communicate the disease to other bees will be found, and also in some of the cases evidence that susceptibility is not merely racial, *i.e.* that the bees are not suffering from the disease in the first instance merely because they are all the offspring of a particular queen.

Results of Experiments in Re-Queening.—To a one frame lot of bees, an Isle of Wight diseased remnant, a healthy queen obtained from Wales with driven bees, which had wintered at Aberdeen, was introduced upon the 28th March 1917. Honey was fed from an Isle of Wight diseased stock, and the frames in the hive (two) were both from Isle of Wight diseased stocks.

Up till the 2nd of May, exactly five weeks, this lot continued to exhibit symptoms of the disease, but after this date these disappeared, and for four weeks the stock appeared perfectly

healthy. We regarded this as the period in which the old lot of infected bees were gradually dying out, while meantime the young bees of the new queen exhibited no signs of infection.

On the 31st May two frames of bees from another stock were added. From this time onward throughout the summer the stock gradually increased in numbers, and at no time could it be said positively that Isle of Wight disease was present. At the beginning of August the strength had reached ten frames with brood on eight. A rack of sections was placed on the frames. This month, however, was very unfavourable to the bees, and on the 13th crawlers were seen in front of the stock, and this was observed up to the 4th September. This symptom passed off, and subsequent to this date was not again observed. The stock, which was short of stores, was fed with Pascall candy and put up for winter.

On 23rd January it was found to be much reduced in numbers, but to have plenty stores. It was still in existence on the 5th February, but on the 10th it had died out. The queen was found apparently dead also, but on removal and warming she revived.[1]

On more than one occasion bees were removed from this stock for experimental purposes in the late autumn. The cause of its dying out is not clear. Our impression on reviewing the whole history was that the new stock built up by the Welsh queen introduced to unhealthy bees never contracted the disease.

In one of the apiaries, Isle of Wight disease developed generally during the working season, 1917. A number of the stocks were re-queened. The season proved highly successful for honey, although the disease continued. The stocks were wintered, but before spring all were dead.

Season 1918 in the same apiary. On August 23rd, a sick stock was re-queened with a young imported Italian queen. Six weeks afterwards there were Italian bees, offspring of this queen, amongst the crawling diseased bees. A duplicate experiment also yielded the same result, offspring of this second Italian queen being found amongst the crawling bees at the end of six weeks.

Our conclusions regarding re-queening are that, whilst it may be useful temporarily in the early part of the working season, it is not successful in ridding a stock of the disease.

Experiments with Brood of Diseased Stock.—With a view to obtaining information as to the possible infectivity of the brood in relation to this disease a number of experiments have been performed, of which the following are typical examples.

No. 1. This stock was obtained in the spring of 1918. Samples of the bees were microscopically examined on several occasions. At the end of May two bees were found heavily infected with *Nosema apis*, and again this parasite was found in two bees at the end of June. These occurrences were exceptional, as in numerous other instances such examinations yielded negative results, and the parasite was not found after the latter date specified above. It is certain there was no general infection with this parasite.

[1] The queen of this stock was subsequently given to the remainder of an Isle of Wight diseased stock, and later to one frame experiment of date February 28th, 1918. She later headed a *Nosema* experiment in May.

The stock about the middle of May was covering six frames and had young brood and eggs upon five, besides sealed brood. Increase was rapid, and before the 18th of June the stock had yielded four frames of bees for the formation of nuclei or strengthening of other stocks.

On the 10th June one frame of brood from each of two Isle of Wight diseased stocks was introduced. Again on the 18th a third frame of brood, also from a similarly diseased stock, was introduced. This brood had all hatched by 6th July, and the frames were in ordinary routine utilised by the queen in egg-laying. The stock steadily built up, and by the middle of June was thickly covering twenty frames There was a large quantity of surplus honey, while the second brood box of ten frames also contained considerable stores.

No signs of Isle of Wight disease have ever been observed in this stock, which on 1st November remained strong in numbers and healthy. During the whole season it has stood in an experimental apiary into which Isle of Wight diseased stocks have been introduced as a matter of routine throughout the summer and autumn. Further, it actively robbed several of these stocks early in August. The presence of *Nosema apis* amongst the bees has already been recorded.

From the foregoing it may be gathered that the whole of the bees introduced as brood or eggs from the diseased stock was hatched by the 9th of July. Since no signs of disease appeared amongst the bees from that date onward until the bees wintered, it appears that the brood was healthy although bred and a good proportion of it (sealed brood) was nurtured in the affected hive.

No 2. On 15th May 1918 an Italian queen was introduced to a two frame nucleus of queenless black bees *Nosema apis* had been found in the attendant bees which accompanied this queen from Italy. On the 24th the queen was seen upon the frames, and there were larvæ and eggs in the brood nest.

On the 27th May one frame with brood in all stages, but without bees taken from a stock suffering from Isle of Wight disease, was introduced. Another similar frame was given upon the 31st, and another upon the 11th June. Upon the 1st of July three additional frames containing brood in all stages taken from another Isle of Wight diseased stock were placed in the hive, making six frames in all. The patches of brood in all cases were of moderate size. The introduced brood duly hatched, and the nucleus continued to prosper in a normal manner. On the 1st August the stock was making up well, the bees were covering nine frames and the brood nest extended to seven. This represents the maximum strength so far as was observed.

It will be noted that all the brood introduced from the diseased stocks had hatched out by 22nd July. These bees were recognizable by their difference in colour from those bred by the queen. During August they represented a fair proportion of the bees present.

During the whole course of the experiment the stock was watched for indications of the presence of disease, and nothing in the appearance or behaviour of the bees, either black or yellow, suggestive of the disease was ever seen. The stock has wintered successfully.

No. 3. On 27th May 1918 a stock of Punic bees covering five frames which had wintered in Aberdeen was given a frame of brood from an Isle of Wight diseased stock. Again on 31st another frame was given from the same source. On 11th June a third frame of similar brood from another diseased stock was added. The stock increased in numbers rapidly to the middle of July, when the queen was found to be missing and many queen cells were being made. These were removed and a queen introduced, but on 20th July the stock swarmed, and on 1st August the parent stock was covering twenty frames and storing well, but no surplus has been obtained. The last bee from the Isle of Wight diseased stock was due to hatch on 2nd July. Such bees were present in the stock from 27th May onward. On no occasion have any indications of Isle of Wight disease been observed in the stock, which has wintered successfully.

No. 4. On 4th July two frames of brood from a stock suffering from Isle of Wight disease were introduced to a small swarm of Irish bees covering five frames. The stock continued to work normally during the summer and at the beginning of August was covering nine frames with brood upon eight. There were plenty stores. The whole of the brood introduced from the diseased stock was due to be hatched upon the 25th July. There have been no signs of Isle of Wight disease in any of the bees, and the stock has wintered successfully.

No. 5. On 4th July a swarm of bees from Tipperary covering five frames was given two frames of brood from a stock suffering from Isle of Wight disease. The stock built up well during the summer, and in the middle of August had a good supply of stores. There were ten frames of bees, nine of which were carrying brood. The last bee from the Isle of Wight brood was due to hatch on 25th July. No indications of disease have ever been observed in this stock, which wintered successfully and has become the subject of another experiment.

No. 6. On 14th July 1918 twenty frames of brood belonging to an Isle of Wight diseased stock, originally of thirty frames, were placed with a healthy stock, very strong in bees. This stock was isolated in a heather area at the beginning of August. It did well, and is now wintering in good condition, having yielded a large surplus. No signs of disease have ever been seen.

In the selection of the brood in the foregoing experiments the endeavour was always made to utilise the maximum amount of sealed brood In this way bees were taken which had had the full opportunity for receiving infection from attendant bees.

The results have been uniform throughout, and it would appear that bees reared in a stock suffering from Isle of Wight disease are not susceptible to the disease in the brood stage. Further, we may add, dead brood has never been found to be a feature of the disease.

Incidental to these experiments we have found that whilst as recorded the brood removed to a healthy stock did not develop the disease, that which was left with the sick parent stock in due course succumbed to it as adult bees.

Experiments with Queens of Diseased Stocks.—With a view to ascertaining whether bees associated with a queen from an Isle of Wight diseased stock or bred from her in healthy surroundings develop the disease, the following type of experiment was carried out.

Experiment No. 1. On the 11th April 1917 we introduced to a small stock of queenless Welsh bees, covering two frames, which had been wintered in Aberdeen, a queen which survived from a stock recently defunct and exhibiting Isle of Wight disease symptoms. Up to the middle of May progress appeared to be slow, and the queen did not lay well. We removed this queen, and replaced her by another queen surviving from a badly affected Isle of Wight stock. During the following months the stock progressed normally. No signs of disease could be observed, and at the 23rd July the bees were covering ten frames with brood on eight. August was very unfavourable to the bees generally. No surplus stores were obtained, and feeding had to be resorted to before winter. On the 24th January 1918 the stock was found to be alive and was supplied with Bacterol candy. On the 9th February the bees were on six frames with brood sealed and unsealed on one. At the end of February this stock was disturbed by workmen, and losses appear to have been incurred through the bees flying out in too cold weather. In the middle of March the hive was found empty save for a few dead bees, including the queen. There were very good indications that this stock was about to continue satisfactorily in the forthcoming spring, and the failure appeared undoubtedly due to the external cause indicated. We regard this experiment as successful in showing that a queen surviving from an Isle of Wight diseased stock may continue for a satisfactory period (10 months) without communicating the disease.

Experiment No. 2.—This stock consisted of bees obtained from Wales in the autumn of 1916. It was wintered upon frames from an Isle of Wight stock, and in February the bees were fed upon Bacterol medicated candy, and meantime the Isle of Wight stock frames were removed and replaced by others. At the end of March the strength was low, amounting to about two frames. On the 28th of this month the Welsh queen was removed and a queen from an Isle of Wight stock was introduced. During April and May the stock did moderately well, and at the end of May covered about five frames; the bees worked well, and at no time were there any signs to indicate that Isle of Wight disease was developing. In the beginning of May the bees robbed stores from an empty hive containing the frames of a stock defunct from Isle of Wight disease. The hive was closed, but the bees were making use of the escape funnel at the top.

Throughout the summer matters progressed well on the whole, and on the 10th July the stock consisted of ten frames good with brood on nine. There was also a considerable amount of stores, the brood nest being rather restricted. A super was put on on the 23rd, but the bees did not make use of it. The month of August was extremely wet, and the bees had few opportunities for flight. At the beginning of September the stock was still a crowded one;

there was brood on eight frames, but the stores were running short. Disease was constantly watched for, but no indications were ever observed. The stock continued well and was fed with Bacterol candy with a view to wintering. At the beginning of November it was concluded that the queen, having been with the stock for over seven months and no disease resulting, had failed to infect the colony, and the experiment was regarded as concluded. At this date the stock was divided and the bees utilised in other experiments.

Experiment No. 3.—This stock commenced with a nucleus of one frame of bees, to which was given a queen from an Isle of Wight diseased stock on 4th June. This queen headed the stock up to 13th July, at which time it was strengthened with bees from other sources, and at this date covered eight frames. At the time of one of these additions the queen was lost. She was replaced by another of similar history. This latter queen remained with the stock, which at the beginning of August had a strength of nine frames with brood upon seven, and was working very well.

On 12th September stock No. 22, a similar experiment, was united without its queen to this stock. The combined colony, originally covering about thirteen frames, is now in one brood box, with dummy excluder between. On 23rd the queen was seen upon the frames. *There were crawling bees on the plot in front of this stock at this date*, and subsequently the same feature was observed on several occasions.

The combined stock was found in January to have died out.

Experiment No. 4.—On 15th March 1918 a queen surviving from a stock depleted with Isle of Wight disease was placed upon a frame with small cluster of healthy bees. The bees were kept in an observation hive and fed with pure candy. Water was given from time to time. They were also given candy mixed with crocus pollen, and on other occasions with candy made up with pea flour. The hive was situated in the heart of the town and opportunities for obtaining stores were limited. At the end of two months there was a small cluster of young bees on the frames and brood on the combs.

This nucleus survived and in fact increased during May and earlier part of June.

On 12th June this lot was removed to another apiary and strengthened with one frame of Punic bees.

On 10th July, having maintained itself normal, this nucleus was added to another which had been headed by a queen of similar Isle of Wight disease history from 1st June, but which was at this date found to have lost its queen. The strength of the united stocks was six frames at this date, and from then onward until the end of August the increase amounted to little more than one additional frame. The queen was not a young one, which accounts in part for the failure of the stock to increase, but at no time has any evidence been obtained that Isle of Wight disease had developed even in a minor degree. The nucleus was headed by a queen surviving from an affected stock for a period of six months. On 12th September this stock was united to No. 21, a similar

experiment. At the time of union the queen was not observed, and subsequent search has shown that she is lost. There were losses owing to the union, but these were small compared with the total number of bees, and the joint stock was wintered up. As recorded under experiment No. 3, disease developed here, and the stock was found to have died out during the winter.

Experiment No. 5.—On 15th July 1918 we removed the queen of a strong stock of Punic bees with brood upon nine frames and substituted a queen taken from a stock suffering from Isle of Wight disease. On the 4th of August the stock swarmed, and the swarm was successfully hived. Up till the 20th of the month the queen with the parent colony had not begun to lay, and upon the 10th September this stock was found to be broodless. On this date the swarm of 4th August was placed on top of parent stock, each with its own queen. The two boxes were separated by excluder. On the 25th September the strength was ascertained to be clustered on eight frames in the parent stock, and on five in the swarm.

During the whole course of this experiment, lasting over a period of three months, from the introduction of the experimental queen until the bees were wintered, no traces of disease were ever observed. The stock was found in January to have numerous dead. There were signs of dysentery upon the frames, and the colony died out in February.

Experiment No 6.—This nucleus consisted on the 18th of March 1918 of five frames of bees with brood upon two. On the 20th a queen surviving from an Isle of Wight diseased stock was introduced. The stock progressed normally throughout the summer, and at the beginning of July was of full strength, having brood on nine frames. On the 7th July a large swarm came off. The queen cells in the parent stock were destroyed and the queen of the swarm was returned. The stock continued to build up, and at the beginning of September, although it had yielded no surplus stores, was large and healthy, with sufficient stores for wintering. At no period of its history have any signs of disease been observed.

In the beginning of March 1919 this stock was found to have wintered successfully.

Experiment No. 7.—On 4th May 1918 a nucleus consisting of two frames of healthy bees having two small patches of brood was given a queen of above named history which survived from a stock of Isle of Wight diseased bees. The queen was an old one, and on 7th June was withdrawn from this stock, which at this date covered three frames, and was replaced on the 11th by a younger (1917) queen of similar history. The stock progressed with no visible signs of disease until upon the 17th July it covered eight frames and had brood upon six. From this date onward until the beginning of September the strength remained stationary. The amount of sealed stores was moderate, and the stock required feeding before winter. No sign of Isle of Wight disease was ever observed in this stock.

In the beginning of March this stock was found to have wintered successfully.

Communication of the Disease.—As recorded above, attempts to convey the disease by combs and stores have in general been failures, while contact experiments of presumed healthy with sick bees have yielded a proportion of positive results. We incline strongly to the view that the sick worker bee is the chief agent in communicating the disease to other bees.

Notwithstanding the variation in the result as shown in the other experiments, the evidence as a whole derived from a very wide experience in dealing with the disease in the North of Scotland particularly, leaves practically no doubt in our minds as to the infective nature of this disease. The results recorded show that extinction after known contact with the disease is more frequent in winter than in summer. This is doubtless because in large measure loss in summer is compensated by production of bees; at the same time the closer association as a cluster in winter probably fosters the disease. Also, as the ventilation of the hive in winter is usually much more restricted, this has probably the same effect.

With regard to those cases in which the disease did not develop after contact within the working period, *e.g.* No. 5 (p. 179), but in which at a later season it appeared, we have observed that occurrences of this nature are not infrequent. We have in common with various bee-keepers of experience found that in stocks which have been associated in a particular area with sick bees, *e.g.* those taken to heather in summer, the disease often appears in the following working season. In these cases infection was not conveyed to the bees which were actually in contact with the disease, for with the exception of the queen these had completed their normal life without showing any signs of the disease before it appeared in the stock. And these bees which actually developed the disease were never in the infected area at all.

The readiest explanation in such cases, and one which must hold the field in the meantime, is that in these instances we have an infection from an independent source, and that original contamination was merely assumed. We acknowledge, however, that cases of this nature are fairly numerous, and that we cannot set aside entirely the possibility of another explanation. In the experiment quoted above, No. 5, contamination did take place, and no disease followed in the bees in the hive at the time, whilst it developed in the summer following. The assumption of a latent non-infective period for the causal organism would explain all such cases; so also would the absence in the first season of the conditions necessary for its development in the bees. These views imply a prolonged vitality for the organism outside the bee.

From the results recorded under brood experiments it would appear that the queen from an Isle of Wight diseased stock does not transmit the disease hereditarily. This is corroborated by the general results obtained in the above described cases where such queens were transferred from their sick stocks to healthy, in which they produced bees over prolonged periods covering usually full working seasons without the appearance of disease.

We have further obtained some evidence that such queens do not produce bees which are specially susceptible, *i.e.* of inferior racial quality. Brood from such queens removed from the infected

stock and transferred to hives in the immediate neighbourhood did not develop the disease on reaching the adult stage, although the opportunities for infection were very favourable.

In none of our experiments, with the possible exception of No. 3 (p. 185), did the queen convey the disease by contagion.

From the fact that the queen in a diseased stock invariably survives to the last, it is generally assumed that she is immune to this dsease. Such an assumption is not altogether warranted. It must be borne in mind that she is constitutionally adapted to a much longer life than the worker bee and to live a different kind of life. It may be that the queen does contract the disease, although she does not die before or along with her worker offspring. In this connection one feature has impressed us in reviewing our results from experiments with queens. We are not satisfied that the production of queens from Isle of Wight diseased stocks is as good as that of queens of similar age from healthy stocks. This problem is the subject of investigation at present.

General Conclusions.—In the course of our enquiries we have had ample opportunities of studying this disease in all its aspects. The following statements are based entirely upon our own observations and experiments, some of which are not given in detail in the foregoing paper.

The presence of this disease in a stock is manifested by the inability of the worker bee to fly. In fine weather during the working season stricken bees leave the hive and loiter upon the alighting board, or crawl upon the ground or grass in front. They frequently climb the stems of grasses or other plants. They tend, especially as the day advances and the weather becomes cooler, to gather in clusters upon the ground, where they remain almost motionless, except for occasional trembling of the wings and body, until they die. When the weather is not too cold they may survive a night's exposure, and if warmed become more active. But individual bees, once they are stricken with the disease, do not recover, and this independently of whether they have suffered from exposure outside the hive or not. Notwithstanding the fatal nature of the disease, we have been able to keep alive for two months in the autumn a remnant of an affected stock in which practically every bee was unable to fly and showing all the ordinary indications of the disease. Withir the hive, as we have noted in sick stock kept in observation hives, the smitten bees do little work, they feed little, and frequently show so great weakness that they fall from the frames. Not uncommonly they immediately attempt to regain their position by climbing back again. They may show their weakness further in lack of co-ordination of the fore and hind wing, the latter frequently projecting at right angles to the body. Very usually the hind gut (colon or rectum) is dilated with undischarged fæces. We regard this as largely due to the incapacity of the bee for flight, defæcation normally taking place only on the wing. The fæces are usually at least semi-solid in character, but when the temperature of the hive is high and there is liquid food (syrup or honey) the condition may become dysenteric.

These familiar symptoms indicate the final phase of the disease, and we have proved its presence in bees while still capable of flight. Our results suggest that infection takes place most readily through contact with sick bees, and that this may occur in the early phase of the adult condition, before the bee has commenced to forage. It is not certain that drones contract the disease, although they may suffer indirectly through the disorganisation of the hive economy when the disease is widespread within it. We have already indicated our results regarding the relation of the disease to brood and to the queen. A hive population is continuously undergoing renewal by loss of older bees and the production of new bees. Recovery in a stock can be attained only by the failure of the disease to spread amongst the young as the older die out. The rate of spread varies in relation to factors at present unknown, and, as far as appearances go, is further obscured by the rate of production of new bees by the queen. When she is young and prolific she may far outstrip the losses from disease, and the colony may maintain itself so as to be profitable to the owner for a time. When new bees cease to be produced the disease gains upon the colony, and in this way the failure of stocks from the disease is more common in autumn and in winter than at other times.

The ordinary symptoms described above are not specific to the conditions known as Isle of Wight disease, but appear to be usual when adult bees are incapacitated from various causes Hence there are instances in which the bees of a stock may appear to be suffering from Isle of Wight disease, and losses from crawling may continue for several days or even a longer period. But in such cases the non-infective nature of the trouble becomes apparent when the later produced bees are seen to be quite healthy. The "disease" is then usually spoken of as having "passed off," and the bees are said to have "recovered" from the disease. In Isle of Wight disease in our experience there have been no recoveries of the sick bees nor of affected stocks, although the rate of progress has been very varied. The temporary sickness here referred to we have observed on a number of occasions, sometimes widespread in a district and affecting practically all the stocks. In such cases it would appear to be due to some disturbing factor in the nectar or pollen available at that time. We consider that May sickness, which occurs in other months as well, is of the nature here described. In other instances we have concluded that the failing of wintered bees in spring has assumed the appearance of Isle of Wight disease. Bees which have travelled long distances with ready facilities for feeding sometimes show symptoms similar when eventually released. Our later experiences have confirmed us in the view that Isle of Wight disease is an infectious disease, but we have not found *Nosema apis* to be casually related thereto. Experiments dealing with this aspect of the problem are described in a succeeding paper.

SOME EFFECTS OF SHEEP-REARING ON THE NATURAL CONDITION OF SCOTLAND.

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SCOTLAND owes more than is apparent to the influences which have sprung from the development of agriculture and the rearing of domestic animals; and no animal has played a greater part in the moulding of present day Scotland than that friendly alien, the sheep. The effects of sheep-rearing which I have in mind are not those evident effects—the influences upon Scottish commerce, farming and breeding—to which attention has often been drawn. They are the less obtrusive, but not less far-reaching results which force themselves upon the notice of the naturalist who would trace the history of Scottish domestic animals from the dim ages before history began. Such effects are to be seen in the surface features of Scotland, in the nature of the hill-lands, in the distribution of forest and of pasture, and are as clearly shown in the composition and distribution of the present day wild fauna of the country.

The importance of the domestication of animals lies in that man gains control of their breeding, and so can increase their numbers to an extent limited only by the available food supply. Therefore, even in a country where native wild animals have been converted into domesticated stock, the fresh accession of numbers has wide-spread effects upon the wild vegetation and the wild fauna. Suitable pastures have to be created from former wildernesses, the multiplying domestics usurp the food-supply of the wild animals, the feeding grounds of the latter are curtailed and their numbers fall off. The effects are even more marked when a domestic animal is brought from a foreign land to a country where its kind has no wild representatives; for the new-comer seizes upon a food-supply which formerly supported its quota of native animals of other kinds. Such is the case with sheep in Scotland.

There is no evidence that wild sheep were ever natives of Scotland. None of their bones have been found in the deposits of former times beside those of the animals which inhabited the land when man made his first scattered settlements in the country-side. On the other hand there is evidence that at a very early stage in their colonization of Caledonia the men of the Polished Stone Age brought with them, on their migrations from the south, flocks of domesticated sheep. These early sheep were not like the familiar sheep of to-day. They were smaller in body, longer and more slender in limb, their horns were large, their wool was short and of a pale brown colour; yet their essential habits, their congregation in flocks and their need of wide grassy pastures, have remained the same.

How has Scotland been affected by the introduction of this alien race?

Sheep and Forests.—Directly and indirectly sheep have contributed to the disappearance of the great forests which in past

time spread over wide tracts of the country. In natural conditions the maintenance of a forest is due to the constant springing up of seedlings in the humus, each ready, should opportunity be offered it by the decay and collapse of some old giant of the woods, to push towards the light and fill the temporary gap in the woodland. Similarly the extension of the forest along the valleys or to higher levels on the mountains is naturally brought about by the development, beyond the margin of the wood, of seedlings which in full time bear fruit and continue the process of expansion. In its first stage this process can be traced along the edges of most of our natural woods of birch and fir. But the first stage is all that can be traced, for these gradual conquests of nature are brought to a full stop by the introduction of sheep. In the severity of winter, if at no other time, the necessity for food drives the flocks to browse upon any available supply, and the seedlings, the hope and stay of the future, are grazed to the ground. As a consequence not only is the expansion of the forest checked, but natural repair is held in abeyance, the places of the dead-falls are left desolate and bare, and the forest decays.

The danger which threatened the woodland from the promiscuous pasturing of flocks was recognised by the old Scottish laws—the *Leges Forestarum*, attributed by some to the time of William the Lion in the later years of the twelfth and early years of the thirteenth centuries. To guard against it they ordained that a proportion of each flock of sheep found in the forest should be forfeited to the forester or to the king; while of straying goats (and goats, which in former days were bred in Scotland in great numbers, have shared with sheep in the destruction of the forest) one was to be hung up in the trees by the horns for the first three trespasses, and for the fourth one was to be slain and its bowels left in the wood.

Even in recent times the destruction caused by sheep in Scottish woodlands has been manifest. The old Statistical Account of Scotland records the destruction of a considerable wood in the parish of Drumelzier in Tweeddale through bad management, particularly by allowing sheep to graze within its bounds; and Sir John Stirling Maxwell significantly describes the natural birch-wood above Loch Ossian as consisting of "ragged trees belonging to the *pre-sheep period*, and seedlings dating from the time when the *sheep were cleared* and deer were not yet numerous."[1]

In the more natural conditions which hold in countries where agriculture is less dominant than in our own, the open antagonism between sheep (or goats) and the forest is still more patent. In a recent account of the forests of Sweden it was stated that, owing to the trampling and browsing within the forest of domestic animals, and especially of sheep and goats, the pine woods were gradually retreating or disappearing in the neighbourhood of farms. Principal Perkins of Roseworthy College considers the passing of a flock of goats to be as destructive to young trees and shrubs in Tunisia as a bush fire. But the crowning example of the direct influence of browsing domestic animals upon forest is furnished by St. Helena, which, well-stocked with woods when goats were intro-

[1] "Loch Ossian Plantations," 1913.

duced in 1502, was by 1731 utterly denuded of trees through the destruction of the saplings by goats and the natural decay of the old trees; so that of one part of the island Charles Darwin wrote after his visit in the *Beagle* in 1836, "this place is now so utterly desert, that nothing but so well attested an account could have made me believe that trees could ever have grown there."

In indirect ways also the breeding of sheep hastened the downfall of the forest. Pasture was necessary for the sustenance of the flocks, and new pastures could most readily be obtained by the demolition of the forest. It was in that part of Scotland where sheep have for centuries been noteworthy for their numbers, and where to-day they are still most thickly congregated, that the primeval forest of Scotland first disappeared. In the fifteenth and sixteenth centuries visitors to Scotland from foreign parts, and Scottish historians alike, were amazed at "the immense flocks of sheep" which roved the Lowland pastures. Bishop Leslie, in 1578, estimated individual flocks as containing four, five, eight or even ten thousand individuals, and Pitscottie in describing the peaceful times of James V. adds, "wherethrough the king had great profit for he had ten thousand sheep going in the Ettrick Forest in keeping by Andrew Bell, who made the king as good count of them, as they had gone in the Bounds of Life." But even in those days the great woods of the Lowlands were far on the way to extinction, and the country once known as "Forest-shire" was perhaps as innocent of woodland as it is to-day.

Now we know from much more recent history that a first step in the preparation of sheep pasture was the levelling of the forest; for, less than a century ago, the brothers Stuart described in their "Lays of the Deer Forest," how in Strathfarrar, "twelve miles of pine, birch and oak woods were burned in the tenantry of the late Eskedail to improve the sheep pasture." In view of such evidence, and of the concurrent disappearance of the Lowland woods with the increase of sheep-breeding, we cannot regard the deliberate destruction of the old forests of Scotland without reckoning sheep as "accessory to the fact."

Furthermore, the forest suffered through the endeavours of the husbandman to shield his flocks from the ravages of the many wild creatures which in Scotland's savage days prowled the country in search of food; for there was no surer way of ridding the land of pests than that of destroying the lairs in which they sought safe shelter and secluded breeding places. But to this aspect of the problem I shall return in discussiug the influence of sheep-rearing upon the wild animals of the country.

Sheep and Vegetation.—The influence of sheep upon the lesser vegetation of the country, while less imposing than in the case of the destruction of forests, is nevertheless probably more evident to the seeing eye. Yet here the change has been one rather of substitution, of the replacing of one type of vegetation by another, than of patent destruction. In great part the effect has been due to the unwonted numbers of individuals which spread over the land with the introduction and steady progress of the breeding of sheep. A calculation based on present day numbers in definite areas

would indicate that before sheep were brought to Scotland, the native browsing animals of the country—the Red Deer and the Roe, the Elk and the Reindeer—were thinly sprinkled, each individual requiring on an average between 20 and 30 acres for its support. But the number of sheep in Scotland on an average taken for the ten years 1906 to 1915 was 7,129,135; and this, even supposing the numbers to be equally dispersed throughout the whole length and breadth of the land, represents a uniform population of one individual to less than 3 acres. As a matter of fact the actual concentration in the sheep districts is very much greater, for many areas are unsuitable for sheep pasture, and from other areas, such as industrial districts and land under crop, sheep are excluded. Thus in sheep countries, such as Berwick and Roxburgh, sheep average, over all, more than 1 to the acre, and in the 95,000 odd acres of the Kelso district the average rises to close on 1½ to each acre.

A concentration so great compared with that of the original wild browsing stock of the country has had two marked effects upon vegetation. The first is due to a new access of manuring, the second to the selective feeding of the flocks. The unaccustomed distribution of manure on natural grass lands (and it must be remembered that even sparse manuring carried on through many centuries may have a cumulative effect not easy to be calculated) results in general in the fostering of particular types of vegetation which frequent rich soil, and in the gradual disappearance of the typical inhabitants of a "poverty bottom." The latter are ousted by richer grasses and by such weeds as nettles and sorrel; and I have seen heather moorland, heavily manured by natural agency, transformed into thickets of dock.

The browsing of sheep has also an effect of its own. The pasture is nibbled close to the ground, and this causes a strong growth from the roots which, if the agency be continued long enough, results in the formation of a deep springy turf. Further, the taller herbs, which in an unbrowsed natural area give an effect of irregularity to the plant association, share in the fate of the grasses, so that uniform cropping soon stamps upon the pasture an unaccustomed and artificial regularity of surface. This effect is well seen where the edge of a moorland has long been cropped by succeeding flocks of sheep, for here the heather, kept in check by constant browsing, becomes almost indistinguishably part and parcel of the close turf. Larger plants are restricted in the same way. I have been puzzled at a distance by the solid conical bushes which crowned a bluff in Easter Ross overlooking the Dornoch Firth. Closer inspection showed that the bushes were whins, the fresh shoots of which had been constantly pruned by sheep, until the bushes resembled less the familiar straggling growths of gorse than a series of gigantic bee-skeps. In the neighbourhood of these old and scattered bushes no fresh upstarts of whins were to be seen in the pasture, though in natural conditions, in the absence of sheep, I have no doubt that the whole area would soon have become a dense gorse thicket.

Such results have followed directly on the action of the sheep themselves, but their presence has also entailed secondary modifi-

cations of vegetation, due especially to the efforts to improve wet or mossy places by the creation of "sheep drains" for the removal of superfluous water. The results may be traced by the disappearance of the extreme types of marsh vegetation, such as sphagnum, rushes, cotton grass, bog-myrtle and other semi-aquatic plants, in favour of an altogether drier type of vegetation which includes many grasses, heather, bracken and gorse.

To the reader these influences of sheep on vegetation may appear to be trivial and of no serious moment. Contrast, however, the turfy slopes and treeless grassy moors of the Cheviot Hills or of the Southern Uplands generally with the heather hills and native birch and pine woods of the Northern Highlands. Keeping in mind that sheep-pasturing on a large scale has been characteristic of the former for many centuries (it was already the wonder of the sixteenth century visitors to the Lowlands), while the first sheep farm in the North was established by southern farmers at Corrimony only in 1797, I do not hesitate to set a share in the transformation of the Southern Uplands, from a region of moor and forest to the best hill-pastures in Scotland, to the long continued influences, direct and indirect, of the sheep themselves.

Sheep and Native Animals.—The influence of sheep-rearing upon the wild animals of Scotland has been of that slow but persistent type which is usually associated with the ordinary workings of nature—a process little in evidence during its progress, and made apparent only in the results that have been reached through lapse of time. In essence the results resemble those of any successful invasion: a first foothold, gained by ousting the native animals from some meagre tract of country, was gradually extended, and as new areas came under the sway of the domestic flocks, outpost after outpost of the original fauna fell, so that the range of the former denizens became restricted and their numbers decreased.

The incoming of sheep told first, and that directly, upon the browsing animals of the country. At that time Red Deer, the predominant partners, shared the pastures of forest glade and river-meadow with Roe Deer, Reindeer and Elk; and, far from being confined to the dreary mountain wastes we know as "deer-forests," they inhabited the whole country from the northern shores of Caithness and Sutherland to the margin of the Solway Firth. Now it is evident that the numbers of the browsing animals were limited by the food-supply available; but it is a rule in nature that a species does in general develop up to that limit provided other conditions are favourable. We may therefore take it for granted that the pasturage of Scotland was stocked to the limit of its capacity before the advent of the shepherd's flocks. The new accession of numbers of browsing animals at once altered the natural balance between food and native stock, and by as much as the sheep consumed the pasture on which the deer had depended, by so much the races of deer declined.

There were other factors at work, but the direct antagonism between sheep and deer, due to their subsistence on the same food supply, had a share in that gradual restriction of the haunts of deer which can be traced onwards from prehistoric days. The details

of this process are too many to mention (they will be found in the writer's account of the Influence of Man on Animal Life in Scotland, shortly to be published by the Cambridge University Press); the main steps are sufficient illustration. At the coming of man deer ranged throughout the whole land, from shore to shore; by the middle ages they had been driven from the Lowland sea-board and in the south country were congregated in the Southern Uplands, especially in the great Ettrick Forest; by the end of the sixteenth century, in the early half of which the example of King James V. had given a new stimulus to sheep-breeding in the south, Red Deer and Roe, the last survivors in Scotland of the race of deer, had been altogether or all but driven from their last strongholds in the Scottish Lowlands.

Elsewhere in Scotland, concurrent with the extension of sheep-rearing, the same fate of gradual restriction of range has befallen the Red Deer, the latest example being cited in *The Field* of 25th Jan. 1919, where, in discussing the new sheep runs at Kintail, a writer alleges that "the amenities of sheep-grazing drove the deer first to the tops and then on to other ground, where sheep and shepherds—not to speak of sheep dogs—are not continually disturbing them." There is nothing unlikely or surprising in the statement; this has been the inevitable fate of deer since, away in the mists of time, man first decided on the introduction of the alien, sheep, to the pasture lands of Scotland.

But it is not only the larger members of the wild fauna that have been directly influenced by the advent of sheep, nor does the influence always tend to restriction of numbers and of range. Take, for example, the case of the Green-bottle Fly, *Lucilia sericata*, the parent of the destructive sheep-maggots. The female fly has adopted the practice of laying her eggs about the hind quarters of a sheep, into the muscles of which the maggots burrow after hatching, causing the sheep extreme torture, and reducing it, if neglected, to a pitiful condition of health or even to death. It is possible that the coming of sheep, by affording to the fly a new and easy means of livelihood, actually changed the habits of this pest, for its relatives deposit their eggs not on a living body but on carrion. However that may be, it is certain, from evidence gathered by Dr. Stewart Macdougall, that the extension of sheep-rearing has caused an increase in the numbers of the Green-bottle, and has greatly increased the area over which its ravages spread. This has been especially marked in high hill pastures which, now badly affected, were, according to the consensus of opinion of sheep-breeders, almost immune until recent years. The same effect has been noted in Australia, especially in New South Wales, where the extension of the range of the Green-bottle has been particularly marked of late, and where the damage caused to stock on the sheep ranges has led to the development of energetic measures for the repression of the pest.

These illustrative examples indicate the two directions in which sheep have directly influenced Scottish animal life; the indirect influence of sheep-rearing is more subtle in its workings, and leads one deeper and deeper into the maze of action and interaction which ends in the "balance of nature." To follow any of the

trails of this interference with wild life to its end would be tedious; only a few typical first stages can be cited.

I have shown that sheep played their part in the transformation of the surface features of Scotland. This transformation reacted on the animal inhabitants of the areas concerned. The destruction of the forest (sheep were only one of the factors involved) led to the decrease or disappearance of forest-loving animals: we have definite evidence of the total or almost total extinction of such birds as the Capercailzie and the Great Spotted Woodpecker, and of the Squirrel; but many smaller creatures must have shared in the fate of these denizens of the woods. Marsh and moorland were transformed into pasture, and the birds and other creatures of the swamps and the wastes were displaced in favour of the frequenters of grass-lands. But more striking results followed the introduction of domestic stock and especially of sheep, for the roving flocks were not easily guarded, and their safety could be insured only by the destruction of the wild beasts and birds of rapine which made of them their prey. The old writers were at no pains to hide their detestation of the hordes of wolves and foxes which in wilder conditions exacted a heavy toll from the flocks; Boece wrote in the early half of the sixteenth century, "The wolffis ar richt noisum to the tame bestiall in all partis of Scotland; except ane part thairof namit Glenmores, in quhilk the tame bestiall gettis litill dammage of wild bestiall, speciallie of toddis [foxes]", and not many years later Bishop Leslie testified that in Scotland there were "nocht few, ye contraire, verie mony and maist cruel wolfes, cheiflie in our North country, quhair invade thay scheip, oxne, ye and horse." So the wolves and foxes had of necessity to disappear before the invasion of the sheep; but while foxes are still represented, although by a sorry band compared with their former hordes, the wolves were long since altogether wiped out, yet not before many fine woods had been destroyed to deprive them of their last secluded places of retreat.

The same fate befel the greater birds of prey. Martin wrote of the Golden Eagle in 1703, "The Eagles are very destructive to the Fawns and Lambs, especially the black [*i.e.* the "Golden"] Eagle"; and as a consequence only a scattered rear-guard of the great eagle hosts of bygone days remains. The White tailed or Sea Eagle suffered even more at the hands of the protectors of sheep; but its destructiveness was a byword along the shores where it bred. In 1701 Brand, in his description of Orkney and Shetland, wrote: "There are also many Eagles, which do great prejudice and hurt to the Country; for the Lambs they will lift up in their Claws, and take them whole to their Nests, and falling down upon the sheep, they . . . first pick out their eyes, and then use the Carcases as they please"; and in 1774 Low wrote, "Eagles from the neighbouring isle frequent this much and make great havoc among the lambs." And on this account the White-tailed Eagle has now been exterminated in Scotland.

Such illustrations as these, gathered from a mass of available evidence, give a hint of the trend which sheep-rearing has taken in modifying wild nature in Scotland. Other influences, however, have been at work tending in the same directions, so that it is

impossible to state precisely the extent to which any ultimate effect is due to sheep and sheep alone. On the other hand it must not be forgotten that the examples given are only the more or less patent surface indications of an influence which for centuries has been penetrating deeper and deeper into the native conditions of the country, until its ultimate effects have been lost in the intricacies of the "web of life."

FORESTRY AND HILL FARMS.

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ANY increase of the forest area in Britain necessitates that new land must be found outside the woods and forests now standing or recently felled. If large areas are to be secured, it must for the most part be from hill country which is now occupied by moors for sport and by hill farms for grazing sheep and cattle. It is generally admitted that the new forests must go on to cheap land. A recent calculation shows that in very favourable situations rents up to 18s. per acre may be secured from forestry. As a general rule, however, where rents are over 7s. per acre, the utilisation of the land is such that it should not be taken over for forestry even although a slightly higher annual rent might be expected from trees. When the rent falls below 5s. per acre, forestry may hope to compete favourably, and every shilling below this means a greater chance of success. Such rents are to be found almost only on the hill farms with little or no arable land. Farms of this kind occupy nearly two-thirds of Scotland, whereas the arable land is only 25 per cent. and woodlands about 4½ per cent. It would thus be unwise to take over the arable land while there is so much non-arable land available for forestry.

As an increased supply of home-grown timber is an urgent necessity for national economy, and sheep farming is an important industry, our attempt is to present without bias some considerations on forestry in the hill farm country.

The Hill Farm.—In a country of hills and valleys like Scotland, the hill farms may be described as consisting of three main parts:—the low valley ground, the intermediate slopes, and the outlying hill-tops. The valley bottoms, haughs or infalls consist of the greener grassy herbage along the banks of the larger streams. Here or on a neighbouring slope will be the farm or shepherd's house, surrounded by enclosed fields with arable land (if any), meadows and grass-parks. The slopes extend from the valleys upwards to the tops, and they are occupied with herbage varying from heather on brown hills to mixed grasses on the green hills. Also on the slopes there will be streamlets or burns, and flushes or "green gairs" from springs.

These are important items on a grazing, for the better water supply means a fresh green herbage much frequented by sheep, especially in early spring or in a summer drought. The tops

may be steep summits with short herbage, but they are often flat and rolling, and if broad they almost always carry peat with cotton-sedge ("draw moss"), heather, blaeberry and other peat plants.

These three parts together make a hill farm, but they are not all of the same value. The centre of the farm is the valley infalls and enclosed land so essential for wintering stock. The hay, corn and turnips grown here are the winter fodder required when the stock are kept off the hills by snow, and for any cattle wintered indoors. A certain amount of hill hay may be secured, but this cannot replace the "in-bye" land, the extent and produce of which determine how many stock can be wintered at home, and how many must be sold or wintered away. From the forester's point of view the valley land is valuable because there is greater shelter and the soil is generally deeper and better. On the other hand, few foresters would select old arable land if land that had never been ploughed could be got. The low ground is more adapted for slow-growing hard woods, and does not suit the more productive conifers, because on old tilled land these become affected by a root-rot which decreases the rate of growth and destroys the timber.

The outlying hill-tops have little to tempt the forester. They are generally exposed and wind-swept, and if flat there is generally peat, which is not favourable to many trees. For the sheep farmer the tops may be a valuable part of the holding. If there is upland peat and heather within easy reach, as is often the case in the South of Scotland, and if the stock can be quickly collected into shelter, then the "draw moss" and heather of the peaty tops form an important herbage from February onwards. The hill-tops are less useful when they lie far out, are difficult of access and not easily herded.

The compromise between forestry and hill farming is to plant the slopes that lie above the valley bottoms and below the tops. These slopes include much ground suitable for coniferous trees (Pine, Larch, Spruce), with or without hardwoods on the lower slopes. Successful plantations on these slopes may be seen in many parts of Scotland. It must, however, be admitted that, while in some cases the presence of trees on the valley slopes might improve the conditions on the tops, as a rule the forest belt would tend to isolate the high ground, so that it could be used only by a "flying stock" grazed during the summer months only.

This brief survey arrives at the same conclusion as has already been advocated by Lord Lovat and General Stirling of Keir.[1] The report is specially valuable because it deals with a definite area—Glen Mor—which the authors discuss with complete knowledge of the problems and possibilities of the Western Highlands. It includes the important subjects of rents and rates, tenure of land and details of finance. These items vary so much from place to place that they are not dealt with here, but they will require careful consideration for each area which it is proposed to put under forests.

The scheme of afforestation in the Lovat report was prepared with such full consideration of the hill farms that we take the

[1] "Afforestation in Scotland." Published by the Royal Scottish Arboricultural Society, Edinburgh, 1911.

liberty of quoting parts of it. "Wintering" is regarded as "the all-important question on which hill-farming and silviculture in the Highlands depend." "It is not difficult to see that ground under 1200 feet—the only ground which can be planted, and the only ground which can maintain stock in winter—has not only a value of its own for feeding, but has an even greater value as the sole means by which the great expanse of high ground can be placed in a position to feed a summer stock." The general principles given include two directly bearing on our topic:—"That sheep ground and sporting land should be planted so as least to interfere with their existing uses and rental values"; "that no arable land should be planted," and that if it is necessary to take certain farms, the enclosed land is to be made into small holdings for the forest workers.

The scheme of forestry advocated is to plant the area gradually, and after the trees are old enough to allow sheep to winter in the woods. One plan is that one-third of the wintering is to be afforested, so much each year, and no further ground is to be taken from the farm until after the ewe stock has been allowed to winter once again in the planted area. This means that two-thirds of the wintering ground is to be left untouched for about 15 to 20 years, but the planting is spread over 15 years, and as each year's planting becomes ready, the sheep are to be allowed to enter the woods in winter for grazing and shelter. Referring to other parts of Scotland the authors say:—"There are throughout the length and breadth of Scotland tracts of what might be called 'average sheep land,' rented at from 9d. to 2s. per acre, which could be planted with advantage on a method exactly the same as that advised for deer forests." The authors' advice is sound when they add:—"That the Forest Authority should approach the sheep-farming problems with caution, and should be aided by the best expert advice."

The proposal to admit sheep to woods about 20 years old has been much discussed since the report was published. The forester has expressed doubts as to damage to trees and the possibility of under-planting. The sheep-farmer may also doubt the advisability of grazing under coniferous trees. The advantages of shelter would be set off by difficulty in herding, and even the best herbage under trees cannot compare with that on the open hill.

Assuming that a considerable part of the forestry of the future will find a home on the valley slopes of hilly country, it remains to be considered how the afforestation can best be carried out. The possible methods may be grouped as follows:—Shelter belts, woods of 50 to 100 acres, forests of 1000 acres or more.

Shelter Belts.—It is generally recognised that these are a considerable advantage on a hill farm. Recently we have heard many discussions on raising more cattle on hill farms, and there is a very unanimous opinion that cattle cannot be wintered or partially wintered out of doors in higher districts without shelter, and that if more shelter were available more cattle could be raised. The sheep farmer is not quite so hopeful, because though woods afford shelter from wind and rain, the trees and the increased

number of fences and walls may hold snow and cause drifting where sheep are sheltering.

The purpose of shelter belts is to break up an exposed area so that the fields are more or less surrounded by trees. The tree belts may be wide, but generally they are only a few trees broad, and if so they cannot be regarded as a serious attempt at forestry. The trees conform more to the character of the marginal trees in plantations; they have less growth in height, are much branched, and have a low commercial value. Under modern systems of close planting and careful attention, some timber may be obtained from the wider shelter belts, and it is worthy of consideration whether in many cases wider belts would not prove more effective than narrow ones. Wide belts would use more land but they would produce taller trees, thus creating shelter to a greater distance from the belt. The improved timber is an advantage, but the system is not economical forestry Shelter belts are therefore of more value to the grazier than to the forester. Where there are shelter belts between the hill and the lower ground, the land higher up the slopes can be enclosed. In many valleys there is little or no meadow or grassland above the flat river haughs, but where one passes an estate with shelter belts, there the enclosed land lies up on the lower slopes, sometimes to considerable altitudes. The herbage of the upper fields is generally better and more abundant where there are shelter belts. This is partly the result of shelter, partly the effect of better fencing.

Woods.—The success of a forestry scheme depends much on having the trees together in as large blocks as possible. Fencing is always expensive, at no time more so than at present, and all margins of woods must be kept as short as possible. Large woods produce more timber per acre, and there is less wastage from exposed margins. No elaborate calculation is required to prove that there is much less margin or outer edge in a block of 100 acres than on ten small blocks of 10 acres each. Larger solid blocks are also more economical to work. A square block of 640 acres (1 sq. mile) means that workers need not be far from their work, only a few miles of main roads are needed, and that nurseries, saw mill and light railway may be all within a couple of miles of the growing trees. If the same acreage of timber is scattered over an estate of 10 square miles, the distances are multiplied many times. If timber is to be grown as cheaply as possible—and the hill farmer is as much in need of cheap timber as any one—then the forester must have facilities to produce that timber. In any State scheme of forestry, it may be assumed that the forest areas will be made as large as possible. It will probably be necessary to provide housing for the workers, and it is more economical to make a village, and all that goes to make a village, for a larger number than for a smaller. The whole scheme of planting, maintenance and timber production should provide work for the whole year, and this entails a large area of timber of all ages.

The ideal timber forest should be as large and as compact as possible. On the other hand there are limitations to the size of woods. The forester cannot use the high ground, because trees can

be planted only up to the "wind-line." This averages about 1000 feet altitude, but it varies considerably with the topography of the country. In many parts of south-western Scotland trees become wind-swept and of little value at about 400 to 500 feet, whereas in a complex of high hills, such as Speyside and Deeside, trees thrive up to 2000 feet altitude. If large blocks of timber were planted between the lower valley ground and the higher tops, these would be separated, and neither would be so useful. There is thus room for discussion whether the woods should be laid out in smaller blocks, say 50 to 100 acres, or larger ones, say 1000 to 2000 acres each.

The smaller plantations will find more favour amongst stock-farmers. By means of carefully planned smaller woods it should be possible to combine forestry and some of the advantages of shelter belts. The march between two farms suggests itself as a possible place, and the middle slopes of some of the larger farms could furnish one or two blocks of 50 acres without much loss in grazing to the farm. A system of smaller woods is probably better suited to the working of an estate than to the needs of a State scheme of forestry. Woods of this class are covers for game, and they supply home-grown timber required for many purposes on the estate. The farmers would benefit through better maintenance of buildings and fences. The question of keeping foresters employed is not such a difficult one on estates with small woods in conjunction with farms, as it would be with a forest authority having a number of small woods and no farms, The greater the aggregate area of the woods, then the more labour must be employed, and this directly and indirectly would assist the hill farmers. There is need at the present time for men who can repair walls and fences, make drains, and in other ways assist in the improvement of hill pastures. This is work which could be done by some of the men required at certain seasons for forestry work.

The Larger Forests.—The establishment of large forest areas would probably mean that entire sheep farms would be purchased or otherwise secured for forestry. Any rent obtained from summering stock on the higher ground or wintering on the lower ground would be supplementary. This has been a frequent experience in connection with urban water supplies. The conversion of a valley into a reservoir puts at least one farm out of action, so that it cannot be properly developed, and the rent suffers accordingly. Some water schemes in the north of England have in this way converted areas of mixed upland farms into hill grazings, with restrictions as to stocking near the reservoirs and larger streams. It is because of these conditions that there is a movement to encourage city corporations to afforest their water-gathering grounds.

That the provision of 1000 acres of land for tree-planting will generally mean taking over a whole farm is evident. The following figures are available for the counties of Peebles, Selkirk, Roxburgh, with Ewes Water and Eskdale in Dumfries. There are about 300 farms with over 500 acres of hill land:—66 per cent. of these are less than 2000 acres, 25 per cent. are between 2000 and 4000, and

9 per cent. are over 4000 acres. Hence in this part of Scotland, favourable for afforestation since it is nowhere very high, there is no great choice except to take over a whole farm of 2000 acres, or such large tracts from the larger farms that the whole system would require to be changed. In the Highlands there are more large farms, but the proportion of hill top land above the tree line is also greater. Whereas in a southern farm it may be possible to plant a large proportion, say three-fourths, it is the case on many north country farms that only one-fourth can be utilised for trees.

A large forest for timber would involve some encroachment on the low valley ground. The forester prefers to begin planting fairly low, and to build gradually towards the higher altitudes. There would also be provision for housing for workers, and any gardens or cultivated land for them should be on the enclosed land of the farm. The working buildings would form the railhead, and for transport the easy access offered by a low valley would be essential. A valley like Talla and some neighbouring ones on the Tweed would thus offer great facilities. Throughout Scotland there are many such valleys which at present carry little or no arable land, so that afforestation need not encroach much on the arable area.

The effect of any scheme of forestry on grazing will depend to some extent on the period taken to plant the area, the species of tree used, and the time when stock can be allowed among the trees. If the whole area were planted rapidly, there would need to be a great reduction of the stock, and in some cases the top land might be isolated unless the tops could be included with farms in neighbouring glens. If, however, the area were planted at such a rate that a considerable part of it could be opened for grazing before the whole were planted, then the reduction in stock might be diminished. The time when woods might be opened depends on the trees planted. Woods of what the forester calls "light demanding trees" would be available for grazing first. Larch is probably the best from the grazier's point of view. The canopy of larch woods opens early, and as it is light in the foliage, it allows a fairly dense herbage to spring up beneath it. Unfortunately larch is liable to disease, so that it is limited to small woods in favourable situations. Scots Pine in woods opens its canopy only after middle age, and during the earlier years little or no herbage grows beneath it. Birch is the best of the broad-leaved trees for undergrowth. Elm, ash and oak favour undergrowth, but in the hill forests the acreage of these will rarely be extensive. Generally speaking, there would require to be a reduction of the grazing stock during the earlier years of a forest scheme, but later, as the woods opened up, there could be a gradual increase and a certain amount of income from grazing.

The Lovat report gives as the first duty of a central forest authority the provision of a survey to include a broad investigation of the silvicultural possibilities of each part of the country. This is to be accompanied by a detailed consideration of all the economic conditions of any area selected for forestry. This recommendation has borne fruit, and there is now available a survey on these lines for many parts of Scotland. Such a survey has many possibilities in selecting centres suitable for forestry, but

less suitable for stock-farming. It would be a distinct gain if unhealthy sheep areas could be utilised for forestry. The hill country includes groups of farms with a high death rate, and where the stock carried is low. Such farms are generally low rented. Several could be named that are not far from existing railways, and are near successful timber-producing woodlands.

The problem of utilising hill ground for forestry is an intricate one, but it can be solved if properly dealt with. Afforestation need not greatly affect the existing utilisation of the hills by stock-grazing, and what it takes in one way it can compensate for by providing material and men for more intensive utilisation of the hill country.

RURAL ECONOMY OF FRANCE.

(*Continued.*)

H. M. CONACHER.

WE have so far dealt with the other great river basins of France—the Seine-Marne basin remains; and the upland regions such as the central plateau, the Pyrenees, and the high ground on the Eastern border, Alps, Jura, Vosges, as well as the peninsula of Brittany and the North, including the Somme valley, and the upper parts of the valleys of the Flemish rivers, which are in French Flanders, stand outside the scheme of the main river basins.

The Seine-Marne valley, apart from its natural agricultural character, includes the capital, and the industrial area, of which Rouen is the centre, as well as the Port of Havre. These three centres do not make a continuous whole, but there is a good deal of connection among them, and, apart from providing markets for the agricultural produce of the Seine basin, they exercise a general influence over the agriculture greater than that of Lyons and Marseilles in the Rhone valley.

The whole area is distributed among the old provinces of Normandy, the Île de France, and Champagne. Normandy of course includes more than the lower valley of the Seine. The departments of the Manche—the peninsula, the west coast of which from Mont St. Michel to Cap de la Hogue makes a right angle with the north coast of Brittany—of the Orne and Calvados, which marches with the eastern border of the rectangle of La Manche, for the most part lie outside it, excepting the part of Calvados which includes the coast line, including Caen, Trouville and Honfleur, which may be said to lie on the south of the "Embouchure" of the Seine.

This division of Normandy for our purposes must be noted, as some of the parts of Normandy which are most devoted to cattle raising—which is one of its most important branches of agriculture—lie outside our area. The Lower Seine then includes the two Normandy Departments of the Eure and Seine Inférieure, which, for the most part, lie on its south and north banks respectively.

The Île de France—centre of the realm of mediæval France just as was Brandenburg of the modern kingdom of Prussia, though at times in the Hundred Years' War the centre was shifted to

Orleans and Bourges, just as after Jena the Prussian Court left Berlin for Königsberg—includes the Departments of the Seine-et-Oise lying about both sides of the river Seine, and containing more than half of the country between Paris and Rouen, together with Paris and the small Department of the Seine—which bears a relation to Paris comparable to that of the County of London and the London Postal Area to the cities of London and Westminster, but is not yet as thoroughly suburbanised as the so-called greater London, or the Lower Ward of Lanark to Glasgow—the Seine-et-Marne lying immediately East of the Seine-et-Oise and having the Marne in its more Northern and the Seine in its more Southern portion, and the two more Northern Departments of the Oise and the Aisne.

These two Departments contain names which are very vivid in our memories. The Western part of the Department of the Oise round Beauvais, its chef-lieu, lay outside the fighting; but the valley of the river Oise, which rises just over the Belgian frontier near the so-called Trouée de Chimay and flows South-West through the North-West part of the Department of the Aisne and the South-East of the Department of the Oise, finally joining the Seine about thirty miles west of Paris, gives a line of advance on Paris from the north-east comparable to that of the Marne from the direct east.

These things are reflected in railway communications—and though there is nothing quite like the fidelity with which the main line of the Est clings to the valley of the Marne, still the main line from Paris to Maubeuge, which is part of the international line from Paris to Charleroi, Namur, Liège and Cologne, besides giving a connection with Brussels at the Franco-Belgian frontier, keeps fairly near to the valley of the Oise in the Department of the Oisé, and somewhat to the left of the line of the river in the Department of the Aisne, as it goes through St. Quentin and Le Cateau.

Similarly the line from Paris to Hirson and Mézières through Soissons and Laon keeps east of the Oise, but on the whole roughly parallel to it for the greater part of its course. Anyhow, on or near the actual river are such places as Guise, Chauny, Compiègne, Senlis and Pontoise, which seemed to be coming within the war zone at the first German irruption in 1914, just as Compiègne did last year. The Aisne Department, besides including the Upper Oise Valley, is cut through by the Aisne from a point North of Rheims to half way between Soissons and Compiègne, where it joins the Oise. It is a long stretch of territory North and South touching the Belgian frontier at one point and extending South of the Marne near Chateau Thierry.

The province of Champagne includes the Departments of the Marne, the Aube, the Haute Marne, and the Ardennes.

The Department of the Marne is the most important of these, and includes Châlons-sur-Marne and Reims, its chef-lieu. The Departments of the Ardennes (which includes a portion of the Upper Aisne) and of the Aube, through which the Aube and the Seine run parallel, lie north and south of the Department of the Marne, while the Haute Marne lies south-west of the Marne and the Aube and slopes up to the Plateau of Langres.

This high ground is a connecting link between the western extension of the Vosges and the Burgundian hills of the Côte d'Or. In it rises the Marne, just as the Seine rises to the south-west in the Côte d'Or hills. This ridge of high land is an important watershed, as it divides the valleys of the Saône and Doubs from the Seine-Marne system. It may be said to be one of the ramparts of the older France as distinct from Burgundy, but in modern times the strategic frontier is further east, and the Trou de Belfort is the "key" to this side of France.

The axis of the river system with which we are immediately concerned may be said to be a line drawn from Langres through Troyes and along the south side of Paris to le Havre. Three-fifths of that line will lie between Langres and Paris and the rest between Paris and le Havre-Troyes on the Seine, and the chef-lieu of the Department of the Aube will lie about half way between Langres and Paris. The town may be known to British travellers as being the "first stop" from Paris by expresses going on the more Southern main line of the Est, which makes for Switzerland by way of the Upper Marne, Upper Saône and Belfort. It is 103¾ miles from Paris, and some of the fastest trains did the run in less than two hours before the war—which shows that fast trains did run in France and not only on the Nord line.

The Langres-Troyes-Paris-Havre axis line would on the whole be in contact with the Seine over the greater part of its course, which is thus seen, in spite of its wriggling curves between Paris and its estuary, to maintain a definite direction as much as most rivers that do not flow over a dead level. The greater part of the area included in the basin would lie north of that line, and most of the tributaries, the Aube, the Marne, the Aisne-Oise, flow in on that side, the Yonne and the Eure coming in at a wide distance apart on the south.

The two Norman Departments of the Lower Seine and Eure have a certain amount in common. They are both areas which contain a considerable number of what are for France relatively large estates. Thus in certain parts of them 200, 250 and 300 acres are taken as the lower limit of grande propriété. A great number of these lands are let out to tenant farmers on lease, and lands thus disposed of are usually farmed better than the smaller holdings. Such farmers do not as a rule acquire holdings of their own. There has been a certain tendency in recent years for owners to resume land and manage it themselves. This practice has grown up among retired manufacturers and merchants from the large towns in the area.

The difficulty of getting hired labour does not seem to be less here than in most parts of France. In the Eure, in order to keep labourers in the country, employers have founded an Association, which lets small gardens to them, Mutual Benefit Societies, and a system of pensions—but all in vain. If it were not for squads of Bretons and Flemings, the cultivation of beet root in the Vexin (the district round Andelys on the Seine east of the river but in the Department of the Eure) would be impossible. But even these unsophisticated Bretons and Flemings, it appears, "se font rares et exigeants."

The Eure shews a considerable diversity in its kinds of farming, viz.: the cultivation of ordinary cereal crops, roots, forage crops, sugar beet, flax and colza, orchards, fruits and vegetables, and dairying, breeding of cattle, horses, sheep (in one district) and fattening of calves.

In both Departments the existence of a considerable town population as well as the relative nearness of Paris encourages dairying and market gardening.

One could, however, scarcely do justice to these Norman Departments without mentioning their great speciality, the Norman breed of cattle—and for this purpose it is necessary to associate with them the two Western Norman Departments of Calvados and La Manche. In the Lower Seine good pasture lands are worth £40 an acre, which is higher than the value of arable, and but little lower than that of more intensively cultivated ground. As a cattle raising country one might compare Normandy with the Western counties of England, Somerset, Devon and Hereford. The Norman breed, however, while far from being a pure dairy breed like the Ayrshire, is valuable for its milk-yielding qualities. In 1914 it is said that there were about 1,800,000 cattle, exclusive of calves under six months, in France, mostly in Normandy, but also spread over other districts, all of this breed.

The figures for the five Norman Departments were:—

Manche	.	340,000
Calvados	...	260,000
Orne ...	..	216,000
Eure ...	...	137,000
Seine Inférieure		320,000

The Norman breed has also found its way into the centre, north-east and north-west of France.

To quote from a report by M. de Lapparent, Inspector General of Agriculture,—"In following the Norman breed into the different parts of this wide territory (a list of Departments being given), to which should be added different districts, where numbers of them are being introduced every day either to provide milk for the 'creameries,' which are multiplying, *e.g.* in La Vendée and the two Charentes, or to feed the large towns as far south as the coast of the Mediterranean, we must take into account that its area of expansion is still likely to extend in the centre and in the west, wherever the dairying industry is of importance, in proportion as agriculture improves and the production of roots and forage crops gains in quantity and quality. This expansion will be limited only by the requirements of other breeds raised for a different purpose (such as fattening and farm work), or other dairy breeds as good as the Norman, or better suited to the climate or the style of rearing determined by their environment. The explanation of this expansion is that among the chief dairying breeds it is the Norman which least loses its qualities when it is removed from its original home, that it adapts itself best to different types of grazing and stall feeding, that not having too delicate a hide it has less to fear from insect bites, that it can endure relatively high summer

temperatures, and that it makes a good end by fattening well, after producing calves of good quality."

The original home of the Norman breed is to be found in the Departments of La Manche and Calvados, one variety being called the "Cotentin," from the line of coast of that name which faces westwards towards the Channel Isles. In recent years great progress has also been made in the improvement of the breed in the Department of the Lower Seine, so that breeders from that region often compete successfully at shows with those from La Manche.

According to an earlier writer the breed is of a "bay" colour, as the French call it, with brown or black streaks or marbling. The height varies so that we are told that some writers distinguish between two breeds—one for beef, which is the bigger, and a slighter breed for dairying. The validity of this distinction, however, is disputed. The head is long and the horns short, tending to curve inwards. The body is long, but the build is not in appearance over massive; the limbs are short. They have big frames. The line of the back is not straight and often dips in a saddle. The haunches are close and the hind-quarters relatively light. The skin is tough rather than fine. The growth is slow and maturity late, as in all breeds that live very much under natural conditions and not interfered with by civilisation.

In quoting from the writer in an encyclopædia, who gives this description, M. Lapparent remarks that civilisation has intervened at one time (in the earlier half of the nineteenth century) in the direction of crossing the Norman breed with Durham (*i.e.* presumably English shorthorn) blood, so much so that there has been a reaction, and the local associations have decided to try to secure improvements by the "in and in" method, fearing a generation back that the breed would lose some of its distinctive character and its milk yielding capacity.

Apparently what has been aimed at is the creation of a breed of double utility. In any case it appears established that by one method or the other considerable improvements have been made in the dominant type. Bulls are not used until they are fourteen or fifteen months old, and kept on till the age of three or later. The establishment of shows has helped towards this end. Special shows instituted by the State are held in the five Norman Departments. At the time when a reaction from the crossing with Shorthorns was setting in, it was decided to start a herd book for the breed. This was done in 1884, and was the first (for cattle?) in France.

By the end of December 1909 530 bulls and 1770 cows had been registered. The smaller breeders have tended to fall away from registration, but the larger establishments have their stocks still registered. M. Lapparent observes with reference to the evolution of the breed:

"L'accroissement constant de l'industrie laitière et de la production des élèves destinés à la vente et l'accentuation de la faveur accordée aux bœufs précoces de croisement durham ont porté à diminuer progressivement l'élevage des bouvillons (bullocks). D'autre part, la précocité plus grande obtenue par l'amélioration des reproducteurs et par celle de la nourriture dans le jeune âge a

fait renoncer de plus en plus à soumettre au joug ceux qu'on élève. Il y a une quarantaine d'années que les bœufs ne travaillent plus dans le Cotentin, trente ans dans le Val-de-Seine, vingt-cinq ans dans les arrondissements de Cherbourg et de Valognes. . . La statistique n'indique que 12,000 bœufs de travail pour la Manche, alors que les existences de bouvillons au dessus d'un an sont portées a 35,000. Dans le Calvados on n'emploie aucunement les bœufs au travail et on y élève cependant 15,000 bouvillons."

In this connection it must be kept in view that in France, with its large consumption of veal, there is not the same divergence between dairying and meat producing as with us. Calves are killed at the age of three or five months. All calves, whether intended for breeding or fattening, are not allowed to suckle, but are fed from the pail with "lait complet" for a fortnight or month, and thereafter with skim milk and farinaceous food, if they are meant for the butcher. It is curious that in the coast district of Avranches (which looks towards Mont St. Michel) the shorthorn blood seems to have left more marked effects than elsewhere. The soil of that region yields good pastures suitable for fattening.

The concentration on one branch of the industry or another is marked in different districts. Thus in the district just south of the mouth of the Seine with Lisieux as its centre there is a considerable production of cheese, the well known kinds of Camembert and Pont l'Evêque being made in this region. Calves are commonly sold here a week or a fortnight old. Further south again, in the Department of the Orne (still in Normandy), the fattening of calves, sold at three months for the Paris market, is common. They get barley meal and eggs as well as milk. The raising of heifers, native and imported, is also done in parts of the Orne. They are sold largely to merchants, who take them into the more distant districts, which import Norman breeding cows. The Department of the Eure offers similar examples of the distribution of agricultural industry. Three zones have been distinguished—

(1) in which the distance from Paris allows the export of fresh milk;
(2) the pastoral zone at the west of the Department, which favours breeding and the feeding of bullocks;
(3) a middle region, mainly arable, also devoted to various forms of dairying.

The district of Caux in the Seine Inférieure is recognised by agriculturists as having a distinct character of its own. It is roughly a triangle, lying within lines drawn so as to connect the three towns of Havre, Dieppe and Rouen. This district possessed formerly a distinct variety of the Norman breed, called after it, but at present only about one-thirtieth of the cattle stock of the district belong thereto.

Apparently the Caux agriculturists introduced shorthorn blood with a view to securing a "dual utility" breed. One of the leading men who went in for crossing said—"The crossing was perhaps pushed rather too far, and the trade complained that the beasts were too fat. On the other hand, as the breeders were getting too

little milk (from the mixed strain), they gave up crossing with the Durham and substituted the Cotentin."

This change happened about 1880. The shorthorn blood, however, seems to have left a lasting impression. In time, however, the effect seems to be a diminution in the yield of milk. So the breeders gradually gave up using shorthorn bulls. The practice, however, seems to have had indirectly a good influence. It put the breeders in the way of trying to improve their breeds; and when the shorthorn was found to be not an unmixed success, they turned to a more careful selection of Norman bulls, and this process achieved a good deal of success.

The greater part of the bullocks fattened in the Department of the Seine Inférieure are to be found in the Caux district. They are usually fattened by the actual breeders, partly reared, and stall fed towards the end of the process, being sold at the age of three years. The Bray district of the Department, where different forms of the dairying industry have always been important, kept clear of the fashion of crossing with shorthorns. The breed of the district is kept going by a steady import of bulls from the Cotentin.

The Seine-et-Oise and the Seine-et-Marne may be taken more or less together, including an area which has Paris for its market. Perhaps on the whole the value of the soil is a little greater in the former Department. Arable lands in each go up to 3500 francs the hectare, which is £56 an acre, natural meadows up to 5000 francs the hectare in the Seine-et-Oise and up to 3000 in the Seine-et-Marne, and then only in the district of Melun (near Fontainbleau), and market gardens and similar land up to 4000 to 5000 francs the hectare in both Departments. In both Departments there is a fair number of relatively large properties, viz., round 375 acres in the Seine-et-Oise and 200 acres in the Seine-et-Marne, which are usually let to farmers according to a practice of long standing in the former Department, and these farmers apparently do not seek to purchase land. There is the usual difficulty of getting labour. The small proprietor in the Seine-et-Oise is described as "independent," as if economic dependence were a *sine qua non* of the capitalist system. Hence labour is done by "nomads." In the Seine-et-Marne they come from the Nièvre and the Seine-et-Loire, or even from Belgium.

The vine is cultivated to a small extent in these Departments. The reporter to the Ministry of Agriculture on the Seine-et-Oise distinguishes between districts of grande culture and petite culture. In the former the occupiers of small holdings are at a disadvantage with those of large holdings in respect of means of production,—*i.e.* not merely in regard to agricultural machinery, but also in regard to working capital and the use of "artificials." "Le petit exploitant est resté trop longtemps à l'écart du progrès de l'agriculture moderne; l'effet de cette negligence routinière se fait sentir aujourd'hui, et la supériorité de la main-d'œuvre de la petite exploitation ne suffit pas à effacer son infériorité productive. Cette infériorité productive se complique, d'ailleurs, de l'infériorité des résultats économiques obtenus."

In another connection he notes that the main purchaser of land, apart from residents in Paris who buy to build a house with a

garden, is the small owner. "Celui-là va jusqu'à entamer son capital d'exploitation pour arrondir son petit domaine."

Similarly in the Seine-et-Marne—"L'outillage agricole a pris un développement considérable dans les moyennes et les grandes exploitations. Dans beaucoup de cas, la moyenne culture possède l'outillage proportionellement le plus important. La grande culture est généralement seule à posséder une batteuse; la moyenne comme la petite, d'ailleurs, a recours à des entrepreneurs de battage. La petite exploitation se trouve, sous le rapport du matériel, dans un état de très grande infériorité."

In spite of this, however, in the Seine-et-Marne the small man seems to hold his own rather better than in the other Department. He has sufficient capital. He uses chemical manures. "Les résultats économiques qu'il obtient, produit brut et produit net, sont supérieurs à ceux obtenus par le grand exploitant. Les petits et les moyens cultivateurs achètent de la terre toutes les fois qu'il y en a à vendre, et la payent presque toujours comptant."

In both Departments the dairying industry is mainly occupied with the production of sweet milk—hence there is not much room for modern dairy utensils. In some parts, however, cheese is made.

In the Seine-et-Marne the price of land has gone up in the canton south of Melun. This is due to the rise in the value of sporting rights. Fairly large estates devoted mainly to sport are also noted in the districts of Melun South-East, and Meaux, East of Paris. In this Department the supply of milk for Paris and the making of cheese (especially Brie) are important forms of dairying.

In the Oise, the other Department of the old Île de France, the land seems to be of less value than in the Departments nearer the Seine There is a fair number of relatively large holdings, viz., over 250 acres, and letting to farmers is quite customary. There has been some slight tendency to split up the larger holdings into moderate sized ones; while the small holdings have remained stationary in some districts, but in others have been consolidated, so that moderate sized holdings have gained at the expense of large and small. The fall in the birth rate is given as the cause of this movement, so far as affecting small holdings. Rural labourers are fairly well off, but show little disposition to buy land.

There has been great improvement in the character of the machinery used in all classes of holdings. The small holder is, however, at a disadvantage with the large in this respect. He seems to hold his own best in the district of Noyon and in the actual valley of the Oise, where the land is lower.

The north-west part of the Department is called the Plateau of Picardy and lies north of Beauvais. As is natural from its situation, the Department of the Oise has introduced Norman cattle to a certain extent. It is, however, a meeting ground of several breeds. The Bray district, lying near the district of similar name in the Seine Inférieure, is mainly given over to the Norman breed. North of this district the Norman breed comes into contact with the Picard, and there has been a certain amount of crossing between the two. Dairying is too important here to allow the farmers to specialise in breeding.

South of this region milk for the Paris market is the main concern—and Norman and Dutch cattle are used there, as well as some Flemish and Swiss, according to M. Lapparent. In the Plateau of Picardy Flemish cattle prevail. The south-east of the Department is of fertile soil; large arable farms, given over to beet-root and cereal crops, are the rule. Hence cattle are less common in the south-east of the Department. The clay soil with numerous streams gives good pasture, and a great deal of feeding is done.

The province of Champagne is less productive agriculturally than Normandy or the Île de France. It is of course one of the best known wine-growing districts in France, and a few of the vineyards go up to even the high value of 30,000 francs the hectare or £400 the acre. This is in the Department of the Marne. It may be remembered that there was a dispute some years ago between the representatives of the wine industry and the vine growers in the neighbouring Department of the Aube, on account of what the latter regarded as a disparaging discrimination against their wines.

On the higher ground of the Marne Department sheep farms are common. These are of moderate size. The difficulty of finding trustworthy shepherds apparently checks any tendency towards the consolidation of holdings in this region. Similarly the unpromising character of the chalky soil requires considerable capital to be sunk in the way of improvements before the land repays cultivation. Tenant farmers willing to do this are not numerous. This means that land has to be worked on the whole by its owners, and this again tends to keep down the holdings, which are usually identical with estates, to a moderate size.

Indeed there has been a definite tendency towards the division of larger estates into ones of moderate size and a consolidation of small ones, as being too small units to work with the proper machinery needed for modern farming.

Part of the Aisne may be held to be within the Champagne country—*i.e.* the districts round Soissons and Laon. These districts include a good deal of the vineyard area of Champagne. In the high ground near Soissons large properties are said to have increased owing to the development of sheep breeding, but it is possible that what are here called large may not be greater than the moderate sized farms referred to in the Department of the Marne.

The reporter on the Aisne to the monograph on peasant property, which has been much quoted in these notes, remarks that in the districts where farming has been "industrialised," as indicated apparently by concentration on the growing of sugar beet, one of them, the region round Soissons, is a land of small properties, but of la grande culture—*i.e.* the kind of culture suitable for large holdings. To quote—"Là, cependant, le petit exploitant se trouve encore, malgré les ressources du credit agricole, trop souvent lié au fabricant de sucre qui lui fournit des avances de façon à éviter la surenchère des concurrents possibles pour l'achat des récoltes. La petite culture se maintient parce qu'elle produit elle-même, qu'elle choisit plus judicieusement, qu'elle surveille plus étroitement.

Elle sait adopter les bonnes méthodes de la grand culture; elle connaît l'emploi des engrais chimiques: les constructeurs mettent à sa disposition des instruments agricoles bien appropriés a l'importance de l'exploitation."

In the Department as a whole, holdings are quite commonly let to farmers. The leases are of long duration, which the reporter considers to be adverse to any quick movement of progress or reaction, but, as he observes, one is dealing here with deep rooted local usage. Near Château-Thierry and Soissons farmers buy their farms.

The Department of the Aube is recognised as being capable of division into five agricultural districts. In the "Jurassic" region of the North-West the vine is cultivated. In the "Champagne humide" it is mainly forest and pasture. In the "Champagne crayeuse," a plain extending over nearly half the Department, cereals dominate. The "Nogentais," a small district in the north-west of the Department, "est un pays de grande exploitation de culture industrielle et intensive (betterave sucrière)."

Over the Department as a whole there seems to be observable a tendency similar to that noted in the Marne, whereby small holdings and large alike are being encroached on by those of moderate size.

AGRICULTURAL SEEDS IN 1919.

THE Testing of Seeds Order, 1918, issued by the Ministry of Food, replaced and modified the Testing of Seeds Order, 1917, and requires a statement of the quality of seeds mentioned in the Order in the case of a sale.

The principal modifications introduced into the new Order are as follows:—

(1) The seeds of the various species of Cranesbill (*Geranium spp.*) are added to the list of injurious weed seeds.

(2) The seeds of Sucking Clover (*Trifolium minus* and *T. procumbens*) are excluded from the list of injurious weed seeds, but the percentage by weight of seeds of these species has to be stated, if this percentage is over 2, in samples of White Clover, Wild White Clover and Alsike.

(3) Mixtures are defined as being parcels of seeds which include more than 15 per cent. of seeds mentioned in the Schedules to the Order in addition to the principal kind of seed comprised in the parcel.

(4) Cereals are included among the kinds of seeds in respect of which a declaration as regards germination is required.

(5) Standards of quality (purity and germination) are established for garden vegetable seeds, garden root seeds and the seeds of some forage plants, and also for cereals in respect of germination only.

In the course of the season general licenses were issued as follows:—

(1) To allow of the sale of cereals without immediate declara-

tion of germination provided that the required declaration is given within a month of the delivery of the seeds.

(2) To establish standards of quality for root seeds and seeds of forage crops mentioned in Part III. of the Order.

The full text of the Order incorporated with an explanatory leaflet (Leaflet No. 44) has been issued by the Board of Agriculture for Scotland, and may be had free on application to the Secretary of the Board.

Farmers and others should assist in making the Order effective by seeing that the required declarations are given in the case of every delivery of seed to them, and should verify these declarations by having check tests made of deliveries.

The following account of the results of tests on samples received at the Board's Seed Testing Station is an indication of the general quality of seeds which are being offered this season. The statistics here set out refer to 6500 samples approximately, which have been fully tested previous to the end of March this year. These figures are not necessarily absolute for the season's seeds as other parcels of seeds may yet be put on the market, but it is considered that a very fair idea of the general quality of agricultural seeds available for this spring can be obtained from reference to the tables here given.

The following table indicates the range of quality of the commoner grass and clover seeds in respect of purity as shown by the results of analyses.

TABLE I.—PURITY.

Kind of Seed.	Highest per cent.	Lowest per cent.	Average per cent.	Number per cent. of samples containing over—	
				1 % of Injurious Weeds.	2 % of Suckling Clovers.
Perennial Rye Grass ...	99·9	72·1	97·5	35	...
Italian Rye Grass ...	100·0	87·7	98·3	28	...
Cocksfoot	99·8	71·1	97·0	10	...
Meadow Fescue	99·9	81·1	97·7	58	...
Timothy	99·9	76·3	97·6	0·8	...
Crusted Dogstail ...	99·5	88·0	97·7	2	...
Red Clover	99·9	77·7	96·7	2	...
Alsike	99·6	87·3	97·2	2	...
White Clover	99·3	70·5	93·3	23	6
Wild White Clover ...	99·0	56·4	89·0	9	51
Trefoil	99·9	94·3	98·8	1	...
Mixtures—					
White Clover and Alsike:					
White Clover ...	...	...	37·0	...	...
Alsike	...	...	+58·4	16	...
Perennial and Italian Rye Grass	99·6	83·8	97·5	57	...

The provisions of the Order did not require a statement of purity in the case of the seeds undernoted unless the percentage of purity is under 97.

The following list shows the percentage number of samples of these seeds in which the purity was less than 97 per cent.

	Number per cent. of samples under 97 per cent. purity.
Tares or Vetches	47
Field Turnip	4
Garden Turnip	7
Swede	2
Rape	0
Cabbage	1
Kale	0
Mangel	12
Pea	1·5
Bean	0
Brussels Sprouts	3
Broccoli	0
Cauliflower	6
Carrot	83
Parsnip	28
Beet	14
Onion	1

Table II. sets out the maximum, minimum and average percentages of germination of various species, and the percentages of hard seeds in samples of clover.

TABLE II.—GERMINATION.

	Highest per cent.	Lowest per cent.	Average per cent	Hard Seeds.
Perennial Rye Grass	98	2	81	...
Italian Rye Grass . ..	98	8	78	.
Cocksfoot	97	10	80	.
Meadow Fescue	99	11	86	. .
Timothy	99	3	89	...
Crested Dogstail	96	7	75	.
Red Clover	99	9	87	6
Alsike	100	19	92	8
White Clover	99	10	81	10
Wild White Clover	93	13	76	12
Trefoil	99	28	81	2
Tares	100	74	97	...
Pea, Field	100	87	97	.
Pea, Garden	100	50	59	...
Bean, Field	98	81	93	...
Bean, Broad	100	18	86	...
Bean, Runner	100	50	85	...
*Mangold	192	15	126	...
*Beet	204	58	122	...
Onion	99	27	73	...
Carrot	87	24	68	...
Swede	100	11	85	...
Turnip, Field	100	12	87	...

* The figures for Mangold and Beet refer to the number of germinating shoots from 100 clusters.

TABLE II.—*continued.*

	Highest per cent.	Lowest per cent.	Average per cent.	Hard Seeds.
Turnip, Garden	100	16	79	...
Rape	96	70	87	...
Cabbage	98	37	79	...
Cauliflower	95	60	76	...
Broccoli	95	44	74	...
Brussels Sprouts	97	30	83	..
Parsnip	95	21	69	...
Linseed	98	51	85	...
Oats	100	70	94	...
Wheat	100	66	95	...
Barley	100	84	94	...
Rye	99	91	96	...
Mixtures—				
Perennial and Italian Rye Grass	93	51	78	...
Alsike and White Clover:				
Alsike...	...	...	85	6
White Clover	...	...	83	12

With reference to those species for which a standard of germination is set up by the Order, the following list shows the percentage number of samples of each species which fell below the prescribed standard.

Kind of Seed.	*Standard of Germination.*	*Number per cent. of samples below prescribed standard.*
Wheat ...	90 ...	12
Barley ...	90 ...	16
Oats ...	85 ...	1·3
Rye... ...	80 ...	0
Tares ...	90 ...	6
Turnip (Field)	85 ...	35
Turnip (Garden)	80 ...	32
Swede ...	85 ...	26
Rape ...	90 ...	56
Cabbage ...	75 ...	31
Brussels Sprouts	75 ...	19
Broccoli ...	75 ...	50
Cauliflower ...	75 ...	40
Pea	75 ...	20
Bean ...	80 ...	14
Runner Bean...	65 ...	8
Carrot ...	60 ...	23
Parsnip ...	50 ...	20
Onion ...	65 ...	24
Mangel ...	135 ...	46
Beet ...	100 ...	21

Reference to the percentages of germination in Table II. will show that in the case of most species samples of very low

germination have been received. This does not necessarily indicate that these samples were put on the market; in probably all cases they were samples of old stocks submitted for the purpose of determining if they were of any value at all.

NOTES ON THE VARIOUS SPECIES.

Perennial and Italian Ryegrasses.—The percentage number of samples containing injurious weed seeds in notable quantity is again large this year, and this points to the need of more care being taken by the grower in the selection of seed from which he intends to harvest a seed crop. The importance of sowing pure seed in order to obtain a seed crop cannot be too strongly emphasised.

Seed containing a high percentage of impurity is much more expensive to clean than seed which is tolerably pure; a greater percentage of the actual Ryegrass is removed in the process of cleaning, and there is therefore a higher relative proportion of Ryegrass wasted, and very frequently the final product is still so impure as to be relegated to second or third grades. The seed thus loses value in three ways. Unfortunately it is the case that many Ayrshire farmers still sow impure seeds for the purpose of obtaining a seed crop, thus perpetuating a practice which is relatively unprofitable, besides being uneconomic and actually wasteful.

Statistics obtained from a trade source show that even in the case of a good lot of Perennial Ryegrass as delivered by the farmer, the wastage in cleaning to obtain seed of the first quality is 25 per cent. of the bulk, and the cost of taking it out is approximately 11d. per cwt.

The average of a season's cleanings shows—

58 per cent. of seed of 1st quality.
20 per cent. of seed of 2nd quality.
22 per cent. of cleanings unfit for sowing

The averages of purity and germination of both Perennial and Italian Ryegrass are lower than was the case last year.

Cocksfoot.—There are good supplies of Danish Cocksfoot, and the general quality of this seed is higher than that of seed offered last year.

American Cocksfoot is of good quality, but contains more impurity than does Danish seed.

Several samples of Scots and Irish Cocksfoot have been received. While these are somewhat impure, the germination is equal to that of Danish Cocksfoot. One recleaned sample gave a germination of 95 per cent. There appears therefore to be no reason why Cocksfoot should not be cultivated in Scotland as a seed crop.

Meadow Fescue is of good average quality. The injurious weed seeds in this species are mainly those of Field Brome grass.

A sample of Scots Meadow Fescue was received from Ayrshire. This had a purity of 81 per cent. and a germination of 79 per cent. The main impurity in the sample was Perennial Ryegrass.

Timothy.—Samples of a few stocks of old seed have been received, but on the whole the seed of this species is of good quality.

American seed frequently contains a high percentage of Alsike and a considerable percentage of White Clover.

Samples of Scots Timothy which have been tested show that this seed is of good quality.

Crested Dogstail shows a somewhat lower average of both purity and germination than last year's samples.

Red Clover.—A feature of the market in Red Clover this year is the Lombardy (Italian) Red Clover which is being offered. This seed is popularly regarded as producing a less hardy plant than the seed of American or English Red Clovers, and this opinion is reflected in the lower price at which the seed is offered.

Supplies of English Red Clover are not abundant, and as was the case last year there is difficulty in obtaining seed of the best quality as the English harvest was a poor one.

American and French Red Clover seem to be plentiful and of good average quality. Red Clover from both these sources is frequently somewhat impure.

Chilian Red is of good quality.

The number of Red Clover samples containing Dodder was 30 per cent. of the total number examined.

White Clover.—There is a good supply of American and Canadian White Clover seed, which is of good quality.

A considerable number of samples of English White Clover have been submitted for analysis. While the germinating capacity of these have a good average, many samples contain a high percentage of injurious weed seeds, especially Cranesbill and Sheep's Sorrel.

Wild White Clover.—The quality of different lots of this seed is very variable. Some samples are very pure, but others contain a very high percentage of other seeds, particularly of Suckling Clover. Two samples received at the Seed Testing Station contained over 50 per cent. of this inferior clover.

Considering the very high price of the seed of Wild White Clover, purchasers should judge of the value of it by reference to the amount of impurity, and should not pay top prices for seed which contains an unreasonable quantity of seeds of other species.

Alsike is almost all of American origin and is of good quality.

Mangold.—Many good samples of Mangold seed have been received, but a considerable number are below the standard germination of 135.

Turnip and Swede.—A considerable percentage of the samples received are of less than average quality, as is indicated above by the percentage number of samples below the standard prescribed by the Order.

Oats.—Approximately 500 samples of Oats have been tested this season. Nearly half of these have been drawn from deliveries of seed offered for shipment to the French Government.

Many of the samples show signs of weathering and of having been heated in the stack, but nearly all samples are above the prescribed standard of germination (85 per cent.).

A considerable number of dirty samples have been received. These indicate lack of attention in dressing, as in many cases the impurity consists of an inordinate quantity of small seeds such as Charlock, Goosefoot, Dock Redshank and other weeds of arable land which can readily be removed by efficient screening.

Some samples contain Runch in obvious quantity.

One sample contained 7 per cent. by weight of Wild Oat.

Wheat, Barley and Rye.—As shown by the tables of averages the samples of these received are of good average quality, although the number of samples is too small to be considered truly representative.

Vegetable Seeds.—In the case of the seeds of most vegetables the matters of supreme importance to the grower are the variety and stock, and these cannot be verified by analysis.

It is therefore impossible to give a general judgment on the value of samples tested, but in view of the number of samples which fall below the prescribed standard, growers would be well advised to have their purchases tested before sowing.

Linseed.—A considerable number of samples have been received for analysis from deseeding stations in the Fife flax growing area The results of these tests are considered very satisfactory.

Minimum Wages for Agricultural Workers.

THE period allowed by the Board of Agriculture to District Wages Committees within which they were to fix minimum rates of wages for men, boys, women and girls employed in agriculture in their respective areas expired on 23rd January Most of the required rates have been fixed and passed by the Central Wages Committee, and are now in force. In a few cases, however, the District Committees failed to fix rates such as to satisfy the Central Committee, and the duty of fixing these rates has now been transferred by the Board to the Central Committee under Clause 7 of the Second Schedule to the Act. The more important of these rates are—Forfar and Perth, for men over 21; Fife and Kinross, for male workers over 18, Ayr, for male workers over 18; North-west Highlands, for women and girls over 16. The Central Committee have now to frame proposals regarding the rates to be fixed for these classes, to give notice of the proposed rates, and to allow a month for objections before finally fixing them. Each District Committee have framed minimum rates according to the circumstances of the district, and according to their own ideas as to the best system of classification, and the Central Committee have allowed the rates so fixed to stand unless where they saw strong reason for disallowing them. There is thus a great diversity in the rates in force in the different districts, a list of which will be found under Official Orders and Circulars. The following table shows the rates now applicable to the more important classes of workers. In each case the highest rate applicable to the class is given.

PRINCIPAL MINIMUM RATES IN FORCE—*in Shillings per Week.*

District.	Shepherd.	Ploughman.	Cattleman.	Ordinary Worker.		Adult Woman.
				Man over 21.	Youth from 18–21.	
Northern Counties :						
Shetland ...	37	37	37	37	30	25
Orkney	31	31	31	31	27	20
Caithness ...	36	36	36	30	28	20
Sutherland ...	40	38	38	30	30	20
Moray Firth ...	36	36	36	30	30	20
North-Eastern Counties ...	35	35	35	35	30	20
Forfar and Perth	...	...	...	...	32/6	4d. per hour.
Fife and Kinross	...	...	...	...	...	18
Lothians and Peebles	36	36	36	36	30	20
Border Counties ..	40	35	35	30	30	20
Dumfries and Galloway ...	...	38	...	33	33	20
Ayr	...	...	...	...	...	4½d. per hour.
Clyde and Forth	38	38	38	38	36	20
S.W. Highlands	36	36	36	30	29	3/6 per day.
N.W. Highlands	32	32	32	32	25	...

The differences in the rates fixed are partially explained by the differences in the methods adopted by the various District Committees. In the matter of age, some of them have made the adult rate applicable to all male workers over 18, while others have fixed a higher wage for men over 21 than for youths from 18 to 21. Some Committees, such as the Clyde and Forth, Lothians and Peebles, and North-eastern Counties Committees, have made no distinction as regards the occupation of the workman, while others have fixed higher rates for special classes of workmen than for ordinary labourers. For instance, in Dumfries and Galloway, while an ordinary labourer may be employed at 33s. a week, a ploughman must be paid at least 38s. Others again have fixed a higher rate for experienced than for inexperienced men. For instance, in the Moray Firth district, while a qualified ploughman, cattleman or shepherd must be paid at least 36s., an unqualified man may be so employed at 30s.; in the Border Counties, while a ploughman or cattleman who has two years' experience of farm-work must be paid at least 35s., a man of less experience can be so employed at 30s.; and in the South-west Highlands, while an experienced ploughman, cattleman or shepherd must be paid at least 36s. a week, an inexperienced man may be so employed at 30s. In the case of shepherds, a man, in order to be entitled to the highest rate of minimum wage, must be in charge of a hirsel of sheep in Caithness, Sutherland and the Border Counties. Several Committees have passed an order to the effect that when a man is required by the conditions of his employment to keep and feed a dog, the minimum rate applicable to him is to be raised by 2s. 6d. a week to provide for the maintenance of the dog. The North-

west Highlands Committee have fixed a rate of 32s. a week for a man who is married or has relatives to support, while their rate for a man who has not a wife or relatives to support is only 27s. The high rates for Shetland compared with those for Orkney were passed by the Central Committee, because the Shetland Sub-Committee were unanimous in recommending them after re-consideration of the rates first fixed for that County.

Under Regulations made by the Board of Agriculture, the duty of deciding what benefits or advantages (such as a house or allowances in kind) may be reckoned as payment of wages in lieu of payment in cash for the purposes of the minimum wage, and of determining the values at which they are to be so reckoned, rests with the District Committees, subject to general principles defined by the Central Committee. Those general principles have been stated in the January issue of this JOURNAL. Most of the Committees have now settled what benefits may be so reckoned, and have generally included in the list all benefits which are allowed by common custom in any part of their districts. Some Committees, however, have decided not to allow any deduction to be made from the minimum wage payable on account of free cartage provided by the employer to the workman, while several have valued this benefit at £1 per annum, and the Forfar and Perth Committee have placed it as high as £4 per annum. According to the general principle prescribed by the Central Committee, the house is to be reckoned at the value last placed upon it in the Valuation Roll. Some of the more important valuations of the common allowances are shown in the following table.

VALUES PLACED ON BENEFITS AND ADVANTAGES.

District.	Oatmeal per stone.	Milk per gallon.	Potatoes per ton.		Coals per ton.	Board & Lodging per week.	
			Dressed.	Undressed.		Adult Male.	Adult Female.
Northern Counties—	s. d.	s. d.	£ s.	£ s.	£ s.	s. d.	s. d.
Shetland ...	4 2	1 6	6 0	...	3 14	15 0	10 0
Orkney ...	4 4	1 6	6 0	...	3 7	17 6	10 0
Caithness ...	4 0	1 6	6 0	...	2 1	15 0	10 0
Sutherland ...	4 5	1 6	6 0	...	2 4	17 6	10 0
Moray Firth ...	Fiars' prices	1 9	6 0	...	Controlled price	14 0	14 0
N.E. Counties	4 1	2 0	6 0	5 0	Price to employer	14 0	11 0
Forfar and Perth	4 4	2 3	6 0	5 0	1 16	21 0	17 6
Fife and Kinross	4 2	1 10	...	4 10	...	...	...
Lothians and Peebles ...	4 4	2 0	6 0	...	1 10	20 0	20 0
Border Counties	4 4	2 3	6 0	...	Current price	18 0	12 0
Dumfries and Galloway ...	4 2	2 3	6 5	...	1 15	16 0	14 0
Ayr	Wholesale price	Control price	Control price	...	Price to employer	16 0	14 0
Clyde and Forth	4 4	2 3	6 0	...	1 10	18 6	15 6
S.W. Highlands	4 4	2 0	6 0	...	2 0	16 0	13 0
N.W. Highlands	4 4	2 3	6 0	...	Wholesale price	17 0	13 6

The comparatively high values placed on coals in the Northern Counties and the South-west Highlands are no doubt due to the difficulty of transport. The high values placed on board and lodging in Forfar and Perth and the Lothians and Peebles are noticeable, as also are the low values placed on that benefit in Shetland, Caithness, the Moray Firth, and the North-eastern Counties.

In many parts of Scotland it is a common custom for the employer to provide, in part payment of wages, the food of animals, such as a cow and "follower" (generally a stirk), or a certain number of sheep, known as a "pack." The conditions on which this arrangement is made vary greatly. The employer may or may not provide the animal, and he may or may not provide hay, straw, turnips or artificial feeding-stuffs, and where hay is provided, it may or may not be cut by the workman in or out of the employer's time. Committees have therefore found it difficult to fix any average value on this benefit. The general principle prescribed by the Central Committee is in the following terms and does not require them to do so, and some Committees have left the value to be determined in each individual case of dispute.

Keep of Animals.—In valuing such a benefit as the keep of animals provided by the employer in part payment of wages, the District Committee shall have regard to the net value of the benefit to the workman in the district or part of the district.

The following are some of the most important decisions of Committees on this subject.

KEEP OF A COW IN £ PER ANNUM.

District.	With Artificial Food-stuffs.	Without Artificial Food-stuffs.	With Hill-grazing only or Hay cured by Workman.
Northern Counties—			
Shetland	15	10	5
Orkney	...	15	...
Caithness...	20	15	7
Sutherland	20	15	7
Moray Firth	...	15	6
N.E. Counties	...	17	5
Forfar and Perth	...	21	12
Border Counties	...	18	10
Dumfries and Galloway ...	...	15	5
Clyde and Forth	19	14	5
S.W. Highlands	...	15	10
N.W. Highlands—			
Mainland...	...	12	...
Skye	...	8½	...
Outer and Small Isles ...	...	7½	...

Several Committees provide that the actual cost of any artificial food-stuffs supplied is to be added to the above values.

The value of the keep of sheep has been left by most Committees to be determined in each individual case, but it has been fixed in Dumfries and Galloway at (for hill sheep) twice the rental per sheep paid by the employer; in the N.W. Highlands at 30s. per

ewe per annum, the ewe being provided by the employer; in Sutherland at 30s. on the low ground and 20s. on the hill; in Caithness at 30s. on the low ground and 10s. on the hill; in Orkney at 30s. per ewe; and in Shetland at 20s. per blackfaced or cross ewe, and 7s. 6d. per Shetland ewe.

Most Committees have placed no value on the privilege of keeping a pig, but in Sutherland it has been valued at £7 per annum; in the Moray Firth at £2; and in Forfar and Perth at £8, or for straw only at 15s In Orkney, Caithness and Shetland the privilege of keeping poultry has been valued at £1 per annum, and in the N.W. Highlands at 1s. per annum for 20 hens, not to be charged to shepherds.

Where a value has been put upon peat for the purpose of the minimum wage, some Committees have determined it at the value per annum placed on coal. The N.E. Counties make 8 loads of peat equivalent to one ton of coal. In Dumfries and Galloway and the Clyde and Forth peat is valued at £4 per annum, and in the S.W. Highlands at £6 per annum, if the farmer bears the expense of cutting, carting and stacking. In the Border Counties it is valued at 2s. per week, less any out-of-pocket payments by the workman for cutting and winning.

The Forfar and Perth Committee have valued bothy accommodation, including fire and light, without attendance at £10 per annum per man, and with attendance at £13; and the Fife and Kinross Committee have valued bothy accommodation, including coal, light, cooking utensils, bed and bedding and towels at £10 per annum.

Smut in Oats.

A PAMPHLET[1] has recently been published by Mr. W. W. Philip, Estates Office, Gigha, in which he describes the results of experiments carried out by him in the years 1915, 1916 and 1917 for the prevention of Smut in Oats. The following notes extracted from the report will be of interest to agriculturists:—

The experiments consisted in treating the seed before sowing, and at first four different forms of treatment were resorted to, viz.: Formalin, Copper Sulphate, Patent Smut Dressing and the Hot Water Method. The copper sulphate dressing, which was used at the rate of ¾ lb. for four bushels of oats, was, however, found to be so damaging to the germination of the seed that it was at once abandoned. Further, it was found at harvest that the Patent Smut Dressing and the Hot Water Method[2] showed no improvement compared with the plots sown with untreated seed; the report accordingly deals only with the experiments in the use of formalin.

The formalin mixture, consisting of half a pint of formalin (40 per cent.) in 18 gallons of water to 20 bushels of oats, was sprinkled from a watering can over the seed, which was turned frequently so

[1] "Prevention of Smut in Oats," by W. W. Philip, published by J. Maxwell & Son, High Street, Dumfries. Price 6d.

[2] Mr. Philip's experience of the Hot Water Method is unusual, but the favourable effects of formalin have been corroborated by other investigators.

as to ensure that the mixture would reach every part of the grains. Samples of the formalin-treated seed, along with samples of the same seed untreated, were submitted to germination tests, but there was no appreciable difference between the samples as regards germination. Experimental plots were thereafter sown with the formalin-treated seed and with the untreated seed respectively.

The results of the 1915 experiment showed a complete prevention of smut from the formalin-treated area, while in the adjoining untreated area the smut stalks amounted to about one sixth of the crop. In addition the value of the grain and straw per acre harvested on the formalin-treated area amounted to £13, 6s. 3d. as against £10, 18s. 2d. on the untreated area.

In the following year the experiments were repeated, but on a somewhat larger scale. The germination tests again showed no difference in the percentage of germination. The experiments with formalin-treated seed embraced 42 acres; on the whole area not one smut stalk was discovered, while on the untreated area the diseased stalks were present to the extent of at least one sixth of the crop.

In 1917 the area under treatment was increased to 112 acres, and the results afforded in every case a complete corroboration of those of the preceding two years. In every instance the prevention of smut was thorough, and there was a convincing gain in the value of the grain and straw. The mixture was this year used to dress 30 bushels of oats instead of 20 bushels as in 1915, and the dressing was found to be quite effective in preventing smut. It is, however, all important that the formalin solution should have access to every part of each grain of seed, and for this reason any departure from the original formula is not recommended.

In 1917, on the 112 acres under treatment, the grain and straw were estimated to have acquired an increased value equivalent to £269, 5s. 4d., this being obtained by an expenditure of 28s. for Formalin, or 3d. per acre.

In conclusion, the writer urges that, while he considers it proved that the eradication of smut can be attained by treatment with formalin, preventive steps should be taken, and that the sowing of any seed saved from a smut-affected crop should be prohibited.

Recent Investigations in Agricultural Chemistry.

IN Vol. III of the Annual Reports on Applied Chemistry recently published by the Society of Chemical Industry, there is an important review by Dr. E. J. Russell, Director of the Rothamsted Experimental Station, of the effects of the war, especially in its later phases, on agriculture.

At the outbreak of war the country raised about one-half of its total food, excluding beverages such as tea, coffee and wine, which could not be produced here. Some commodities were produced in less quantity than others: we produced nearly all our milk, but only a small part of our bread. For many years the cultivation of wheat had declined, until only about ten weeks' supply was grown

here each year, the rest being imported from North and South America, Australia, Russia, Roumania, etc.

For the first two years of the war there was general acquiescence in these conditions: food came into the country, and optimistic views were held as to the duration of the war. The home production fell, and was at a low ebb at 1916. At the end of 1916, however, the Government adopted a new policy. The war was making increased demands on shipping, and the submarine menace emerged into reality; food could no longer be imported on the same scale as before. A programme for increased home production was therefore worked out, and bodies of experts set up to deal with the technical problems involved. A wholly new conception was introduced; hitherto the farmer, like any other business man, had worked frankly for profit; he had been left to decide on his own plans, and had adopted whatever course he thought best, and the merits of his methods had been judged solely by the amount of profit they had yielded. Now, however, the farmer was required to grow food: calories, and not pounds, shillings and pence, were to be the guiding consideration. The Boards of Agriculture in England and Scotland were given drastic powers of compulsion, which, however, it is pleasant to record, have only rarely had to be used, the patriotism of the farmers being a sufficient incentive to the great endeavour they had to put forth.

In passing from money units to food units, it became necessary to alter considerably the scheme of husbandry. Meat production on grass land, one of the most lucrative branches of farming, was shown to yield only a fraction of the food per acre given by corn and potatoes. Consequently the order went forth that a certain proportion of grass land must be ploughed up and planted with corn or potatoes. This programme gave rise to many of the technical problems that have occupied the attention of the agricultural chemist.

A second series of problems arose out of the need of fertilisers. In peace time this country had exported fertilisers, not because they were unnecessary for our soils, but because the type of farming commonly adopted did not call for much fertiliser. The new food production programme, however, required considerably more; but unfortunately a competitor appeared who would not be denied. The common fertilisers were superphosphate (made from African rock phosphate and sulphuric acid), sulphate of ammonia (made from ammonia and sulphuric acid), nitrate of soda (imported from Chili) and potassium salts (imported from Germany). Of these, the Ministry of Munitions claimed the whole of the nitrate of soda, much of the ammonia, and a large proportion of the sulphuric acid; while the import of potassium salts from Germany naturally came to an end. Thus at the very time when the need for fertilisers was greatest the supply threatened to be cut off. Had labour been available the difficulty might have been mitigated; but unfortunately there came at the same time an imperative call for men.

It will always be a credit to the British farmer, and a source of pride to the administrators and expert advisers, that in these difficult circumstances the food production of the country was not

only maintained, but markedly increased; 1916 had been one of the lowest years on record; 1917 showed a marked improvement; and 1918 a still greater improvement, the production of food being greater than in any previous year on record.

FERTILISERS.—After dealing with the importance of conserving farm-yard manure, and particularly the liquid manure, Dr. Russell describes the various methods which were suggested to utilise "Nitre-cake" instead of sulphuric acid in the manufacture of superphosphates and sulphate of ammonia. "Nitre-cake," it may be explained, is the residue left in the manufacture of nitric acid, and enormous quantities were produced during the war. Its use to replace a certain amount of sulphuric acid was quite successful, but since the signing of the armistice sulphuric acid has been liberated, and the problem has disappeared.

Nitrogenous Fertilisers—Sewage.—For many years serious efforts have been made to produce a useful manure from sewage. Many calculations have been made to show the value of the material lost in the sewage, but no really successful manure has yet been prepared. Recently, however, a new method of procedure has been evolved, yielding the so-called "activated" sludge, which, apparently, possesses considerable fertilising value. It contains, when dry, no less than 6 or 7 per cent. of nitrogen, and the nitrogen is in more readily available forms than the earlier forms of sludge. The importance of further experimental work to determine what proportion of the sewage nitrogen is recoverable is indicated.

The attempts to utilise peat as a source of nitrogen have, so far, not been successful. The possibility of the utilisation of sea-weed as a source of nitrogen and potash has frequently been discussed. As in the case of peat and sewage, the great practical difficulty is the preliminary drying.

Calcium nitrate and cyanamide (Nitrolim) were becoming fairly well known to farmers, but during the war they were required for munitions, and were not available for ordinary use. Numerous trials have shown that calcium nitrate is usually as effective as sodium nitrate, and it has the further advantage that it does not induce a sticky condition in heavy soils. The makers have taken out a patent for neutralising the nitric acid with a mixture of rock phosphate and limestone, instead of with limestone alone, which is said to yield a hard dry mass of considerable fertilising value.

Cyanamide is somewhat less effective than calcium nitrate per unit of nitrogen, but it is not hygroscopic, and can be mixed with other fertilisers to make compound manures. It tends to contain a substance which is toxic to plants. The cause of the occurrence of this substance is now known, and it is reasonably hoped that it will sooner or later be eliminated.

In view of the large stocks of ammonium nitrate, prepared for making explosives, that will be in existence at the end of the war, numerous attempts have been made to utilise it as a fertiliser. It has obvious advantages. It contains a considerably higher percentage of nitrogen than the substances ordinarily in use—35 per cent. instead of 20 per cent. in ammonium sulphate, and 16

per cent. in sodium nitrate. On the other hand it is highly deliquescent, so that it could not readily be stored on the farm or applied with an ordinary drill.

From patents which have been taken out, it may be inferred that, in Germany, efforts have been made to prepare Urea from cyanamide and use it as a fertiliser. It would have the advantage of high concentration—46·7 per cent. nitrogen—and would thus be by far the richest fertiliser on the market.

Whether these two substances—ammonium nitrate and urea—prove useful in agriculture or not, it is certain that there is a great future before synthetical nitrogenous fertilisers Both the United States and Japan have arranged for great developments of the industry.

Dr. Russell points out that one of the most important problems presented to the agricultural chemist is the evaluation of nitrogen compounds for fertiliser purposes. Unfortunately no really satisfactory laboratory analytical method has been devised, the various processes all involving the assumption that substances decomposable in the laboratory in a certain order will decompose in the same order in the soil. The only safe method is to make pot experiments, which, unfortunately, are lengthy and tedious. An important series of pot experiments, extending over twenty years, has just been concluded by J. G. Lipman of the New Jersey Experimental Station with the following results:—

	Relative Availability	*Nitrogen recovered in Crop per cent*
Sodium Nitrate ...	100	62 4
Ammonium Sulphate	76	47 5
Dried Blood	62	38 7
Farmyard Manure	52	32 7

In English experience these fertilisers come out in the same order, but usually with less difference between ammonium sulphate and sodium nitrate

Phosphatic Fertilisers.—Phosphatic fertilisers have come in for a considerable amount of investigation The difficulty caused in the manufacture of superphosphate by the shortage of sulphuric acid has already been referred to. In addition to the use of "nitre-cake" other methods were suggested for dissolving the rock phosphate. In the United States, rock phosphate was added to fermenting farm-yard manure in the hope that the acids liberated would dissolve it This proved illusory, but a certain degree of success was attained when sulphur was added; the sulphur apparently was oxidised, and the resulting acid attacked the phosphate.

Basic slag, being a home product assumed great importance during the war. A great change, however, has occurred in the method of manufacture which profoundly affects its composition. This is due to the substitution of the basic open-hearth process for the Bessemer process in steel making. The new slags are much poorer in phosphates, and contain only 20 to 30 per cent instead of 40 per cent as in the old slags. There is the further difference that in the new slags the phosphate is much less soluble in citric

acid. Thus, the old Bessemer slags would contain some 40 per cent. of phosphates, 85 or 90 per cent. of which was soluble in 2 per cent. citric acid solution, while the modern open hearth slag contains 20 or 30 per cent. of phosphate, only 30 to 50 per cent. of which is soluble in citric acid. Dr. Russell points out that there has been considerable discussion as to how far solubility in citric acid is a true indication of the availability of the slag in the soil. The available data appear to suggest that high solubility is desirable where the growing period is short, but less important when it is long; further investigation of this important question is needed.

Robertson and Gilchrist have investigated the conditions under which rock phosphate itself could be used as a fertiliser. In general it is found to act well, especially when very finely ground. Indeed, with further improvements in the mills, rock phosphate under suitable soil and climatic conditions might prove almost as effective as bone-meal or even slag. American experience also justifies this view; rock phosphate is effective, but slower in action than superphosphate; each farmer must, therefore, decide which is the more economical fertiliser for him to use.

A new phosphatic fertiliser has been prepared in the United States—an ammonium phosphate sold as "Ammophos," the ammonia being obtained from cyanamide. The material is a light grey powder containing 13·5 per cent. of ammonia and 43·1 of phosphoric acid (P_2O_5), *i.e.* two-thirds as much nitrogen as sodium nitrate, and three times as much phosphoric acid as ordinary superphosphate.

Potash Manures.—The various new sources from which Potash Salts have been obtained since the war are next considered This subject has already been fully dealt with in recent numbers of this JOURNAL: "The British Potash Industry," Vol. I. (1918), p. 468, "The Alsace Potash Deposits, Vol. II. (1919), p. 76; to which the reader is referred for further information.

Other Fertilisers.—A considerable amount of interest has been taken in the use of other substances, such as waste lime, sodium sulphate, and calcium sulphate as fertilisers. The waste lime, when dry enough to be handled and transported, is of considerable value. Calcium sulphate and sodium sulphate appear to be of little value Sodium chloride (common salt) is distinctly useful, especially for mangolds. The question of the use of manganese salts has also been revived, but field experiments in this country have not proved successful.

The effect of magnesium compounds has been studied in some detail, and is of interest because of the importance of magnesian limestone as a source of agricultural lime. Until more information is available, Dr. Russell concludes that the safest rule is to restrict the use of lime from magnesian limestone to heavy soils where it does good, and to refrain from using it on light soils where injury has resulted.

SOILS.—The most important investigations have perhaps been those on the acidity of the soil, the cause or causes of the acidity, and the best method of estimating it

In the region of soil biology the most interesting developments

have been the steady increase of knowledge of soil protozoa and the increased recognition of the part played by fungi in soil processes. Unfortunately no British mycologist has attacked the subject with the thoroughness it deserves, and we are dependent for most of our information on the American workers.

FEEDING STUFFS.—During the war the most interesting work on feeding stuffs was the search for substitutes carried out in the various countries affected by the blockade. The most important of these has been a substance prepared in Germany by digesting straw with dilute caustic soda solution. The material is said to be eaten by animals more readily and to be more digestible than untreated straw: (See this JOURNAL, Vol. I. (1918), p. 292, "The Composition and Utilisation of Straw"). Wood pulp has been utilised as fodder in Sweden. It is mixed with molasses and protein compounds, and is said to be nutritious; the output this year is expected to reach 20,000 tons.

Departmental Committee on Sulphuric Acid and Fertiliser Trades.

IN February 1917 the Minister of Munitions, after consultation with the President of the Board of Trade, appointed a Committee to consider and report on the position of the Sulphuric Acid and Fertiliser Trades as affected by the new acid plants erected by the Government during the war. In February 1918 the Committee presented a report, with certain omissions and modifications necessary in the national interest, but the Report in its complete form has now been published as a Parliamentary Paper (Cmd. 23/1919).

The production of sulphuric acid in the British Isles before the war was about 1,000,000 tons per annum as 100 per cent. acid (= 1,500,000 tons chamber acid) This quantity may also be taken as the national consumption, since both the export and the import of sulphuric acid were negligible in amount. A table is given showing the estimated pre-war consumption of acid by the more important trades, and it is interesting to note that about 60 per cent. was absorbed for the manufacture of fertilisers — superphosphates, 300 000 tons; sulphate of ammonia, 280,000 tons. The home consumption of sulphate of ammonia for agricultural purposes was, however, only 60,000 tons per annum and the remainder was mainly exported.

The enormous demand for sulphuric acid of high strength for explosives manufacture led to very far reaching changes in the sulphuric acid industry; the importation of oleum from America was also undertaken on a considerable scale. These measures, however, being insufficient, a policy of new construction was entered upon, large oleum plants were constructed in connection with Government explosive factories, and at the same time private manufacturers were encouraged to extend their chamber and concentrating plants. As a result the productive capacity of the country has reached a figure far in excess of the pre-war consumption, and has created a post-war problem of considerable difficulty. The gross surplus is estimated at 653,000 tons 100 per

cent., or 979,000 tons chamber acid per annum, but this estimate may require to be diminished in view of the fact that it is based on the assumption that all plant at present under construction will be completed, and that there is to be no scrapping of plant.

In dealing with the subject of the fertiliser industries before the war it is stated that the export of superphosphates had declined in 1913 to 63,000 tons. This decline is attributed to various causes, amongst others being the competition of continental countries with the aid of a cheap by-product acid from zinc manufacture. It is also pointed out, however, that British manufacturers are less favourably situated owing to the fact that this country possesses no natural advantages for the production of superphosphates, since both pyrites and phosphate rock have to be imported as raw materials. In this latter connection a recommendation is made that the Government should take steps by international commercial treaties or otherwise to secure an effective permanent control or command of an adequate supply of phosphate rock. In a recent issue of *Nature* reference is made to this recommendation, and it is pointed out that certain of the Colonial possessions of the Germans contain valuable deposits of phosphate rock.

The prodution of superphosphate was very materially reduced during the war, the amount produced in 1916 falling to about 500,000 tons as compared with 800,000 tons in 1913. Recently, however, the paramount necessity of increasing the home-grown food supply has been realised, and steps have been taken to secure a large and immediate production of superphosphate.

Dealing with the difficulties of absorbing the post-war surplus, the Committee express the opinion that by far the most important prospect of utilising the increased quantities of acid is in the manufacture of artificial fertilisers, and to this end they recommend that the powers provided by Section 9 of the Corn Production Act should be widely used to enforce the adequate use of fertilisers. Any necessary measures should, at the same time, be taken to secure the sale of fertilisers to the farmer at reasonably low prices. It is also recommended that by lectures, by practical demonstrations and by experiments carried out at Government expense on plots easily accessible in various parts of the country, farmers should be encouraged and educated in the increased use of fertilisers.

The Committee, however, do not consider that there is any reasonable prospect of the whole of the surplus being absorbed by increased consumption, and recommendations are made with a view to stabilising the industry, and to enabling the manufacturers to meet the post-war position without undue financial hardship.

Profit-Sharing in Agriculture.

AN article under this title appears in the *Edinburgh Review* for January last (Longmans, Green & Company, London, price 6s. net). The subject is dealt with very fully, and the writer's arguments provide food for thought for those interested in the economics of agriculture. All may not agree that profit-sharing is the panacea for the present and prospective labour troubles in agri-

culture, but the following brief notes of the article will show that the case submitted is at any rate worthy of serious consideration.

In introducing the subject the writer refers to the Corn Production Act, and to the establishment of Wages Boards, which are empowered to determine the minimum rates of wages for agricultural workers in each district. Trade unions are now established in agriculture and must be reckoned with, but it is pointed out that farming is not a standardised industry like cotton spinning, for example, and that it is not an industry suited to regulation by the orthodox trade union methods. In support of this contention the writer advances the following arguments:—

> "Strikes constitute too dangerous a weapon. A very few weeks', even days', strike will ruin a harvest, and with it the farmer, a stockyard cannot be closed down like a mill; cattle will be injured or killed if their milking or feeding is interrupted. Apart from disputes, the regulation of the industry is difficult, a stockman or a shepherd must work not by hours but by the sun and the needs of his animals, and even as regards the other labourers, work has to be related to the weather. Moreover, the farmer is dependent on the goodwill of his men, because he cannot in many cases define a standard of performance."

The writer instances the case of Australia, where trade union control has reached a perfection of organisation. Owing, however, to world-wide competition, agriculture in Australia cannot become a protected industry, able to raise its prices to any level the cost of labour may impose upon it, and a point is soon reached when the returns are inadequate to meet the charges and restrictions imposed upon labour The result has been the destruction of capitalist farming, which engages men as labourers, and its replacement by single-handed holdings, on which the man is free from trade union restrictions and can work as long and as hard as he pleases. Men who formerly ran big dairy herds have found it necessary to let off their cows in bunches of twenty or so with the requisite land, making businesses which can be handled by a single family. As payment the owners take half the milk and buy the other half, handling the whole in the butter factory, which they retain under their own management. Such a method preserves some of the advantages of business on a large scale, while ensuring the hard work and personal care irrespective of fixed hours which prevail when a man is his own master. Thus small holdings, single man businesses of some sort or other, are likely to grow as the trade union movement strengthens in agriculture, and the result will be due less to the question of wages than to the restriction on hours and the formal definition of men's duties.

Reference is made to the fact that small holdings are usually advocated, not only for their social value in enabling a determined man to make a start for himself on a minimum of capital, but as directly increasing the productivity of the soil. The writer considers the latter argument to be based on a misapprehension, in view of the fact that the productivity of the soil depends not on the size of the farm but on the style of cultivation followed. A

small holder must produce intensively in order to live, but when the land is fitted for intensive culture, a large holding, by reason of the opening it affords for organisation, can be rendered more effective, acre for acre, than a number of small holdings. Continuing further the writer says, "This is not an argument against small holdings; they are a necessary part of the rural economy, and there is at present a need for a far greater number of them, but by themselves they do not solve the agricultural problem nor provide for the prime necessity of greater production from, and better use of, the countryside. But if small holdings are not to be the general solution of the rural problem, the universal method of satisfying the agricultural labourers' demand for a proper footing, what other alternative is there to a continuous and destructive warfare between master and men?"

The solution, in the writer's opinion, is to give the farm worker a share in the profits over and above his wages, and to make him a partner in the enterprise. The object is two-fold—to ensure that what the land produces shall go to those who earn it, and yet to prevent the industry being broken by an excessive wage rate. The limit to wages is the productive capacity of the man on the soil, and the best way of persuading the workmen not to attempt to force wages over that limit is to make them partners in the business. The determination of the fair share for employer and men respectively to take out of the profits is obviously all important, and the writer's scheme is elaborated in considerable detail, but must here be explained very briefly.

Three interests are entitled to share—capital, management and labour. Each interest should be paid at market rates as nearly as they can be found, and any profits remaining should be divided according to the payments which have been made to the three interests. Capital, represented by the farmer as a rule, will be paid, say, 2 per cent. over bank rate to represent the element of risk in the enterprise; management, again the farmer, will be credited with the sort of salary at which a manager of that style of farm could be obtained; labour will receive the current rate of wages. These three outgoings would be added together, and the profits remaining would be calculated as a dividend upon this total, and distributed *pro rata* at so much in the pound on whatever has been paid on each interest. A hypothetical example is taken of a rented farm of 1000 acres, which is assumed to have £10,000 of working capital invested in it, and an annual wage bill of £1400. The interest on the capital at 6 per cent. would amount to £600, and the farmer as manager might be assigned a salary of £400. If a profit of £1000 remained after labour, capital and management had been paid, the participators in the profit would be £600 for capital, £400 for management, £1400 for labour—£2400 in all, on which a profit of £1000 would permit of a dividend of 8s. 4d. in the pound. In other words, the farmer as capitalist would receive a further £250, and as manager an additional £166, while the labourers would share to the extent of £584. It is suggested, however, that a first step should be to build up a reserve fund, and to that end 20 per cent. of the profits should be set aside and accumulated until the fund is equal to one year's normal payments

to capital, management and outgoings. Two actual cases of profit sharing in 1915 are quoted, in which, following the lines above suggested, the surplus allowed the payment of dividends of 8s. and 13s. 9d. in the pound respectively.

Objections will be urged to such a system of profit sharing by the farmer capitalist, who will require to know why he should be content to surrender a considerable share of the earnings of his farm. The answer to this is that in view of the organisation of the men's unions he will have no chance of retaining so large a share to himself as heretofore. If by yielding voluntarily a part of his profit he can secure the willing co-operation of the men, the working of the farm may so improve that his income will be maintained, otherwise he must make up his mind to a career of warfare with the union, of victories and concessions, of strikes and lock-outs.

The writer believes that a great opportunity for the adoption of the proposed system lies in the farm colonies, which are being called for in order to provide returning service men with a place upon the land. It is suggested that the State or a Public Utility Company should take up land in considerable blocks, put in a competent manager, and instal the settlers—the ex-service men—as partners in the large enterprise, instead of as venturers upon separate small portions for each. It may be urged that co-operation among the groups of small holders would be equally effective, that they can buy and sell collectively, pool their labour, etc. The writer argues, however, that the main items of farming in this country, such as the growing of corn crops, the raising and fattening of sheep, even potato growing, do not lend themselves to co-operative production. They demand large fields to enable machinery or horses to work with due economy, and in a co-operative group every occupier would be wanting to hire the common stock of horses and implements at the same time for such operations as seeding and harvest.

Summing up his proposals, the writer states that the great advantage of the suggested scheme of partnership in farming is that it can be brought into operation at once, without any disturbance of the system of management prevailing in the country. It gives the labourer an immediate and growing interest in the business, and it in no way comes in conflict with the fixation of standard rates of wages by the Wages Committees, or the reasonable organisation or direction of labour by the trades unions. It makes for the independence of the men, and for considerate management on the masters' side. Partnership affords the only working alternative to a constant struggle between the capitalist farmer and the workers, a struggle which is specially dangerous to the productivity of the business of agriculture, when the duties of the labourer are insusceptible of exact definition, and his goodwill is the most valuable of all assets.

Forth Reclamation.

RECLAMATION and drainage of land are subjects which are at present very much to the fore, and pressure is being brought to bear on the Government Departments concerned in order to secure the adoption of schemes which, it is urged, will not only provide employment when needed, but will also add materially to the area available for cultivation.

Among the schemes now receiving public attention is one with the aim of reclaiming certain areas from the Forth. The problem as far as this district is concerned is no new one; in Sir Robert Sibbald's account of Linlithgowshire, written in 1710, the reclamation of certain slob land, opposite to the Kinneil Estate between Bo'ness and the river Avon, was recommended, and in the years 1820-1838 a foreshore reclamation to the extent of 366 acres was carried out by the proprietor of the Tulliallan Estate in the neighbourhood of Kincardine. The latter was the first important foreshore reclamation on the Forth, and the following extracts from a report on the subject, which appeared in the Transactions of the Highland and Agricultural Society for Scotland for 1839, may be of interest:—

TULLIALLAN RECLAMATION.

West Embankment.—This embankment encloses a bay between the town of Kincardine and Kennetpans, on which the spring-tides rose 8 feet in the line of the embankment. It was commenced by Lord Keith in April 1821, and was finished by the end of the summer of 1822. It is constructed entirely of mud, wheeled with barrows from both the outside and the inside of the site of the embankment. It is covered on the sea-face with salt grass-turf, and formed, on an average, of 11 feet 6 inches high, and 4 feet broad at top, with a slope seaward of 3 feet horizontal to every foot of rise, and on the land side 1 foot 6 inches of slope to every foot of rise.

The extent of this embankment is 2020 yards, and encloses 152 imperial acres It crossed three water runs, which were very soft and difficult to erect the bank on; and towards the west end the mud was mostly a new deposit, which slid down so often as nearly to baffle every effort to keep it up. At first no brushwood was used in the construction of the work, but it was found afterwards to be impossible to erect the bank where the mud was soft without it. During the time of its construction four openings or slaps were left, 30 yards wide each, for the ebb and flow of the tide; these were afterwards reduced to two. An attempt was made to close these two in the autumn of 1821, but without success; they slipped out four times, and it was found impracticable to fill them up until the bottom of the openings were strongly piled and brush-warped, which was done in the spring of 1822.

The whole embankment subsided considerably in the course of erection, and in some particular places this continued very much for a considerable time afterwards. It was heightened in 1823, and again a considerable portion of it had 3 feet added to its height in 1824, and the same was found to be necessary at different periods up to the year 1836.

The principal errors in the construction of this embankment were the back slope being too steep, and the sea-face not having stones to protect it from the wash of the waves which carried off the turf, thereby occasioning a great expense in replacing them. The want of stones also occasioned a considerable expense in the construction of brush warpings for a protection. These consisted first of small ones erected perpendicular to, and afterwards a strong upright one parallel with the bank, to the height of high-water spring-tides; these proved ineffectual, and the breaches made in the embankment had to be faced with stones, which work is still in progress, and will be continued till the whole seaward slope is made secure. During the time of erection, the not securing the bottoms of the opening left for the ebb and flow of the tides was also a great error, by which the mud which had accumulated within the line of the embankment was run away so deep as to render it nearly impossible to fill them up, so as to bring them to their proper level; indeed, the last had to be filled up from the inside, thereby lowering the surface of the accumulated mud so much as to render from two to three acres nearly useless.

The expense of this embankment up to the end of 1823 was	£5021	3	10
To the end of 1826	1082	16	9
	£6104	0	7

besides several considerable repairs since, some amounting to several hundred pounds.

The mud or alluvial soil over the whole of the space thus reclaimed from the sea is of very great depth, and of very excellent quality. It was necessarily very fully impregnated with salt, so much so as completely to impede, for two or three years any sort of vegetation.

In most places within this embankment, beds of the ordinary sea-shells, such as oysters, cockles, mussels, limpets, etc, are still to be found four feet under the surface. The first appearance of vegetation was in 1823, a year after the tide was shut out, when the Poa maritima and Aster tripolium began to take possession of the general surface of the mud, and the Agrostis stolonifera and alba along the course of the fresh-water runs.

In 1823 the ground was divided into fields of from fourteen to seventeen acres with ditches; and in 1824 it was, for the greater part, wedge-drained at the distance of 18 feet between each drain. A crop of oats was sown over the whole, a great portion of which never grew, and the produce fell very far short of the seed sown. In the beginning of the ensuing year, 1825, the whole of the reclaimed land, with the exception of one field kept for cropping, was sown with rye-grass and white clover, mixed with some other grasses. This was repeated in the after part of that year, and also on the following season, 1826; this being a very dry season, the grasses did not succeed well, but the following season, 1827, the grass was good and continued to improve until 1830, when the fields thus sown down began to be broken up in rotation for oats, barley, potatoes, beans, wheat and clover-grass, which has been the rotation

of crops pursued ever since. The wheat was good in quality but deficient in quantity, and straw, potatoes and barley very good; beans, oats and clover-grass excellent, almost unequalled. The field which was not sown out in grass with the others was cropped with oats, barley, beans, grass, oats, potatoes, barley, grass, etc. in rotation; these crops were very deficient at first, but continued to improve progressively as the salt was extracted by cultivation; it has, however, not been equal to the other fields which were sown down, in the first instance, to grass and pasture. Commencing with grass seems to be by much the cheapest and best method for extracting the salt from lands thus reclaimed from the sea, the over quantity of which seemed to be the cause of barrenness at first, and it became productive in proportion as the salt was extracted from it. Sheep and cattle throve uncommonly well on these fields while they were in pasture, and both the grass and bestial pastured thereon improved as the fields advanced in age.

Longannet Embankment.—This work is situated on the east side of the shipping pier of Kincardine, stretching from thence to within a short distance of the rocks at Longannet Point, at which point it reaches the shore at the quarry; the whole length being 3046 yards, or about 1 mile and three-fourths of a mile.

This embankment runs parallel with the current of the river, at the distance of 100 yards on an average from the low-water mark of spring-tides, and encloses a long flat bay formed by the two points of Longannet and Kincardine, measuring about 214 imperial acres. Over this space the spring-tides rose at the end next to Longannet 11 feet 6 inches, and on that next to Kincardine 7 feet. The soil is a deposit of mud, in some places to a very great depth, and nowhere less than 15 feet. The original alluvial soil, a deposit from the river, is of very tough strong texture, the more recent deposit much lighter and mixed with peat moss.

The embankment is constructed of stone rubbish and rubble stone on the outside, and of mud within; the mud was chiefly taken from the sea-beach on the outside of the bank.

The seaward slope is two and a half feet horizontal for every foot of rise, and the inside slope is 2 feet horizontal to every foot of rise; the breadth at the top is 4 feet, and the height from 16 feet 6 inches to 12 feet.

The work commenced in the spring of 1829 by forming a bank of stone, rubbish and rubble stones obtained from Longannet quarry, commencing at the high water of spring-tides. By means of a railroad it was carried along towards Kincardine, during that and the two following years, about 900 yards, at a level of about 2 feet above the high water at spring-tides, the breadth of stones at the base, where the bank was full height, being 50 feet. Behind this embankment of stones the base of the mud bank was formed at the same time, and raised to the height of 8 feet; and connected with this portion of the work is a jetty for the shipment of stones, and one of the slaps or openings, 60 yards wide, which was left for the ebb and flow of the tide. In this portion of the work also there is placed one of the tunnels intended for the discharge of the land water. The 900 yards thus erected having reached the point where it is less exposed to the heavy seas from

the south-east, and where it does not require so strong an embankment of stones, the railway was not extended farther; and a punt or lighter boat, carrying forty tons of stone at a time, was substituted to carry the stones from the jetty to the rest of the work. For the next five years, until 1836, the work went on in this manner progressively, so as to allow time for the low parts to silt up with mud and to rise to the height wished for. By the end of that period, a ridge of stones, 30 feet at base at the highest place of the bank, to 20 feet of base at the lowest, and averaging 8 feet high, was laid down from where the railway ended up at Kincardine Pier.

By the middle of the summer of 1836 the mud had risen along the lowest parts of the ground within the railway portion by a deposit of mud as much as 7 feet 9 inches, by which it had accumulated above the level of high water of neap-tides. It was now considered that the time had arrived when the mud embankment should be formed behind the stones, and when the work should proceed more rapidly, with the view of shutting out the water and finishing the work. This part of the work was commenced in the summer of 1836 at the place where the railway portion ended, and it went on regularly until the closing of the tide slaps or openings, which took place in January 1838. These openings were left, while the rest of the embankment was constructing, for the ebb and flow of the tide. They were five in number of different breadths, from 120 yards to 60 yards. The bases of them all were raised above the general surface by at least 2 feet. The mud portion of this part of work, which was exposed to the rapid and powerful action of the tide while flowing either way through these openings, was well secured with brush-wood, and the stone part of it was carefully laid and wedged down in the form of a causeway to prevent the run of the water carrying out the bottoms. A number of temporary tunnels were also placed in different situtations at proper heights to aid in drawing off the tide-water. Besides which, a second permanent tunnel for the escape of the land water and drainage of the soil to be reclaimed being placed in May 1837 near the upper end of the embankment, it was used also for drawing off the tide-water. This, at one period when the embankment was low, it was of importance to accomplish as early after the fall of the tide as possible.

Very little progress was made with the mud bank in 1836, but a great effort was made in 1837; and the whole, excepting the openings, was completed by the end of that year to the height of 2 feet above the high water of spring-tides, and secured on the outside with stones from the quarry by the punt-boat.

The cost of this work, from the commencement to the end of February 1838, was £11,959, 7s. 7d., and it will still take above one thousand pounds to complete it.

In the rail-road portion of the embankment there are about 90,000 tons of stones and quarry rubbish, and in the other portion, where less was used, there were about 80,000 tons, and some more are still required to complete the work. The stones settled down a great deal in the course of erection, in soft places 5 feet, in the course of two days.

It may be observed that the line of this embankment is very long, the height of it very great, and the expense necessarily also very great for the quantity of land reclaimed. The attempt was hazardous, and it would not have been made, at least with any prospect of success, without the command of so much stone conveniently situated.

An Experiment in Rural Education.

AT a time when the importance of developing and maintaining interest in country life and in agriculture is recognised on every hand, the following contributed notes on a teacher's attempt to solve this aspect of the national problem in a very limited sphere may be of interest. The writer makes no claim to originality, but suggests that the record, which is one of actual experience, may be of some value to other teachers.

The human material given to the teacher to work with consisted of evening and day students in a large technical and secondary school. The majority of these were connected with "the works" wherein the industry and interest of the townspeople were centred, while the minority came into the town with bursaries from the outlying country districts. As was to be expected, applied engineering and chemistry were strong, but biology was weak, and relegated for the most part to girl students. There was no good bookshop in the town. The mechanism at the teacher's disposal consisted of a fairly sized and fitted laboratory, with a north light only, to supplement which a small unheated glasshouse had been erected; there was also a derelict border at the foot of a bank, which served as a deposit for tins and rubbish from the neighbouring street.

The problem before the teacher was, how best to develop the character which makes good in country surroundings either at home or in the Colonies. Such a character must be resourceful and able to adapt what comes to hand when there is no shop at the corner; he (or she) must have eyes quick to see and the trained intelligence which is able to draw deduction from things seen, but to refrain from any rigid refusal to profit by new knowledge, *i.e.* he must love truth better than his own opinions; if, moreover, he has acquired a faculty for appreciating colour and form, cinemas may allure him less than the green of springtime or bare branches against a winter sky.

The methods used to attain the ends in view were laboratory work, field and garden work, and the training of what Professor Lyde has called the "outlook faculty." In the laboratory, students were in the first instance taken away from books to things and thrown on their own resources. They might make what use they liked of apparatus, glasshouse and garden; they might move about freely and devise experiments, but excepting for consultation with the teacher and a break in the two-hour period, there was absolute silence. This silence was insisted on as the only way of getting a job done where everyone had much to accomplish in a limited time, but its chief value lay in the independence it fostered in place of the tendency to rely on one's neighbour in a difficulty. Each

student was responsible for replacing apparatus after use, and for reporting anything missing or broken.

Let us suppose that soils was the matter to be taken in hand with a class aged sixteen. The work opened with a cursory examination of various types of soil, clay, sand, loam, etc., in which the differences were obvious to eye and touch; then followed a discussion on what one or other of the students already knew from experience, and a talk on rough methods of analysis; experimental work to ascertain the constituents of surface and subsoil, potting loam, etc. was then planned; from this there naturally followed experiments on the effects of different soils on plant growth. Finally results were tabulated and compared, possible sources of error and the risks of drawing hasty conclusions were discussed, and the knowledge gained was memorised. Students were encouraged to link up new knowledge with that previously gained, and to set themselves new questions to answer. Such questions as, "Would this membrane work well in osmosis experiments?" would meet with the answer that the askers could ascertain for themselves, and they generally proceeded to do so. The setting up of experiments was designed with a view to developing manual skill, and students often gained considerably in dexterity.

The laboratory was kept full of living things—in spring tall branches and twigs cut during pruning made it like a miniature wood; later on, every species of flower was brought in as it opened, named, and entered on the big illustrated calendars which hung round the room,—the rarer species were placed in specimen tubes where all could see them; in autumn fruits gradually replaced the flowers. All this was left to the voluntary effort of the students. The same freedom was allowed in observation and drawing as in experimental work—students moved about, found what interested them or illustrated their point, and then sat down to sketch it. They were trained to appreciate the fact that a scientific drawing is worthless unless it shows clearly all points which have been observed and which are relevant to the matter in hand. Stress was laid also on accurate memory drawing and on unprepared observation tests, *e.g.* "Sketch the dandelion and thistle fruits," "Name half-a-dozen field weeds you have come across lately, and say how they propagate themselves," "What trees are in flower just now?" "Show the points of difference you have noticed between an ant and a spider."

As students passed from elementary to more advanced stages, text books were introduced, but the necessity for translating words into reality was much dwelt upon. Students were asked to make rough sketches to illustrate the text or discussion, and learnt that until they found it possible to do this, the words could have little or no meaning for them. It is of course quite possible for a student to work through a series of diagrams or of microscopic slides without ever projecting them into the third dimension and thus learning to know the actual structure. To get over this difficulty, students were given plastiscine and encouraged to build rough models.

Although a great deal can be done by bringing the countryside into the laboratory, nothing can fill the place which out-of-doors

work must occupy in rural education. The derelict slip at the foot of the bank was reclaimed and converted into gardens. There was an embargo on weeds, but otherwise students were free to follow their own plans and to make what experiments they liked. Seeds and bulbs were bought cheaply, and there was co-operation as well as rivalry in the efforts made to present a somewhat less disreputable appearance in the playground than had hitherto been the case. The teacher, however, recognised that games lay a foundation for co-operation and fair dealing in after life with which no other work can compete, and that where time and space for games are limited, nothing should be allowed to encroach upon them. Field work was counted as school work. About once a month and on sudden holidays, the class set themselves to answer questions which had arisen in the laboratory and which could be solved only in the fields, and they also gained material for further questions. It was here that those who had been counted "stupid" sometimes came into their own. They could not write essays or learn history, but they could work with plants and animals, and discovered a life interest which might otherwise have escaped them. Excursions not only quickened observation, but led to a recognition of the fact that the country is never dull. Although many people are too dull in themselves to make the most of it, no season of the year is without interest for those with eyes to see.

Last, but not least in the scheme, came the training of the outlook faculty. In the first instance, books and lecture work were rejected for more direct methods of dealing with things rather than words, but, as the work went on, the horizon widened from the known to the unseen. Everyday work was linked up with great discoveries—why should we grudge time in looking at small things, when a study of the salivary glands of the mosquito formed a link in the chain of a discovery which had saved countless lives and rendered great commercial enterprises practicable? Stories of the web of life and of those who are helping to unravel it had their place. "I never passed Lister's house in London without thinking of what you told us of him," said a student long afterwards.

It is always difficult to estimate results. Failure in examination was very rare, and some have done brilliantly when brought into competition with the wider world. This might be attributed in part to their having had to rely on themselves, and to have a whole-hearted detestation for slovenly work and slipshod statements. The war has cut athwart too many lives to make numerical calculations possible or reliable. Letters from former students, however, provide ample evidence that training on such lines led to appreciation of country life and interest in the basic industry of agriculture.

Unless some such teaching is provided, there is a danger in the present system whereby promising boys and girls are withdrawn from the country schools to receive secondary education in the towns. On the other hand the ignorance of townspeople on natural phenomena and agriculture is in need of enlightenment.

In conclusion, no teacher, however able, can inspire the enthusiasm which was the driving force in the experiment described if he is given neither time nor opportunity to gain fresh inspiration

for himself. When he begins to rely on old lectures and to work through fixed courses of experiments instead of meeting the needs of each class of new comers he will cease to inspire. "I will give my boys to drink of the running water and not of a stagnant pool."

The Testing of Forest Seeds during 25 Years, 1887-1912.

UNDER this title a collection of the results of tests of approximately 2000 samples of seeds of forest trees, and, in particular, of conifers, was published for private circulation in 1915 by Herr Johannes Rafn, the well-known Copenhagen dealer in seeds of forest trees. The publication is issued in English and German as well as in Danish. The author deals critically with the results of artificial tests of tree seeds, and in addition supplies information from concurrent observations of the behaviour of the same samples in the seed beds, and makes judicial criticisms of the general and particular practices of the forest seed trade drawn from his own undoubtedly unique and wide experience. These criticisms and opinions are supported by an analytical tabulation of results of tests which form an excellent reference both for the seed-analyst and for the forest nurseryman. The bulk of the results are compiled from information supplied by the Danish Frocontrol, but the additional information regarding the origin of the samples is invaluble.

The whole publication emphasises the importance of the testing of forest seeds as a guide to sowing, and the author insists strongly on the fact that samples of seeds that fail in the germination test invariably fail in the nursery.

The main points of interest to the Scottish forest nurseryman are summarised below.

EUROPEAN CONIFERS.—*Pinus sylvestris*, L. (Scots Pine).—The best seed obtained is that of West Norwegian and Swedish origin, seed from Finland comes next, and Scottish seed comes out worst in the averages of tests. This feature is regarded as due to the collecting, in Scotland, of the cones before they are ripe.

The following excerpt from the tables shows the marked difference which exists between seed coming from these sources.

	Average wt. of 1000 seeds.	*Purity % Average.*	*Germ. % Average.*	*Real Value % Average.*
Scots Seed	6·41 g.	95·4	67·3 and 2·3 fresh	66·4
W. Norwegian Seed	5·22 g.	99·0	89·7 „ 2·3 „	91·1
Swedish Seed ...	5·15 g.	99·8	85·5 „ 4·7 „	89·6
Finnish Seed... ...	4·54 g.	98·0	65·3 „ 11·1 „	74·9

Scots seed is in demand, however, as it gives a much quicker and stronger growth than seed from other localities.

Pinus austriaca (Austrian Pine, Corsican Pine and allied species).—The seed weight of *P. Austriaca* is about one third greater than that of *P. Laricio.*

The seed of these species germinates well when new, but quickly loses germinating capacity after the first year, though the seed does not lose in weight.

An example is given of results of tests of one sample from each of the three species, kept and tested annually for three years.

	1st year.	*2nd year.*	*3rd year.*
P. Austriaca, Höss. ...	89	73	46
P. Laricio, Poir.... ...	84	67	64
P. Pallasiana, Lamb. ...	87	44	10

Pinus montana, extensively used in the plantations on the heaths of Jutland as a nurse for spruce, generally shows a high germination when the seed is good.

Larix europœa, D.C. (Larch).—The germination of this species is never high, the average being approximately 50 per cent. The average purity is also low, being 82 per cent.

There is a Polish Silesian variety distinguishable by its slender growth, and by the fact that its side twigs are small and stand at an acute angle to the stem. If reliable seed of this variety could be obtained it might prove extremely useful.

Picea exelsa, L.K. (Spruce).—The seed of spruce is easily germinated, and good seed can be depended on to give a high figure. Danish Spruce is not particularly good, being dealt with in small quantities, but Norwegian and Swedish seed is a first class article. The keeping quality of spruce and particularly of *P. borealis* is great.

The weight of Spruce seed decreases in inverse ratio to the distance from the equator and also to the altitude. Thus the weight of 1000 seeds from Central Europe is nearly double that of the same number of seeds from the Northern Norwegian forests.

AMERICAN CONIFERS.—*Cupressus Lawsoniana.*—The Danish seed is larger and germinates better than American seed.

C. Nutkaensis germinates hardly at all.

C. macrocarpa also germinates very indifferently.

Picea alba, L.K. (Canadian White Spruce).—Danish seed is heavier and germinates better. This is also the case with *Abies balsamea*, *A. nobilis* and *Cupressus Lawsoniana.*

Abies balsamea is the only American Abies which retains its vitality for a year.

Picea sitkaensis, Carr. (Sitka Spruce).—The seed quality is generally good but the seed is slow to germinate, requiring a high temperature and a long period of incubation. The seed is now obtainable very pure.

Sitka spruce often fails in the nursery; the seed requires a careful soaking and pregermination before sowing.

Sitka spruce may be taken for the purpose of demonstrating the dearness of "cheap" seed.

If a sample of good clean seed is compared with a sample of impure so-called "cheap" seed the difference in value obtained is very instructive, *e.g.*—

Sample 1, containing 79 per cent. of pure germinating seed, cost 37s. 8d.

Sample 2, containing 19 per cent. of pure germinating seed, cost 30s. 4d.

In buying the latter one would be paying more than three times the price of the useful seed which one would pay for in sample 1.

Pseudotsuga Douglasii, Carr. *P. glanca Mayr* (Douglas Fir).—The author considers there is justification for considering the green and the blue Douglas as distinct species, while reserving judgment on the question of whether or not the two may be found to intergrade.

There is no indication of difference in the seed-weight in the early samples, but an addendum records that two samples of Douglas lately received from the latitude of San Francisco, altitude 4000-5000 feet, showed a seed weight double the average of all the samples of green coast Douglas. The occurrence of a big grained Southern variety is thus probable though not definitely established.

There is, however, a considerable difference between the green and the blue Douglas in germinating capacity.

The blue has an average germination of 76, while that of the green is 53 and 12 fresh.

Seed of the blue Douglas germinates rapidly and is well germinated in ten days, while that of the green takes thirty days to show full germination. The established plants, however, of the green Douglas grow much more rapidly than those of the blue variety.

Thuja gigantea (Nutt).—The seed germinates well and gives a full germination in twenty days.

The seed of *Tsuga Mertensiana* germinates well and retains its vitality fairly well.

Pinus Banksiana is frequently of excellent quality, but that of *P. monticola* does not show well in artificial germination.

Abies grandis would do better if not so severely threshed. Very frequently the seed is of poor value.

JAPANESE SPECIES.—Some scathing comments are made on the indiscriminate methods of the Japanese in supplying consignments unreliable in respect both of description and of germinating capacity.

The Larches are the only species of importance. The harvest of Japanese Larch is spoiled by the premature collection of cones. The seed is frequently worthless, but when good germinates readily.

SEED WEIGHT WITH REFERENCE TO DISTRIBUTION AND DETERMINATION OF VARIETY.—The seed weight of spruce and of Scots pine falls in inverse ratio to the distance from the equator and to the altitude.

The author believes that in many cases the seed weight may give definite indications of the origin of Danish forests of both species.

The weight of seed of *Pinus montana gallica* decreases over a period of years in Denmark, and this may be due to hybridisation with the many stemmed form which occurs abundantly in Jutland.

Siberian Larch seed is double the weight of Tyrolese seed, and must therefore be considered a distinct variety.

Pinus monticola from North Idaho weighs only half as much as seed from California.

The seed weight of *Picea alba* as collected in Denmark is much higher than that from forests of the Black Hills of South Dakota; the inference is that the Danish forests originated from seeds of the early coast forests collected by the early settlers in the East United States.

The seed weight of *Pinus Murrayana* from the Sierra Nevada is double that of seed from the Rocky Mountains.

SEEDS OF BROAD LEAVED TREES.—The results of testing seeds of deciduous trees by laboratory methods are of little value, only Alder and Birch being suitable subjects for the test. Most of the others are excluded either because of their size or their slowness of growth.

The seeds of some species are slow in germinating, and its worth cannot be accurately estimated by laboratory tests.

SLOW GERMINATING SPECIES.—The following species require a soaking and pregermination before sowing—Sitka spruce, Pinus Jeffreyi, Pinus strobus, Abies Nordmanniana, A. magnifica, Pinus monticola.

The following require to be prepared "stratified" for a year in the nursery—Pinus Cembra, P. Coulteri and P. Lambertiana.

Worm Diseases in Young Stock.

PROFESSOR D. C. MATHESON, F.R.C.V.S., of the Department of Pathology and Bacteriology, Royal (Dick) Veterinary College, Edinburgh, contributes the following notes on the subject of Worm Diseases in Young Stock:—

Attention may be drawn appropriately at this time to the question of diseases due to worms; and those stockowners who had an unexplained mortality among their young animals last year would be well advised to have their stock examined for these parasites, many of which are too small to be seen readily with the unaided eye, while even those which are large enough to be visible may be missed easily if the search for them be casual.

Worms are a serious cause of loss in some districts, as the following examples and quotations show: "In a lot of 42 ewes with 84 lambs he has lost about 20 lambs"—death was due to massive infestation with tapeworms; had the condition been recognised in time many of the lambs might have been saved. "A flock of ewes and lambs in this district are dying . . . strange to say the ewes that were on this field last year went something similar"—round worms were the cause of the deaths; if the condition had been recognised the previous year many of the animals could have been saved, and a recrudescence of the trouble the following year could have been prevented. "Serious scouring, several other calves and one heifer all showing the same condition"—round worms were the cause. "A three-year-old Hackney filly; one of six, seriously infested"—round worms killed the filly. "We always lose some of our foals every year"—round worms caused the loss.

"The birds never throve"—gape worms prevented their thriving and killed a number of the chickens. Gape worms have been found in the human subject.[1] "This puppy is the last of the litter; they have all gone the same way"—round worms were the trouble.

At a time when the rat problem is engaging so much attention the following case is of interest: "We cannot keep any cats in this warehouse; a few weeks after we get a new one it commences to pine and soon dies"—the thick-necked tapeworm was the cause of the deaths; the infection is got from rats or mice. The lungs of a pig that had been ailing were found on examination to contain large numbers of round worms.

All classes of farm animals may suffer, but worms are a special menace to the young. The symptoms to which they give rise are often vague; the affected animals do not thrive; they are dull and their appetites are capricious; presently they begin to scour, and then they waste rapidly and soon die. An animal may betray the presence of parasites by a husky cough. Yet any or all of these signs may be present in an animal not affected by worms, and to establish the diagnosis satisfactorily the worms or their eggs must be found in the excretions of the patient. The segments of many tapeworms can be seen readily in the fresh droppings, but when these have been exposed to the air for a time the segments dry and lose their characteristic appearance, which, however, may often be restored by placing them in water.

Not only are worms themselves an important source of loss, but they dispose animals to other infections by causing weakness or wounds; moreover, they tax the digestive power of their hosts, and the stockowner finds himself compelled to support not only his legitimate stock, but multitudes of parasites as well. Worms retard growth, hinder fattening, and diminish wool production. Worms require special treatment, and therefore an accurate diagnosis is necessary; treatment is most successful when applied early. Too often a number of young animals are allowed to die, and it is not until the disease has made considerable progress in the flock and many of the animals are beyond recovery that help is sought.

The important thing to recognise is, that as soon as an animal appears ill or dies it should be submitted to expert examination, because, if worms be the source of mischief, measures can be taken at once to protect the remainder of the flock or herd and to prevent, as far as possible, infection of the pastures. Adult animals which have survived an attack may harbour the parasite and contaminate the pastures, from which young animals may become seriously, even fatally, infected.

Three of the commonest conditions for which livers are condemned at the slaughter houses are tuberculosis, fluke worm disease, and infestation with tapeworm cysts. Lungs are similarly often condemned because they are affected with worms or worm cysts. The number of livers so condemned every year is not negligible; many lungs are so spoiled.

The dog is the host, upon occasion, of a number of species of tapeworm, seven of which are relatively common, and of these, six

[1] *Jour. Clin. Res.*, May 1913. (Abstract, Leiper, *Lancet*, Jan. 1913.)

pass a stage of their life in the bodies of our common food animals. All these parasites may be mischievous during their movements through the body of their intermediate host, but two of them are a cause of serious disease even after they have come to rest; such is the cyst whose presence in the brain of a sheep causes gid or sturdy, and such is the cyst which causes "bladdery" lungs in sheep. This latter cyst (*Echinococcus*) is a dangerous parasite for man, the infection being got from the dog.

All dogs should be treated for worms at least twice a year as a matter of routine. Such treatment, under expert supervision, will do the dogs no harm if they do not harbour worms, and will do them a great deal of good if they do. It is essential the dog should be really cleansed, and that the worms should be properly disposed of and not spread broadcast upon the pasture. Such systematic treatment of the dogs will help materially towards removing several of the common flock pests, and will remove a menace to man himself. That done, the stockowner and his veterinary adviser may proceed without haste, yet without delay, to clear the flocks and herds from other parasites, and so to fortify the animals against diseases, the cause and the cure of which are still unknown.

The Warble Fly Pest.

FOR years farmers, butchers, hide dealers and tanners have been familiar with the damage caused to cattle, meat and hides by the ravages of the Warble Fly, but few have realised fully how extensive this damage is. A moderate estimate puts the annual loss in damaged hides alone at upwards of £300,000. Add to this the damage done to "jellied beef" and the loss of condition of the animals attacked, and one realises to a certain extent how much the country is paying to keep this undesirable pest in existence.

Last July the War Office, impressed by the damage caused to hides by this fly, called a Conference of all Government Departments, men of science, traders and others familiar with the pest and with possible preventive measures, to discuss the measures necessary to rid the country of the Warble Fly. This Conference formed a Committee to consider and recommend possible ways and means of exterminating the Warble Fly pest.

A Scientific Sub-Committee, presided over by Sir Stewart Stockman, C.V.O., to the Board of Agriculture and Fisheries, has been appointed to supervise and control experiments which are to be carried out in different parts of the country in order to discover, if possible, a method of abolishing this pest. A Government grant has been sanctioned for this purpose, and the experiments are designed to furnish information on methods of preventing the fly from laying its eggs on cattle, and on the effects of drugs in destroying the larvæ in the body of the host before they can produce deleterious effects on the hide.

At the same time it is realised that without active co-operation on the part of the farmer any methods which may be recommended by the Scientific Committee for abolishing the pest cannot achieve their object. Under the direction of the Joint Committee of the Board of Agriculture and Fisheries and Ministry of Food, steps are

accordingly being taken by means of leaflets, charts, diagrams and illustrated lectures, etc. to bring home to farmers throughout the kingdom the damage done by the Warble Fly, and familiarise them with the appearance, life-history and habits of the insect.

Women's Work in Agriculture.

THE following notes on the recent work of women in agriculture have been supplied by the Ministry of Labour :—

Early in 1916 the Ministry opened special offices with a view to supplying farmers with women workers for agricultural vacancies as substitutes for men who had joined the Army, and to help in carrying out the additional work which the increased acreage brought under cultivation rendered necessary. At first women were, as far as possible, recruited from the country, as in many cases they had previous experience of land work, and, at least, some idea of the country conditions. The employment of capable country women removed to a certain extent the prejudice of the farmers against women workers, and it soon became clear that the supply of experienced workers was quite inadequate if the demand was to be met.

In 1917 the Land Army Scheme was organised under special conditions to enable women to be removed from place to place as they were required, and to encourage their work on the land.

The Scheme is now administered by the Board of Agriculture for Scotland and the Ministry of Labour (for a time the Ministry of National Service also took part in the work), while the Women's Agricultural Committees, of which there are forty-seven in Scotland, gave valuable assistance in carrying out the local arrangements. With commendable activity the Committees have gradually extended their attention and interests to several subsidiary branches of agriculture, such as cheese-making, butter-making, bee-keeping, goat-keeping, poultry-keeping, mole catching, and very specially to the housing and welfare of the workers, including, in some instances. the oversight of juvenile workers placed in their districts.

Up to the present time the total number of enrolments in the Land Army amounts roughly to 1500. In addition a large number of "casual" women workers have been placed for outdoor work. These include university students and other women of education, who undertook outdoor work during the summer vacation.

A number of Instructional and Training Centres have been arranged where women receive a short training in farm work, including milking, and in forestry and gardening, to enable them to take posts.

The suitable housing of women workers employed on farms still forms the most serious difficulty in connection with the Scheme. Efforts have been made to meet this difficulty by using caravans, forming local gangs, and establishing hostels, which have proved, a great success in Ayrshire, Fife and Berwickshire. There is an increased demand among farmers for hostels, but in many places a centre within convenient distance of farms is not obtainable and transport forms an obstacle.

A brief summary of the work done by the Women's County

Agricultural Committees and the Departments concerned during the past nine months was given at the recent large and representative Conference of Committees held in Edinburgh, showing generally the work in the various counties. In addition to ordinary farm and general estate work, a number of women have been employed in forestry, especially in the North and West of Scotland, and in gardening. During the season the Committees did valuable work in fruit collecting. From 50 to 60 tons of fruit were collected in Dumfriesshire, Wigtownshire and Kirkcudbrightshire; and fruit was also collected and made into 11,400 lbs. of jam in Mid-Berwickshire under the supervision of the Convener of the Committee. In several districts arrangements were made by the Committees for lectures and demonstrations by the Agricultural Colleges on cheese-making, butter-making, bee-keeping and fruit-bottling, and co-operative societies were formed for disposing of country produce.

At the Conference the future of women's work in agriculture and subsidiary branches was discussed. It was unanimously agreed that there was still important and useful work for the Women's County Agricultural Committees to carry out, and that these Committees should be continued and receive more generous financial support. The importance of maintaining a link between their work and that of the Women's Rural Institutes was referred to.

One of the resolutions passed at the Conference was to the effect that women should have representation on the new statutory committees formed to promote the development of agriculture and subsidiary industries, to enable them to have a voice in any educational proposals affecting women's work.

With the approach of spring fresh applications for women are being received. The demand for women with milking experience is great, and it is hoped that the period of training in this branch will be extended before long. It is gratifying that the attitude of farmers towards the employment of women has considerably changed and improved since the beginning of the war. The value of women's work, their ability, capacity and general efficiency are being appreciated, and although the labour position with regard to agriculture has somewhat changed on account of the return of so many men from the army, it has been recognised that the existing organisation for securing the employment, where necessary, of women in agriculture and cognate industries cannot be discontinued at present without serious loss to the interests of the country as regards production, the convenience and success of the farmers as regards labour, and the welfare of the women workers themselves.

Scottish Women's Rural Institutes.

IN the North-Eastern Area new Institutes have been founded recently in Deer District, Lonmay, Crudie District and Newmill; in the South-Eastern Area at Chirnside, Davidson's Mains, Hutton and Paxton, Haddington and Lauder; in the Central Area at Charlestown. It is interesting to note that Institutes which have

been begun show a steady increase in membership, and that, in spite of the influenza epidemic which has taken heavy toll in the country districts, the majority have carried steadily on. The Institutes are becoming a focus for recreative and educational activities in many places, and during the winter social gatherings, in which the co-operation of the men has been obtained, have formed a feature of the programme.

As has been the case in Canada, an Institute usually begins with enjoyable monthly meetings, but, as time goes on and the community sense grows stronger, other developments take place. The Institute should stand for any and every activity which may bring more interest or happiness into a district. Thus one Institute is now beginning a musical association, another has a pattern club, another is organising evening meetings for girls and also handicraft classes, and yet another is taking steps with a view to providing a children's playground. An Institute which worked hard at sphagnum moss gathering proposes to turn these energies to herb growing and collecting during the summer months.

The Highland and Agricultural Society have granted a small space for a Women's Institute exhibit, which may prove the forerunner of greater things in future. Each Institute will have an opportunity for shewing a little of the best work done by women in their district in food production and conservation, and also in handicrafts, needlework, rugmaking, quilt and blanket making, lace making, basket making, toy making and knitting. Prizes are to be offered in each area to the Institute sending in the best exhibit.

The second annual conference will be held in Edinburgh on Tuesday, July 8th.

Those who are interested in the broader aspect of the Women's Institute movement will find the article of "A New Way of Country Life," by Miss Elizabeth Robins in the *Nineteenth Century* for March, a valuable contribution towards the general literature of the subject.

Demobilisation of Pivotal Men.

THE demobilisation of the pivotal men whose release was applied for by the Board on behalf of farmers and other employers has proceeded more slowly than was expected, the number whose release has been reported to the Board up to the end of March being about half of the total. Representations have been made to the Ministry of Labour and the War Office with a view to expediting the procedure. It must, however, be remembered that a demobilised man is entitled to 28 days' leave before he takes up civil employment; and this no doubt accounts to some extent for the delay. Another matter deserving mention is the fact that a certain number of men have entered other employment, although demobilised expressly on the application of farmers.

Increased Food Production in the United Kingdom.

A TABLE will be found among the Statistics giving the estimated produce of grain, potatoes, roots and hay in the United Kingdom in the years 1914 and 1918, showing the increase that has taken place during the war. Wheat and oats have increased by practically 50 per cent. and potatoes by 23 per cent., while barley is less by 4 per cent. It is a notable fact that while the crops grown mainly for human consumption show such striking increases, those for animal consumption have been maintained at almost the pre-war level. The root crops, taken together, show a decrease, of only 613,000 tons or 1·8 per cent., and hay a decrease of only 72,000 tons or 0·6 per cent.

The following table gives the estimated numbers of live stock for the same years. The total number of horses is practically unchanged, cattle show a slight increase in both classes, sheep a moderate decrease and pigs a marked decrease. It should be noted that the totals, although described in all cases as those for the United Kingdom, do not include the Isle of Man and the Channel Islands, and that the "other horses" in Ireland include only stallions and unbroken horses, whereas in Great Britain the class is a wider one.

Agricultural Conditions.

THE weather during the first three months of the year has been far from ideal, and as a result cultivation is more backward than usual. January was very changeable; in the northern and north-eastern counties there was a considerable amount of sleet and snow, with occasional frosts, but in the western and south-western counties it was comparatively mild with a good deal of rain. Conditions were more favourable in the eastern and south-eastern counties, and work in these districts was not impeded to any appreciable extent. In February the weather was very severe for the greater part of the month, and in many districts ploughing was impossible. In the south-western counties the frost was not quite so severe or so prolonged, and considerable arrears of work were overtaken. The first few days of March were comparatively mild, but thereafter frost was general, and there were several heavy falls of snow. There was practically no growth during the month, sowing operations have been delayed and cultivation generally is very backward.

The reports received are practically unanimous in stating that the wheat crop has suffered more or less owing to the continuance of severe frost and cold winds. It is to be hoped that the set-back is merely temporary, and that the advent of warmer weather will prevent serious damage to the plants. It is not yet possible to give any reliable estimate of the area sown, but a diminution will certainly be shown, and may amount to 5000 acres or more. In addition, it is probable that the acreage of spring wheat will also show a decrease. Practically no barley or oats have yet been sown, a significant contrast with the position at the end of March last year, when the sowing of both crops was generally well advanced. Young grasses and clover are reported to be vigorous and healthy in the western and south-western counties, but elsewhere there has

been very little growth, and in many parts they have suffered owing to the severe frosts.

The planting of early potatoes was almost completed by the end of March in Ayr, Dumfries, Wigtown, Kintyre and Bute, and in South Ayr the planting of the second earlies was about half through. Some planting of early varieties has also taken place in Fife, the Lothians and Peebles, but elsewhere, generally speaking, field planting has not yet begun.

Sheep stocks have had a trying time during the three months under review and especially in March, when heavy snow storms caused considerable losses, particularly among the hill stocks. Lambing has begun among the flocks on arable farms and is well advanced in the earlier districts. The fall of lambs is so far about an average, but the cold weather has retarded progress and has tended to diminish the flow of milk of the ewes. Hill lambing had not begun by the end of March. Hay and straw are short in the northern and north-eastern districts; the supply of turnips is generally low, and in many parts considerable damage has been caused to the roots by frost. Feeding cattle have done moderately well, but the shortage of purchased feeding stuffs has made their progress slow.

The labour situation is gradually improving owing to the demobilisation of agricultural workers, but the supply of skilled men is still short of requirements.

There is a general insufficiency of all labour in Aberdeen, North-East Forfar, South-West Perth, Shetland, Uist, Skye, Dumbarton and Wigtown. The deficiency in the supply of workers has not been felt so much up to the present in view of the fact that the severity of the weather has delayed the usual seasonal operations; difficulties, however, are expected when sowing and potato-planting are in full swing. According to reports received from Perth, Ross, Inverness and Nairn there have been many cases of demobilised agricultural workers preferring to enter other occupations where higher rates of pay are to be obtained.

RECENT PERIODICAL LITERATURE.

The majority of the following extracts and summaries are taken from recent bulletins of the International Institute of Agriculture. Full references to the bulletins, and to the original publications quoted therein, may be obtained on application to the Secretary, Board of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh

The Influence of the Physiological Condition of the Seed upon the Course of Subsequent Growth and upon the Yield; the Effects of Soaking Seeds in Water. *F. Kidd and C. West, The Annals of Applied Biology.*— Of late years in most researches dealing with the Seed the attention has been almost entirely concentrated upon the question of germination, while little attention has been paid to the eventual influence of treating the grain, which would show how far the physiological condition of the plant in the seed-stage may exert a pre-determining influence upon the whole subsequent course of growth and development. The importance of this question is obvious when it is said that the yield from an equal number of plants of a pure line may vary 50 per cent. or even more, owing to the pre-determining influence of the

physiological condition of the seed as affected by environmental conditions both before and during germination.

The authors undertook to study this pre-determining influence and, in the present paper, give the first results obtained by immersing the seeds in water at 17°C. for 8, 24, 48 and 72 hours. The seeds used were those of the pea (*Pisum sativum*), dwarf bean (*Phaseolus vulgaris*), barley (*Hordeum*), sunflower (*Helianthus annums*), white mustard (*Brassica alba*), broad bean (*Vicia Faba*), white lupin, wheat and oats. The effects observed on the rate of germination of the various samples thus treated, as well as on the yield of the plants obtained (length of stem and root), lead to the conclusion that *soaking the seed in water may have a marked effect on the subsequent growth* of the plant. The *nature* of the effect is strongly *specific*, quite different results being obtained by similar treatment upon closely allied plants, as is shown very strikingly by beans. The results of soaking the seeds of the dwarf bean even for 6 hours becomes evident after a month's growth by a decrease of 26 per cent. (as compared with control plants set dry) in the dry weight yield of the tops of the plants. Seeds of the same species, soaked in water for 24 hours before sowing, showed the most rapid and vigorous germination, while later, 12 days after sowing, the total length of these plants as compared with the controls set dry was as 2·4 : 13·8.

The results obtained with the Broad Bean are quite different: the effect of soaking the seeds was found to be increasingly beneficial, not only on the percentage of germination, but also upon the size of plant produced. Thus, 3 weeks after sowing, the average height of the plants produced from seeds planted dry was only 4 cm. as compared with 10·4 cm. in the case of those soaked for 3 days before sowing.

Variations in Seed Tests Resulting from Errors in Sampling. *O. A. Stevens, Jour. of American Soc. of Agronomy.*—Variations in the results of seed testing are largely unavoidable. They may be divided into two groups, one purely mathematical, the other personal or, to a large extent, economic (due to lack of money to buy the best apparatus, and to employ efficient and trained workers). The direct mathematical causes are :—

For germination tests :—Imperfect mixing, random sampling, errors in counting, effect of personal selection (there is a tendency to pick out the better seeds), unsuitable conditions for germination, special condition of the seed.

For purity tests :—Imperfect mixing, random sampling, errors in weighing, effect of personal selection, errors of identification.

During the years 1914 and 1915 the author investigated in the Department of Botany of the North Dakota Agricultural College the errors due to mathematical causes. Both in the germination and purity tests the general plan was for one person to take simultaneously a series of 50 tests from one lot of seed, and to calculate the standard deviation and probable error.

CONCLUSIONS AND RECOMMENDATIONS.—I. The probable error of a single germination test of 100 to 400 seeds for percentages of germination of 99, 97, 95, 90, 80 to 50 respectively varies as follows :—0·75, 1·00, 1·50, 2·25, 2·80 in samples of 100 seeds ; 0·50, 0·70, 1·00, 1·50, 2·00 for 200 seeds ; 0·40, 0·55, 0·80, 1·20, 1·75 for 300 seeds ; 0·35, 0·50, 0·70, 1·05, 1·50 for 400 seeds. The figures increase by about one-fifth in the lower percentages of germination for Leguminosæ containing so-called "hard" seeds. This is for work in which the causes of variation are reduced to a minimum. No attempt was made in this study to determine the range of value when factors other than those of mathematical probability enter to any extent. These values may be used for other experiments involving similar conditions, *e.g.*, in counting 500 seeds to determine the percentage of mixture of two kinds.

II.—In samples which do not contain mixtures of materials with a tendency to separate readily (such as sand, fine impurities, or coarse material), only a small amount of mixing seems necessary. Such samples should receive a supplementary test of larger quantity to show the approximate amount of such materials. For example, these may be first separated by a sieve, and the percentage added to that obtained by a regular test from the remaining quantity.

III.—The accuracy of purity tests depends on many factors. The quantities used should be carefully investigated to determine whether those in current use

may be advantageously changed. The second decimal figure is of no value in most cases. If such accuracy is required, the determination must be made with a sufficiently large sample (*e.g.*, for about 8 oz. of wheat 30 gm. should be taken; for flax and small seeds, three times the usual quantity).

IV.—Results of seed tests should be accompanied by an indication of their accuracy, *i.e.*, by the value of the probable error. In practical tests this should be doubled, because there are about four chances in five that the correct result lies within the figure thus corrected.

V.—The second decimal figure is not necessary for the calculation of the probable error in such tests.

VI.—The amount of seed used for such tests (and therefore the degree of accuracy obtained) should be regulated by two factors—the degree of accuracy required for dependable results, and the amount of work it is possible to handle. In germination tests it is advisable to use 200 seeds per test, the number being increased if desired. It is most important to know the probable error, so that such adjustments may be made.

VII.—Duplicate tests appear to be of little value; one test of 200 seeds will often require less space and time than two of 100 seeds.

Observations on Some Degenerate Strains of Potatoes. *F. C. Stewart, New York Agric. Exper. Station, Bull. No.* 422.—The results are given of investigations made by the author in the experiment fields of the New York Agricultural Station at Geneva to determine the manner in which the potato diseases known as leaf-curl, curly dwarf, mosaic and spindling-sprout are transmitted from one generation to another. These seem to be less diseases properly speaking than forms of degeneracy, for in no case was it found possible to isolate pathogenic micro-organisms. The action of the soil and weather factors must also be excluded.

The two principal results obtained showed that:

(1) The tubers of affected plants nearly always produce more or less degenerate and useless plants. In 1914 47 badly affected specimens were chosen, from which were obtained, in 1915, 197 plants, all diseased with the exception of one (of the Ionia variety).

(2) Perfectly normal plants (Pride of Vermont, Green Mountain, etc.) may produce degenerate types. Tubers of the same plant, and even different eyes from one and the same tuber, may produce both normal and abnormal plants.

This last fact, as well as the constant transmission of the degenerate types, seems to show that these hereditary diseases may be produced as real mutations or bud variations. This is born out by the rapid degeneration frequently observed in the descendants of perfectly healthy plants. For example, a tuber of the Green Mountain variety planted in 1913 gave 63 seed-pieces for the following year; all the plants produced from these pieces were healthy and perfectly normal. The tubers of 36 of these plants were planted in the spring of 1915 in three plots in three different localities, Riverhead (Long Island), Cadyville (New York), and Presque Isle (Maine), and produced in all three places many decidedly degenerate plants.

CONCLUSIONS.—(1) Tubers from plants affected with leaf-roll, curly-leaf, and mosaic transmit these degenerate characters to their descendants. All tubers from plants which are even only slightly abnormal should, therefore, be eliminated.

(2) Degenerate forms crop up unexpectedly as mutations from material which had been perfectly healthy for several generations, so that even a very careful sorting of seed tubers will not exclude the possible occurrence of abnormal descendants subject to degeneration.

Utilisation of Stalks of Flax Cultivated for Seed. *Bull. of the Imperial Institute.*—As a rule the stalks of flax from which the seed has been removed are burned. This is the best way of utilising small quantities as the ash can be applied as fertiliser. When, however, as in Argentina, the United States and Canada, flax is grown on a large scale, other possibilities should be considered. At present there are two such possibilities:—(1) production of tow from the stalks; (2) the manufacture of paper pulp or paper. Both these methods demand expensive equipment, and can be adopted only where there is a large

quantity of raw material and a local market for the final product, which is not sufficiently valuable to export. In Rhodesia the cultivation of flax as an oil-yielding plant is rapidly increasing, and the British South Africa Company sent to the Imperial Institute a sample of flax stalks for information as to the methods of utilising them. The sample contained 11·1 per cent. of moisture and 3·6 per cent. of ash. The fibres extracted were from 12 to 25 mm. long. Treatment with caustic soda gave 44 per cent. of strong paper which did not bleach easily. Treatment with sulphite gave 45 and 46 per cent. of paper which bleached without difficulty. By crushing between rollers, beating and threshing, about 23 per cent. of tow suitable for paper-making was obtained. When treated with caustic soda the tow yielded 50 per cent. of paper but little superior to that obtained from the whole stalks. The shieve when treated with caustic soda gave 43 per cent. of pulp which did not bleach, and could be utilised only if mixed with longer-fibred material or for making very common paper.

Measures against Frit Fly. *The Field* (*25th Jan.* p., 106).—Some experiments carried out by the Food Production Department in 1918 have proved conclusively that early sowing safeguards a crop of oats from excessive damage by Frit Fly. The actual effect of early sowing is to minimise the attack on the young plant, which has reached a hardier condition before the flies are on the wing; but it also reduces the damage caused to the kernel. This damage is seldom recognised, but in 1918, when the young plant escaped almost unscathed, the attack upon the oat kernel is estimated to have caused an actual reduction in the whole crop of the country of something like 8 per cent., although in places 40 per cent. would come nearer the mark. In dry and early districts oat sowing should commence about or soon after mid-February, and in all frit fly areas the crop should be sown as soon as the land is in fit condition.

Experiments on the Influence on the Fertilising Power of Sewage of the Bacteria it Brings to the Soil. *G. Masoni, Modena.*—The aim of the experiments described was to determine whether more or less sterilised sewage exercises on the soil an influence different from that of natural sewage. In one series of experiments the sewage was spread over the earth, in another it was mixed with the earth which was placed in earthern pots containing 26 lb. In the experiments were used :—

(1) Pots without sewage.
(2) Pots with sewage in the natural state.
(3) Pots with sewage sterilised by boiling.
(4) Pots with sewage partially sterilised with sulphuric acid at the rate of 1 per cent. of their weight.
(5) Pots with sewage treated with an amount of sodium sulphate corresponding to 1 per cent. of sulphuric acid.

The better to determine the action of the micro-organisms of the sewage, earth completely sterilised by heating to 130-140° C. for 8 hours was used in the following group of pots :—

(6) Pots with sterilised soil unmixed with sewage.
(7) Pots with sterilised soil mixed with natural sewage.
(8) Pots with sterilised soil mixed with sewage sterilised by boiling.

In this group the sterilised soil of the pots was moistened before beginning the experiment so as to give it the same moisture content as the natural soil.

RESULTS.—The second series of experiments especially (sewage mixed with soil) showed the following facts with respect to the yields and conditions of the plants, not including the fertilising power of the sewage itself :—

(*A*) *Experiments with soil in the natural state.*—(1) Sterilised sewage gave much better results than natural sewage.

(2) Sewage treated with 1 per cent. of sulphuric acid gave almost the same results as sewage sterilised by boiling.

(3) Sewage treated with sodium sulphate gave better results than those

with natural sewage, but, on the whole, slightly inferior to boiled sewage and that treated with sulphuric acid.

(*B*) *Experiments with sterilised soil.*—Pots with natural sewage gave higher yields, not only than the control pots, but than pots with sterilised sewage.

Comparison between experiments A and B.—(1) Of the control pots, those with sterilised soil always gave higher yields than those with natural soil, especially for maize.

(2) With natural sewage buckwheat gave almost the same yields in both natural and sterilised soils, while maize yielded more in sterilised soil.

(3) When boiled sewage was used sterilised soil was always inferior to natural soil.

CONCLUSIONS.—Partial or complete sterilisation tends to increase the fertilising action of sewage.

The two facts :—(*a*) that sterilised sewage gave better results in natural than in sterilised soil ; (*b*) that natural sewage gave better results than sterilised sewage in sterilised soil, lead to the conclusion that although sterilised soil of itself tends to give yields equal or superior to those obtained in natural soil, an organic fertiliser free from micro-organisms has always more effect in surroundings containing micro-organisms capable of acting on it.

Other experiments, in which the earth of the pots was aerated, confirmed on the whole the above results. This calls for a continuation of the study of the influence the bacteria brought into the soil by organic fertilisers may exercise, particularly on the phenomena of nitrification and denitrification.

"Renovated" Butter. *Revue Scientifique, Paris.*—Whilst increasing the quantity of food stuffs they produce the United States are also attempting to improve the quality and increase the commercial value. M. G. D'Avenel gives a significant example of this. Instead of heavily salting their summer butter, the amount of which exceeds the demand, and which is usually mediocre butter not easy to sell, the American farmer has devised what was first called "magic butter," then "boiled" or "sterilised" butter, and which is now known officially as "renovated butter."

The butter is melted as soon as bought on the market by the 80 firms that use the method, then solidified in iced water after 1 per cent. of glycerine and 5 per cent. of salt have been added, then preserved in closed recipients until winter. To return it, according to the demand, to its original state, the salt and glycerine are carefully extracted by again melting it ; it is mixed with 3 times its volume of milk, and the emulsion of butter and milk obtained in this way exactly resembles fresh cream, which is then churned in the usual way. "Renovated butter" is quite pure, since it contains no foreign matter, and, although it is required by law to be labelled "renovated butter," it is nevertheless much in demand on account of its price, more modest than that of choice varieties.

The Churning of Sweet Cream and Acid Cream : Investigations in Sweden. *O. Hesselberg.*—The author seeks to determine whether it is more advantageous to churn sweet cream or acid cream. Of late years the production of butter has assumed more and more the character of an industry the technique of which demands the most modern ingredients and methods, such as pasteurisation, the use of pure lactic ferments, etc., and all improvements in technique have always been concerned with the churning of acid cream. Moreover, should there be any defect in flavour, the consumers, always very exacting in this respect, never fail to impeach the churning of sweet cream should the dairy adopt this method.

Calculations are given showing that the maximum average yield which may be obtained from 100 lbs. of milk (with 3·5 per cent. of fat) by churning acid cream is 4·186 lbs. butter, while when sweet cream is churned the butter yield is 4·184 lbs.

The yield is, therefore, almost identical in both cases.

The method usually adopted in churning sweet cream is as follows :—the butter-milk is skimmed and the cream obtained added to the other cream obtained during the day. This is a great mistake from the point of view of

both yield and quality. If, on the other hand, the "buttermilk cream" is churned a second time one week later, when it is "ripe" the yield is excellent.

The advantages of churning sweet cream are :—

(1) it is unnecessary to acidify the cream ;

(2) defects in quality due to the acidification of the cream are avoided ;

(3) butter made from sweet cream keeps much better than that made from acid cream ; the author showed that, in the first case, butter was perfectly fit for consumption even after two or three months, whereas, in the second case, it deteriorated after fifteen days ; these superior keeping properties are seen especially during the summer and autumn months.

Albuminoids in the Feeding of Live Stock. *G. Wiegner, Berne.*—After considering generally the feeding of cattle, the author discusses at length the part of albuminoids therein and shows that, in the new discussion on the minimum quantity of albuminoids necessary in the feeding of man and animals (raised by the shortage of albuminoids and their rise in price through the war) account must be taken to a far greater extent than has hitherto been done of the biological value of the albuminoids, of the qualitative composition of the foods and fodders and variable degree of digestibility. It is necessary to distinguish between the relative minimum and the absolute minimum of albuminoids necessary in feeding because the physiological laws are not yet known with sufficient exactitude, and there is as yet no feeding technique sufficiently trustworthy to make it possible to restrict either men or animals to the "absolute minimum" of albuminoids (which is, for example, 30 gm. for a man and from 100 to 125 gm. for cattle weighing 500 kg.).

The author believes that, even in times of scarcity, the absolute minimum of albuminoids must be doubled if waste of other food elements of great value is to be avoided, and especially if derangement of the organism is to be guarded against. He shows the reasons, based on abundant experimental data, which led him to form this opinion, and shows the figures given later to be probably correct for the albuminoid requirement of live stock in so far as our theoretical and practical knowledge of feeding will enable us to judge.

It is possible that the absolute minimum of albuminoid requirement for cattle weighing 500 kg. may be reduced to 100 to 125 gm. of digestible albuminoids in the ration, but most workers agree, and rightly so, that 250 gm. is the minimum amount of digestible albuminoids which should be fed. In a diet requiring the greatest possible economy, as in the case of that imposed by the war, this figure may, at the most, be reduced to 200 gm. of digestible albuminoids in the fodder given.

Under better feeding conditions and with albuminoids of high biological value it is possible to recover, in the form of milk albumin, all the albuminoids fed, except that which is indispensable to the maintenance of the dairy cow. It is also possible in practice and under the experimental conditions adopted by the author, to cause 350 gm. of digestible albuminoid contained in a ration to be transformed into 350 gm. of albumin contained in 10 litres of milk with a 3·5 per cent. albumin content. Kellner, however, recommends under the same conditions almost a double quantity, that is to say 550 to 650 gm. of digestible albuminoids for 10 litres of milk.

If, instead of considering the starch value only, account is taken of the qualitative composition of the food according to the rules given in this paper, the quantity of albuminoids required to produce 10 litres of milk may be reduced to 450 gm. Fingerling believes it possible to reduce this figure to 400 gm., but, as the author justly points out, it is precisely in feeding for milk production that a limited excess of albuminoids most rarely represents a wastage of albuminoids. Growing animals can also transform a quantity of albuminoids exceeding that which is indispensable for maintaining the albumin which accumulates in the tissue of the animal, providing, of course, that this is under improved conditions of feeding and development such as specified by the author. As these conditions are very difficult to realise in practice the author recommends that, in this case too, the figure given for the absolute minimum be doubled.

For growing calves the author recommends in time of war demanding the greatest possible economy the following figures drawn up by Fingerling :—

Age of Animals.	Live Weight.	Minimum quantity required for 1000 Kg. of Live Weight.	
		Digestible Albuminoids in Maintenance Ration.	Digestible Albuminoids in fattening or production Ration.
Months.	Kg.	Gm.	Gm.
2–3	70	400	2200
3–6	140	400	1800
6–12	240	400	1300
12–18	320	400	800
18–24	400	400	600

These rations must be considered as "minimum war rations"; their values are 25 per cent. below those given by Kellner.

The amount of albuminoid necessary for growing pigs has not yet been fixed definitely and new investigations are necessary. The author's calculations, however, show that, for growing pigs, the minimum quantity of digestible albuminoids is from 60 to 80 gm. per head daily, though according to Fingerling an average quantity of 30 to 40 gm. is sufficient. It is known that pigs under good growing conditions respond well to albuminoids in the ration.

For a complete ration (maintenance ration + production or fattening ration) Lehman recommends 250 to 300 gm. of digestible albuminoids per head daily, whereas Fingerling reduces these figures to 100 to 200 gm. By numerous practical experiments on the intensive and rapid fattening of pigs (from 20 to 110 kg. in 5 or 6 months) Lehman showed that the rather large quantity of albuminoid he advises gives good results and proves profitable, though admitting that when necessary it may be decreased to 200 gm. as shown by the author.

The author also shows that a ration deficient in albuminoids may often cause serious derangements, especially in growing pigs. In view of the uncertainty of calculating theoretically the quantity of albuminoids to be given to pigs he recommends the use of empirical rules for feeding which would lead to good practical results, and could also be used in war time when the shortage of albuminoids is more keenly felt. Some of these principles and rules for feeding pigs are taken from the works of Lehman on this subject.

Tree Leaves in Live Stock Feeding. (I.) *A. Lhoste, Paris*; (II.) *F. A. Ezendam, Doetinchem.*—(I.)—The author (Director of the Mans slaughter houses, France) shows the value of tree leaves in the feeding of live-stock. The food value of the leaves varies according to the vegetative period and the plant: as a rule it is higher in June and July than in September, and the leaves from the higher parts of the tree are richer in fibre. The plants containing the most nitrogen are alder, acacia, elm, lime, oak and maple.

The results of several chemical analyses made by M. A. Ch. Girard (Professor of the Institut national agronomique) are given in detail. The average food value, in food units, of tree leaves at the end of July is 37·7, and that of meadow hay 31.

The leaves may be fed either green or dry. Green and dry leaves may be given to animals in the following quantities respectively:—horses and mules, 11 to 17·6 lb., 8·8 to 11 lb.; oxen, 22 to 33 lb., 13·2 to 22 lb.; sheep, 5·5 to 6·6 lb., 2·2 to 3·3 lb. Various specimen rations are then given:—

For horses of 1100 *lbs.*—(1) green leaves 17·6 lbs., oats 8·8 lbs., straw 4·4 lbs.; (2) dry leaves 9·9 lbs., oats 11 lbs., straw 3·3 lbs.

For oxen—(1) maintenance ration: dry leaves 14·3 lbs., oat straw *ad lib.*; (2) working ration: dry leaves 22 lbs., boiled potatoes 44 lbs., rape cake 2·2 lbs.

For cows of 1100 *lbs.*—(1) dry leaves 55 lbs., straw *ad lib.*; (2) dry leaves 17·6 lbs., boiled potatoes 41·8 lbs.

For sheep.—(1) green leaves 6·6 lbs., straw *ad lib.*; (2) dry leaves 3·3 lbs., straw *ad lib.*

Twigs.—Twigs with leaves are called "summer twigs," those without leaves, "winter twigs." The true food value in food units is 12·6 for acacia twigs, 13·2 for poplar twigs, 12·9 for beech twigs (negative value because the work of digestion is superior to the number of calories obtained from the food) as against 31 for hay.

Chopped, fermented twigs and non-chopped dry twigs may be fed in the following proportions respectively:—horses and mules 6·6 lbs., 8·8 to 13·2 lbs.; oxen 16·5 lbs., 22 to 26·4 lbs.; sheep 1·1 lb., 2·2 to 4·4 lbs. The following rations are recommended for oxen and cows:—

(1) Chopped summer twigs 16·5 lbs., chopped straw 6·6 lbs., rape cake 4·4 lbs., salt 1·1 lb.; (2) crushed winter twigs 26·4 lbs., chopped straw 6·6 lbs., potatoes 11 lbs., rape cake 1·1 lb., salt 0·22 lb.

II.—According to the author (of the Royal Agricultural Experiment Station of Wageningen, Holland) the food value of dry leaves is about equal to that of medium quality hay. The date and hour at which the leaves are harvested influences their food value. The dry matter content is highest and the nutritive constituents most abundant in July and August. Towards autumn the tannin content increases and digestibility is no longer so good. The leaves are obviously richest in starch in the evening owing to the formation of chlorophyll. Dry leaves must not be exposed to the sun and must be protected from rain. Trees capable of supplying suitable food are acacia, birch, elm, poplar, lime, chesnut, ash and willow; beech and oak are less suitable.

Investigations into the Composition of Seaweeds with a View to their Utilisation as Cattle Food in the Netherlands. *B. R. de Bruyn.*—In order to utilise all available material in the best possible manner so as to remedy the increasing shortage of cattle food, the Royal Agricultural Station at Wageningen for the control of Cattle Foods analysed specimens of seaweeds. On a water-free basis, the composition of *Zostera marina* was:—Albuminoids 20 6 per cent., true albumin 16·9, digestible albumin 4·2, fat 1·6, starch 38·6, crude fibre 14·8, ash 24 4, sodium chloride 12·7 per cent.

Samples of Fucaceae were also analysed. Their albumin content is not high owing, according to Werenskiold, to the presence of tannic acid which, with the albumin, forms an insoluble compound on which experiments have shown pepsin to have no action. The experiments of Sollied in Norway and those of the author have not revealed the presence of tannic acid. The food value of the seaweeds must, then, be attributed rather to their starch even though they have not a high carbohydrate content. The low crude fibre content of the *Fucus* is, however, an advantage.

The few known examples of the previous use of seaweeds as cattle food are quoted. In Ireland, Scotland and the Faroe Islands, dried seaweed is used as a winter feed for cattle and horses, in southern Sweden and Zealand as a food for swine. In Germany, since the war, special instructions have been given with respect to the gathering of seaweeds. They are spread out so that the rain can wash out the sodium chloride sufficiently; they are then suitably dried and baled in a press. Washing with soft water is indispensable, as many seaweeds (the "brown algæ") contain a mucilaginous nitrogenous substance, algine, which with lime and magnesia forms insoluble compounds which would diminish the food value if hard water were used.

In the absence of other roughages, therefore, seaweeds may be fed to cattle when the sodium chloride has been sufficiently removed.

Substitutes in Swine Feeding in Canada. (I.) *G. B. Rothwell*; (II.) *J. M. Trueman, Agric. Gazette of Canada.*—I. For several years numerous experiments in the feeding of pigs have been carried out at the Central Experiment Farm, Canada, and the paper under review gives a summary of the results obtained which may suitably be adopted under the food-shortage conditions brought about by the war.

Cottonseed meal, gluten feed, linseed oil meal and distillers' grains may possibly be obtained, though only in limited quantities. They give good and economical results when added to a basis maize, shorts, barley ration in the following proportions:—gluten feed 20 per cent., linseed oil meal 17 per cent., cottonseed meal 13 per cent. Good results were also obtained with 20 per cent. of distillers' grains. An increase in the percentage of linseed and cottonseed meal added causes protein poisoning, though as much as 30 per cent. of gluten

feed may be given. Maize oil cake, when procurable, is an excellent concentrate fed with shorts, or bran and skim-milk. Maize bran may be profitably fed to brood sows or fattening hogs, but not in quantities exceeding 20 per cent. Consistently good results were obtained with buckwheat screening, which, when fed with skim-milk, proved about equal to a standard ration of maize shorts and oil-cake.

It is not possible to vary very greatly the normal rations of young pigs. Skim-milk appears to be almost a necessity and cannot really efficiently be replaced by any other food. Tankage may, however, be regarded as a milk substitute. The best results were obtained when pigs are weaned without milk by supplying meal dry in a self-feeder, part of which was partitioned off and filled with dry tankage which was consumed as required. Water was freely supplied. The chief value of tankage is as a balance to grain. Middlings for young pigs may be replaced by 70 per cent. shorts, 20 per cent. maize meal and 10 per cent. oil meal. With this, milk in some form is the one best food.

Feeding cut green crops to pigs is not advantageous on account of the labour it involves, and the fact that the feed soon becomes uneatable owing to exposure to the sun and soiling by the pigs, so that much waste occurs. Great advantage is, however, derived from pasturing. As a single pasture crop, alfalfa is unexcelled, though clover is almost its equal. Good results have also been obtained with rape as well as with heavy seedlings (3 to 3½ bushels per acre) of barley, oats or wheat. Of the cereals sown singly barley is the best pasture crop, and, though a mixture of equal parts of barley, oats and wheat gives very good results, it is inferior to barley alone. A summer pasture of alfalfa, clover, or a spring-sown grain or grain mixture is a cheap self-harvested feed for growing pigs. Late summer and autumn pasture should be supplied by rape. An acre will pasture from 10 to 15 hogs in the growing season. An experiment showed the cost per 100 lb. gain to be reduced from $5·30 in paddock feeding to $3·54 in pasture feeding.

Skim-milk is the best single food for the growing hog, but butter-milk, fed fresh, is its equal. For a hog of 60 lb. or over, 400 lb. of skim-milk is equal to 100 lb. of meal. Whey also gives satisfactory results, and, if fed fresh, 100 lb. will replace 19·2 lb. of meal. Skim-milk should not be over-fed. With young pigs the best results are obtained with 1 lb. of milk to 2·5 or 3 lb. of meal; for a 100 lb. or more hog not more than 5 lb. should be fed daily. Milk should be fed sweet to very young pigs, but later there is little difference between sweet and sour milk so long as one or the other is fed consistently. Buttermilk and whey should be fed fresh.

Except in the case of the young pig, feeding twice daily is perferable to three times. Economy is effected by the use of a well-designed self-feeder; a combination of pasture, or successive pastures, with milk by-product and grain self-fed is specially recommended. During the pasture season if grain is self-fed 1 acre of land will carry an average of 4000 lb. live weight of hogs. A series of experiments made in 1917 gave the following results for meal and milk trough-fed, meal and milk self-fed, meal and tankage self-fed, respectively:- Average dailly gain, 0·85 lb., 1·05 lb., 0·53 lb; meal eaten per lb. gain, 1·51 lb., 1·79 lb., 3·9 lb.; skim-milk per lb. gain, 5·2 lb., 3·1lb., —; cost per lb. gain, 4·8c. 5·3c., 10·1c.

II.—For three years the Nova Scotia Agricultural College has made experiments in feeding pigs on grain, skim milk and mangels. The results showed that gains can be made with a comparatively small amount of grain and with less total digestible nutrients than when grain is fed alone. The tables given show that 100 lb. of gain was made with an average of 148 lb. of grain, 900 lb. of skim milk and 110 lb. of mangels, containing 201 lb. of digestible nutrients. Quite a small amount of feed was given when the pigs were only 6 weeks old, but when they neared the age of 24 weeks (200 lb. or over) they consumed as much as 4 lb. of grain, 15 lb. of skim milk and 4 lb. mangels per day. The average daily consumption between the ages of 6 weeks and 24 weeks was 2·2 lb. of grain, 12·9 lb. of skim milk, 1·6 lb. of mangels.

Fish Meal as a Feed for Swine. *Frank G. Ashbrook, Washington.*—The value of fish meal as a feed for pigs has been recognised for some years past, especially by Germany, which used it for this purpose to a far greater extent han any other nation. The experiments described were carried out at the Bureau of Animal Industry Experimental Farm, Beltsville, Md., to compare the

value of fish meal and tankage as supplementary rations and to test the value of fish meal as a supplement to dried potato.

1. *Comparison of fish meal and tankage as supplementary rations.*—Twelve grade Berkshires of uniform size, age and breeding were used. The experiment was divided into two periods, a growing period of 112 days from weaning to fattening age, and a fattening period of about one month. The pigs were about three months old at the beginning of the experiment.

During the growing period the pigs were divided into two lots—1 and 2—of 8 and 4 pigs respectively. Lot 1 was fed 4 parts maize meal, 4 parts middlings and 1 part tankage, and Lot 2, 4 parts maize meal, 4 parts middlings and 1 part fish meal. Lot 2 made a greater daily gain per pig (1·31 lb.) than did Lot 1 (1·25 lb.), and at the end of the experiment the average difference in weight was 10 lb. in favour of fish meal. Lot 1 ate slightly less grain per pig daily (4·53 lbs.) than Lot 2 (4·80 lb.). There appeared to be no difference in growth or general development between the two lots, showing that there was little to choose between the rations.

During the finishing period the same 12 pigs were divided into 3 lots of 4 animals and fed as follows:—Lot 3, 4 parts maize meal, 4 parts middlings, 1 part fish meal; Lot 4, 9 parts maize meal, 1 part fish meal; Lot 5, 9 parts maize meal, 1 part tankage. Lot 4 made the highest daily gain per pig (2·16 lb.), Lot 5 the next highest (2·00 lb.) and Lot 3 the lowest (1·91 lb.). The grain consumed per 100 lb. gain was:—Lot 5, 462·00 lb.; Lot 3, 421·00 lb.; Lot 4, 393·00 lb. It will be seen, therefore, that the best results were obtained with 9 parts maize meal + 1 part fish meal.

2. *Fish meal as a supplement to dried potato.*—Twelve high-grade Berkshire pigs between 5 and 6 months old were divided into four lots of three pigs and fed the following rations:—Lot 1 (check lot), 6 parts maize meal, 1 part tankage; Lot 2, 6 parts dried pressed potato, 1 part tankage; Lot 3, 6 parts dried pressed potato, 1 part linseed oil meal (old process); Lot 4, 6 parts dried pressed potato, 1 part fish meal. The average daily gains were:—Lot 1, 1·57 lb.; Lot 4, 1·32 lb.; Lot 3, 0·91 lb.; Lot 2, 0·80 lb. The rations fed per 100 lb. gain were:—Lot 1, 403 lb.; Lot 4, 428 lb.; Lot 3, 584 lb.; Lot 2, 695 lb. The most rapid and economical gains were made with 6 parts maize meal + 1 part tankage, though those made with 6 parts dried potato + 1 part fish meal were not much inferior.

At the end of the experiment the heaviest animal from each lot was killed to determine the quality of the flesh and fat and the degree of finish. In no case did the meat have any fishy smell or taste.

These results show that, where it can be obtained at a reasonable price in suitable quantities, fish meal, if used in proper proportions, should become one of the most popular and economical supplements for feeding pigs.

Cross between Sheep and He-goat, and between Goat and Ram in Brazil.—Senhor Oscar Canteiro reports the existence at Porto Alegre of crosses between sheep and he-goats which are very fine, and have long wool of the best quality. In view of the long life of these crosses he bred selected sheep to a he-goat of the Toggenburg breed.

According to a correspondent of the periodical *Chacaras e Quintaes* of Correntes (Matto Grosso, Brazil), crosses between rams and goats occur commonly in that State. He himself has a small troup of goats bred exclusively to a ram. The progeny of the cross, locally called "cabrão," have the appearance of kids of a wool breed, but the wool is not curly.

Dr. Fernand Ruffier, in his work, "Manual Practico de Criaçao do Gado no Brazil" describes the Mexican "cuino," a cross between a goat and a ram which lived only a few days.

Researches from the Standpoint of Food Hygiene on the Ganglionic and Muscular Virulence of Macroscopically Healthy Organs in Generalised Bovine and Swine Tuberculosis. *P. Chaussé, Paris.*—When discussing the historical aspect of the question, the author remarks that no value whatever should be attributed to those researches carried out by ingestion; he has found that even the guinea-pig readily resists the ingestion of several million, very virulent bacteria, and a still stronger quantity of virus, if this consists of coarsely ground bovine tubercle material. He also finds that researches by inoculation are insufficiently searching for several reasons and faults of technique.

The author attempted to throw light on the question of ganglionic and muscular virulence as regards food hygiene by acting as follows:—60 samples (18 pigs and 42 cattle slaughtered for food and seized for generalised tuberculosis) were inoculated subcutaneously into guinea-pigs (3-5 subjects for each inoculation) *in the form of muscle juice* and also *in the form of tissue fragments.* The guinea-pigs were killed 45 days after inoculation, and in no post-mortem examination was tuberculosis found.

The ganglia of the seized animals are rarely attacked in a visible manner; many are of quite normal aspect, and the author tried to find whether the microscopically healthy ganglia are virulent.

Virulence was found:—

(*a*) for the 9 pairs of ganglia from the pig, *twice*, in each positive case, with 3 tuberculous guinea-pigs out of 3 survivors;

(*b*) for the 44 pairs of ganglia from the cow, 11 *times*, with, in these cases, 100 per cent. of tuberculous guinea-pigs, and, in other cases, the half or two-thirds.

CONCLUSIONS.—(1) From the 60 negative results obtained in the muscle tests, this tissue is not virulent practically; in consequence, the consumption of muscle, even when raw, of subjects affected with generalised lesions has no appreciable danger.

(2) The consumption of macroscopically healthy lymphatic ganglia is not without danger when they are insufficiently cooked.

The law is therefore right in allowing the consumption of meat from tuberculous animals after sterilisation and removal of the ganglia. But, notwithstanding scientific evidence, the sale of such meat at low prices after sterilisation is against popular opinion, and, in normal times, the greater part of such meat is lost. The author therefore suggests as a remedy that the State should buy such meat at a low price, and preserve it for use in penitentiary establishments.

Flies and Milk Production. *A. W. Baker, 48th Ann. Rep. Entomol. Soc., Ontario*, 1918, p. 91.—The attacks of stable-flies (*Stomoxys*) and horn-flies (*Lyperosia*) on cattle appear to have an immediate effect in reducing the milk supply. Consequently, the prevention of such attacks has a beneficial effect upon the yield. The author found an efficient repellent for the flies in a mixture of equal parts of kerosene, slightly sour milk, and fish oil, to which strong hot soap solution and a little citronella oil were added. For use the solution was diluted with two parts of water, and was applied to the cattle in a spray. The value of its use was at once apparent in a general increase in milk yield; while at certain periods of the test an increase of as much as 4 to 6 per cent. took place. It was found that spraying before the morning milking gave the best results.

The Attacks of Bot-Flies on the Horse, and their Prevention. *S. Hadwen and A. E. Cameron, Bull. Entomol. Research, vol.* ix, 1918.—The authors have investigated the life-histories and habits of the different species of bot-flies which occur in Western Canada. Each of the three species lays its eggs on a particular area of the horse's body, attaching them to the hairs underneath the jaw (*Gastrophilus nasalis*), to the hairs on the lips (*G. haemorrhoidalis*), or to the long hairs, especially on the forelegs (*G. intestinalis*), whence they reach the mucous membrane of the mouth through the licking of the horse. The attacks of the two first mentioned bot-flies cause horses much nervous apprehension, and if persisted in may result in serious stampedes. To ward off the attacks of these flies the authors have devised two simple pieces of apparatus. The first consists of a leather band cut into a series of strips, each about three-sixteenths of an inch wide, and long enough to cover the lips of the horse. The band surrounds the muzzle of the horse, and is attached to the head stall. An extra leather flap, also ending in strips, runs forward to protect the nose. The pressure and movement of the leather strips effectively interfere with the attacks of the haemorrhoidal bot-fly, while the nasal bot-fly is equally nonplussed by a piece of canvas extending from the nose-band to the throat, and protecting the under portion of the head which is liable to attack.

Bot-Flies and Pernicious Anæmia in Horses. *L. Van Es and A. F. Schalk, Ann. Institt. Pasteur, vol.* 32, 1918, p. 310.—Experiments have shown

that injections of extracts of bot-fly larvæ have a distinct and specific effect upon horses. The symptoms produced are those of pernicious anæmia, and the cause seems to be an active poison in the larvæ, which the authors have named œstrine. The disease, produced artificially, can be readily transmitted from affected to healthy horses, its symptoms remaining the same; and the authors, having found the poison œstrine in the excreta of normal bot-fly larvæ, maintain that this is the cause of all cases of pernicious anæmia in horses, and is to be attributed to the presence, not of an unknown micro-organism, but of the larvæ of bot-flies.

The Spread of Louping-Ill in Britain. *S. Stockman, Jour. Compar. Path. Therap., vol.* 31, 1918, p. 137.—The author has continued his investigations on louping-ill in sheep, and has reached the conclusion that the spread of the disease from an infected to a clean sheep is due to ticks. The method of transmission is a subtle one, for experiment has shown that when a female tick (*Ixodes ricinus*) has gorged itself with the blood of an infected sheep, the larvæ, developed from the eggs of that female, can infect new sheep with a disease marked by high fever, and sometimes ending in death. It seems likely that the disease which can thus be transmitted through the egg may be due to a Protozoan parasite of the blood, but the actual agent still awaits discovery. It was noted that only a small proportion of the ticks act as carriers of the disease, for in order to ensure transmission it was found necessary to place large numbers of ticks upon the sheep to be infected. The spring and summer epidemics of louping-ill can be associated with stages in the life-history of the ticks. The discovery of the agency of ticks in the spread of louping-ill suggests means for combating the disease, since the destruction of the ticks would cause the disappearance of the disease. This seems to be best attained by dipping sheep at short intervals, say of five days during the seasonal epidemics of louping-ill. This severe treatment may possibly lead to collapse in the cases of sheep weakened by the disease, in which case the treatment will have to be combined with some less drastic remedy such as inoculation.

Blow-fly Pest on Sheep in Australia.—So acute has become the destruction of sheep in Australia owing to the maggots of the Blow-fly, that many experiments have been made to devise suitable means for the control of the pest. The varying remedies recommended suggest that an ideal means of checking the pest has not yet been discovered. In the *Queensland Agric. Journal* for 1918 (p. 136), H A. Adams recommended the use of a simple fly-trap made by a Kerosene tin, at the bottom of which lie thoroughly decomposed entrails of sheep. This bait is kept moist by an arsenical solution conveyed by means of strips of flannel from a reservoir at the top of the tin. On the following page of the same Journal, L. G. Jones suggests that poisoned baits do more harm than good, since they repel the flies and tend to drive them to living sheep instead. He suggests that in the same way the flies will be repelled from the sheep if the clotted masses of wool about the creature's hind-quarters, instead of being removed, be dipped in a strong arsenical solution of which he gives the prescription. He further suggests that sheep should have an arsenical salt lick, so that some of the arsenic may pass out with the droppings, to the hindrance of the development of the fly maggots.

Treatment for "Worms" in Domestic Stock. *M. C. Hall and W. D. Foster, Jour. Agric. Research, U.S. Dept. Agric.*, 1918, p. 397.—A series of careful experiments were made with the object of testing the value of various drugs used in the treatment of tape-worms, round-worms, hook-worms and whip-worms. The thoroughness of the experiments is indicated by the fact that the animals treated were generally killed some days afterwards so that the number of worms which had resisted treatment could be definitely counted. Simple purgatives, such as castor oil or calomel, were found to be of little use; but oil of chenopodium (in a doze of 0·2 millilitres per kilo, preceded by a doze of castor oil and 24 hours' starvation), totally destroy the round-worms (Ascarids) in dogs, and proved highly efficacious in the case of swine. Against tape-worms in dogs male-fern was found most useful, but cats were liable to suffer in health from similar treatment. Mixed infections of stomach worms in sheep were most effectively and cheaply dealt with by a weak solution of copper sulphate (1 per cent. solution, 100 millilitres to sheep a year old, half that

quantity to younger lambs); while in the case of poultry, turpentine which proved inefficient in the case of dogs and pigs, banished the round-worm, *Ascaridia*, and chopped tobacco stems dismissed its relative *Heterakis papillosa*.

Motorculture by Electricity. *P. Gouy, Paris.*—After discussing the part that motorculture by electricity should play and its advantages, the author states that if electrical motorculture is to be more generally possible, the large electric works—at present rather scattered and supplying energy chiefly for the urban and industrial centres—should not be depended upon too much, but rather that recourse should be had to other sources of electricty which already exist and could be utilised with advantage.

In the mountains as well as in the hill and plain country there are thousands of little waterworks, mills, etc., which often have more power available in the season than they can utilise. It would be very easy to instal turbines or water wheels to drive dynamos, which at small cost would supply a few horse-power to the surrounding estates. This power, divided among the farms, would not only light the houses and stables, but would also run fixed motors for farm work and movable motors for cultivating the soil. In France it is estimated that such small sources give a total of about 1 million H.P, a figure that could be much increased. In fact, many small falls in the country districts of France are not utilised at all. With the help of local initiative, either private, communal or from syndicated groups who would divide the energy among themselves or supply their neighbours, hydro-electric installations could easily be established. Such simple and efficacious combinations would have the advantage of generalising the use of electricity for cultivation and of hastening the utilisation of the water-power as well as the most necessary agricultural progresses.

The author quotes the Senator Chauveau as to the prices of the H.P.-hour for ploughing :—(1) with a steam windlass locomotive burning 7·7 lb. of coal at 24s. 9d. per ton the cost is 1·92d.; (2) with a paraffin engine, 1·44d.; (3) with a high-tension electric current at 0·96d. the kilowatt the cost is 0·08d. He also quotes the French Minister of Agriculture, M. F. David, to the effect that the water-power kilowatt used for cultivation costs from 0·38 to 1·42d., while that obtained from coal costs 1·42 to 3·14d. when coal costs 32s. a ton.

The Function of Agricultural Engineers as regards the Makers of Power-Farming Machinery. *Lieut. Cote, Produire, Paris.*—Considerations of a purely agricultural order are of capital importance to makers, and it appears from a perusal of technical treatises on power farming that mechanical engineers have not had such detailed information as would allow them to take such considerations into account in their researches. It is indispensable that the makers should be supplied as early as possible with all the desired information so as to avoid feeling their way or following a line that would lead only to disappointments to farmers. Many essential points have yet to be cleared up in this order of ideas.

The supporters of power farming are divided into two groups, and it is at present impossible to say which will vanquish the other. For the one, the problem of power farming consists in the simple substitution of mechanical for animal traction in various ways, while preserving the principle of the plough sock as well as the present instruments of cultivation. For the other, on the contrary, the question is that of replacing the work of the plough share by that of tools, the nature of which does not seem very clear any more than that of the movements by which these tools should be worked.

For the first group, supporters of the plough, it is absolutely necessary to turn the earth to a certain depth before winter. The second group insist that the earth should not be turned, but pulverised to a great depth. This theory, containing the principle of "dry farming," seems to be most applicable to very dry soils and new soils.

Makers can, therefore, justly ask the agricultural experts to say which of the 2 methods, ploughshare, or special parts driven mechanically either with a rotary or alternately rectilinear movement, is the best. So far it seems that both methods are of interest. If the experts cannot decide that one method is certainly better than the other, it ought at any rate to be possible for them to state in what regions and under what climates one or other of the methods is the more suitable from the purely agricultural standpoint. They could then easily

deduce over what areas one or other of the methods should be employed; the makers would then be able to decide the importance of the outlets opening for them in the two cases, and run their works accordingly. The engineers have yet to provide them with more precise detail as regards indirect traction by cable and windlass as well as regards direct traction by a motor-tractor, the compression of the soil, and the working speed of the plough. In the case when the ploughshare is to be replaced by working members, driven through suitable mechanism by an engine serving at the same time to propel the machine, the problem appears still more difficult. The author thinks that machines of this kind would succeed only in so far as the work they do (crumbling the soil) corresponds to the requirements of the land. If agreement is obtained on this principle, it remains to be settled how such crumbling should be carried out and to what degree of fineness and if the machine may not be required to have a digging action, all indications that can be supplied only by the farmer. According to the author light tractors of the Caterpillar type, in particular, seem indicated as immediately furnishing the best provisory remedy for the agricultural crisis. Tractors of the Caterpillar type have been used in large numbers for military purposes and have shown their worth. However, these machines could not provide a final solution of the problem of power farming, as such a solution could be reached only through long researches.

The Béfort and Gaillard Electric Ploughing Set. *Le Génie Rural.*—In this system—recently on trial near Paris—the electric current does not come from a section but from a generator forming part of the set. The makers thus use electricity as a mechanical organ acting at the point where it is required, and give that organ all the independence of the other organs forming the set. They are thus able, just as with a petrol engine and with just as much freedom, to generate the power at the required place and when required.

By transforming the initial power into auxiliary current, the makers claim that the power actually available is much greater than the same power used as a tractor in direct traction.

The Béfort-Gaillard system, using a single generator with a minimum cost, has the advantage of always giving direct traction, the generator serving equally as tractor for the set, and all the ploughs of the farm.

The set offered to the French Ministry of Agriculture consists of a steam-generator, working very smoothly and easily controlled. The generator is always supplied with water and coal for a 10 hours' run, *i.e.* for 1 day's work without further supplies. It thus forms a mobile station going where wanted, when it has to supply its 2 sub-stations.

Cable ploughing sets with a single generator all require a return cable or a return pulley. By doing away with the return pulley MM. Béfort and Gaillard obtain a yield of 86 per cent. of energy available at the draw bar.

To provide for unforeseen resistances and all the strains of traction, a good amount of reserve power must be available. At a speed of 85 cm. per second—a good practical speed for all hard work—the tractive effort is 1800 kg. Taking as basis a 5-furrow balance plough working at a depth of 20 cm. and meeting a resistance of 55 kg. per sq. decimetre, the tractive effort is not over 900 kg.; the reserve power is thus amply sufficient to meet all possible needs.

The Béfort and Gaillard set have the following interesting characteristics:—front swingle-trees with automatic decentering, so that cable traction can be used (without an auxiliary return of the cable) for drilled crops; a draw-bar hook buffering and controlling the traction.

A Tractor Plough. *R. Dessaisaix, Jour. d'Agriculture Pratique.*—When a vehicle moves up a slope its resistance increases with the steepness of the slope. The motor drawing the vehicle up the slope uses a certain amount of energy to move itself, so that there is a reduction of the amount of tractive energy available for the vehicle or machine to be towed. This loss is due to the elevation of the motor on the inclined plane and is independent of the nature of the motor. For example, a tractor weighing 6160 lb. which gives an actual pull of 1672 lb. on level ground, and hauling a plough requiring an average tractive effort of 440 lb. per furrow, will give a pull of 1320 lb. for 3 furrows and 880 lb. for 2 furrows on level ground.

If this tractor mounts a 10 per cent. slope, its possible tractive effort drops to 1661 lb. owing to the decreased pressure of the driving wheels on the soil, and the tractor itself requires 616 lb., so that if it gives a pull of 1672 lb. on level

ground, it can only give a pull of 1045 lb. when mounting, which is insufficient for opening 3 furrows, but more than sufficient for opening 2 furrows. The tractor must, therefore, be handled in such a way that, in ascending only 2 furrows are opened, while, in descending, 3 furrows are opened at the same time.

Therefore tractor ploughs destined for use in steeply sloping land should be arranged in such a way that, by moving a simple lever, the number of plough bottoms working could be rapidly changed.

MM. de Lacour and Fabre, 4, Avenue de Villiers, Paris, have exhibited at the Noisy-le-Grand (France) official trials a Galloway plough built according to the principle described above. It is a 3-furrow plough, and, for slopes, the third plough can be raised by moving a lever, when only 2 furrows are ploughed.

In considering the application of mechanical cultivation to the uneven ground in Scotland, the Highland and Agricultural Society of Scotland laid down the condition that ploughs intended to work on hilly ground should be made in such a way that they could be quickly changed at the end of the furrow so as to plough 2 or 3 furrows, according to whether the tractor ascended or descended the sloping field.

The Galloway plough fulfils the condition, which is applicable to so much cultivated ground.

The Haulage of Ploughs. *M. Ringelmann, Comptes Rendus de l'Académie d'Agriculture de France.*—The author has previously shown that ploughing requires 80 per cent. of the total energy necessary for cultivation.

Suitable weather for ploughing is generally limited in extent. Ploughing is not done under good conditions unless the soil contains from 9 to 10 per cent. of water, 11 to 17 per cent. being considered the optimum ; at more than 21 or 22 per cent. of water, the ploughing becomes bad. The water content of the soil, apart from the purely cultural point of view, has an influence on the wear of the parts, on the stability of the machine and, above all, on the tractive effort required by the plough.

As regards wear, in a good light potato soil (tertiary soil of the Grigny Plateau, Seine-et-Oise, France), the ploughshare has to be set 6 or 7 times per acre in dry summer weather. Each setting cost about 7d., working out at 3s. 6d. to 4s. 1d. per acre. In September, when the soil is wet by the rains, one setting suffices for about $3\frac{3}{4}$ acres. Under the conditions of the present case one share is completely worn out after ploughing 44·5 acres, and to replace it costs 6s. 3d. for ordinary steel and 10s. 5d. for hardened steel.

The tractive effort per sq. decimetre of section ploughed increases for the same plough in the same soil in measure as the soil dries (the average density is 2304 in tertiary soil).

The tractive effort for the plough at different dates and for ploughings comparable one with the other as regards dimensions was 47 kg. per sq. decimetre for the soil water-content of 15·4 per cent. ; 46·1 kg. for 11·1 per cent. of water ; 70·7 kg. for 5·1 per cent. of water ; and 78·2 kg. for 3·8 per cent. of water.

The shape of the working parts also influences the traction considerably. Thus, on the same length, at an interval of half an hour, a plough requires, for the same ploughing, from 1·40 to 1·42 times the pull required by a model of better design or more suited to that particular soil.

As the periods during which the soil are in such a state of humidity as to work well are generally limited, power farming has an advantage that, with it, the farmer can work his land in the desired time.

Rotary Harrow Attachment for Sulky and Multiple Gang Ploughs. *P. R. Potter, Scientific American.*—The rotary harrow described consists of a single gang of closely placed spading discs. Each disc is made up of a number of sharp, steel blades, which are narrow and have a curved and twisted shape.

As the disc rolls along, the blades stab and slice the furrow to pieces, and as there is a considerable number of blades, the surface is left with a fine even mulch. There is a lever for regulating the depth and a spring for adding pressure to the blades. As the discs have rather a revolving action than a dragging one, there is an increase of only 7 to 10 per cent. in the draught on the plough. The attachment is made to clamp tightly to the plough frame and is readily adjustable in any direction ; it can be purchased for the single-bottom sulky or the multiple-bottom engine gang.

As the soil is freshly ploughed, it is more easily pulverised, provided the ploughing has been done under the right conditions.

The "Once-Over" Quack Grass Killer. *Implement and Machinery Review.*—The Quack Grass Exterminator Co., 912, Andrus Building, Minneapolis, Minn., U.S.A., makes a new machine for exterminating weeds, particularly couch grass. By running this machine once over a field (whence its name), practically every vestige of crop-killing weed is said to be exterminated.

This new device resembles a tractor, but does not propel itself. Its petrol motor serves to operate the mechanism while the machine itself is hitched to a tractor or drawn by horses.

The machine consists of a framework mounted on wheels, carrying at its forward end an ordinary plough, minus the mould board, behind which is a toothed cylinder, followed in the rear by an elevator running backward and upward at an angle of about 40° into separating mechanism, which, in turn, is followed by a large circular sieve moving in an anti-clock direction as the machine travels forward. Inside the reel or sieve is a horizontal conveyor running to a perpendicular elevator swing in the rear of the machine for conveying the weed refuse into a wagon driven alongside.

The operation of the machine can be described as follows:—The plough share located at the forward end is 16 in. wide and set to run at a depth of 4 to 6 in.; the ribbon of soil cut is passed back, there being no mould board, and brought into contact with the teeth of the forward cylinder which cuts and shreds up the weeds and soil. At this point about 60 per cent. of the soil is returned to the earth, and the weeds, stalks, etc. are elevated into the separating machinery, where a system of separation, not unlike that of a wheat or small grain threshing outfit, separates the weeds and 20 per cent. of the soil, the latter being returned to the ground. All the weeds and roots and the remaining 20 per cent. of the soil pass into the revolving sieve in the rear. The soil is completely lost through the meshes of this sieve, and the weeds are carried upward by the revolving screen and dumped into the horizontal conveyor, in which they are carried to the perpendicular elevator in the rear, where they are elevated into a vehicle to be carted away and burned, or otherwise destroyed.

A field is thus left in a condition free from all weeds, roots and other noxious growths and in a thoroughly tilled condition, ready to be sown at once if desired. The machine has a capacity of 3 to 5 acres per day, according to the nature of the soil, the thickness of the ground and the speed at which the machine is towed.

This new tool is said to be strongly made and should last from 5 to 8 years; its estimated cost is £200.

Motor-Saw Mounted on a Hand-cart. *La Terre Vaudoise.*—Messrs. Mégevet of Geneva make a circular motor-saw for cutting firewood; the saw is driven by a petrol motor, the whole being mounted on a small hand-cart.

The motor is of the Félix-Mégevet type; it is simple, light and runs well. By adding another cylinder, the maker has improved on the old, one-cylinder type. The Mégevet wood sawing plant is completely independent, and can be moved and set up anywhere in the forest or at the farm. Its small size enables it to pass easily into restricted spaces. Its easy transport and use gives it a claim for superiority over other systems.

The circular saw, with its roller-table and well protected blade, is very safe and easy to work. The engine drives directly on the shaft of the circular saw by means of a horizontal belt. The whole plant is strongly built and all the parts are easily accessible.

The engine consumes little petrol. By using this motor-saw great economy in labour can be made, while the work is done more quickly.

The Production of Groats and Oatmeal. *Implement and Machinery Review.*—Description of an oat milling plant, with figures showing the arrangement of the plant in a simple building, according to the plans of A. R. Tattersall & Co., milling engineers, 75D, Mark Lane, London.

Before milling the oats must be thoroughly dried, either in an ordinary kiln heated by coke, or by special oat-drying apparatus (which is preferred in some cases).

The dry oats are elevated automatically from the kiln floor and deposited in a bin ready for cleaning. From this bin the oats fall by gravitation into a special separator and cleaner, which delivers the grain sufficiently cleaned for treatment in the mills. From the cleaner, the oats are elevated and drop into a bin from which they fall to the shelling mill. This mill is fitted with stones of

large diameter, fixed horizontally to a vertical shaft, which loosen the outer cuticle or shell of the grain; the material is removed automatically to a reciprocating sieve, which eliminates any flour or meal made in the shelling process, and the overtails of this sieve are passed through a blower or aspirator for removing the loose shells. The groats are elevated to another bin, also placed over the shelling bin, to repass the stones, when a second separation is made on the sieve and blower. The shelled oats or "groats" next fall into a hopper fixed over the grinding mill, of the "India" pattern, fitted with stones of a special texture suitable for reducing the groats into fine meal as may be required. Following this the flour passes into a double vibrating sifter in conjunction with another blower for removing the fine particles of husk which may be still left in the meal.

This is a type of plant much favoured in Ireland, which country is now a rapidly increasing producer of oats and oatmeal.

The Scott Process and Plant for Drying Potatoes. *Implement and Machinery Review.*—In the Scott process the potatoes are delivered into a washer, which consists of an inclined trough fitted with a revolving spiral. The spiral is driven slowly and forces the potatoes along into an elevator boot. At this point is fitted a device for separating the stones, adjusted so as to float the tubers but not the stones. A stream of water runs continuously in a contrary direction to the potatoes and so washes off all dirt.

The potatoes are now elevated into a *peeling machine*, which consists of a rotating cylinder, the interior of which has an abrasive surface which rasps the skin from the tubers, the peelings passing to the bottom of the containing tank. The rotating cylinder is slightly inclined to induce the potatoes to travel forward. The peeling operation is also carried out under water; the resulting sludge, when filtered and dried makes an excellent cattle and poultry food.

After peeling the potatoes are conveyed to a *slicing* machine, the buckets of this second elevator being perforated to complete the draining of the potatoes. The slicing machine consists of a rapidly revolving disc fitted with cutting knives. The potatoes are fed up to these knives by means of a suitable hopper, and from this point they pass in fine slices into a *drying machine* over a spreading device which distributes them evenly.

The drying machine is in 2 portions. In the upper part or steaming chamber, the potatoes are constantly in contact with steam, which is led into this portion by suitable pipes. The lower and larger portion is the drier proper. This consists of a closed chamber, containing a number of endless moving bands which carry the charge through the chamber. The slices are spread on the top band and travel along to the far end of the machine, when they drop on to the next lower band, and are carried to the feeding end of the chamber. This forward and backward process is repeated until the lowest band carries them right out of the chamber, dry, and deposits them at some point ready for grinding.

The actual drying is carried out by hot air. The air is heated by drawing it over steam-heated pipes by means of large fans which force it to perform a continuous circuit through the heater, into intimate contact with the steamed potato slices, then back through the heater, and so on.

An extraction fan contsantly withdraws a small portion only of the most saturated air, and this is replaced by fresh air at a convenient spot near the heating pipes. In this way great economy is effected in steam consumption, as partly used air is directed into the drying chamber again and again, so obviating the necessity for heating up a complete supply at each journey through the drying chamber and thus avoiding the loss of heat in the exhaust air.

Throughout the whole of the operations the material is never handled, and labour is thus reduced to the bare handling of the potatoes on reception. By the provision of suitable silos in large plants even this operation can be made of insignificant importance.

Where steam is not available for heating, the makers provide a direct-fired air heater which can burn any kind of fuel.

Messrs. Scott & Son, Ltd., 72 Oxford St., London, make all the plant necessary for drying potatoes preliminary to milling, but do not manufacture the milling plant. However, any machine suitable for fine grinding, fitted with fine screens, would meet requirements, such as a Carter disintegrator, fitted with a sifting reel and bagging attachment.

The Scott drier can also be used for other vegetables as well as fruits. The machine costs more than ordinary driers, but it more than repays its extra cost in the economy of labour and fuel.

Food Preparations made with Blood and Meat mixed with Yeast. *A. Ganducheau, Paris.*—Under present conditions it would be very advantageous to use the blood and intestinal organs, generally wasted by the slaughter-houses, to a greater extent for human consumption than has hitherto been the case. The author proposes a new food prepared from this waste as follows:—the blood of pigs, oxen and horses is taken under special aseptic conditions from the slaughter-house as soon as possible after the animals have been bled and successively heated for coagulation of the albumins and disinfection; it is then crushed and fermented with a pure culture of beer yeast (fermentation under slightly acid conditions in the presence of a small quantity of starch sugar obtained from rice, potato, pea-shells, etc. by warm diluted hydrochloric acid). After a few hours at a maximum temperature of 20 to 25°C. the pasty mass ferments and a microscopical examination shows the presence of pure yeast cultures.

The paste thus obtained, strongly modified by the action of the yeast, is not so compact as that of black-pudding or other similar products, and has numerous small holes caused by the gas formed during fermentation. The porous product is thus more easily acted upon by the digestive juices. Visceral tissues when finely crushed previously may be prepared in the same manner as blood.

With respect to the application of bread fermentation to blood and meat, a subject already treated in previous papers, the author points out that the materials used (bread made with mixed flours, leaven, hashed meat and blood) were bacteriologically impure, and, as they were not heated before fermenting, the leaven had combined with the yeasts and bacteria, a disadvantage incurred also in the oriental process in which mixed meat and bean pastes are used.

For this reason the technique used in fermenting albuminoids should be rigorous and, above all, pure cultures should be used. "Risen" blood paste is excellent for making sausages and pastry, and gives products with a very good flavour. Blood and flour biscuit is a complete food of small bulk, and the author believes that the use of the blood from the slaughter-houses may prove very interesting from an economic point of view.

Exports of Implements, Twine, Tractors and Gas Engines from the U.S.A., for the Period 1915-1917. *Farm Implement News.*—The exports of implements, tractors and gas engines from the U.S. to other parts of the world from 1915 to 1917 inclusive is shown in the following Table:—

Articles Exported.	1915.		1916.		1917.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		$		$		$
Hay Rakes and Tedders	...	212,934	...	301,115	...	777,583
Mowers and Reapers ...	...	4,367,181	...	7,347,406	...	12,740,298
Planters and Seeders ...	...	274,391	...	340,437	...	431,358
Ploughs and Cultivators	...	3,371,915	...	5,202,047	...	7,592,145
Threshers	...	1,563,245	...	1,913,974	...	2,749,785
Parts, etc.	...	3,793,183	...	6,104,755	...	9,222,570
Total ...	...	13,582,849	...	21,229,774	...	33,513,739
Binder Twine ... lb.	108,241,737	8,601,520	156,189,298	15,317,309	129,705,369	20,163,041
Stationary Gas Engines ... ... No.	2,415	457,409	3,446	406,297	6,083	840,175
Stationary Petrol Engines ... ,,	20,039	1,549,242	33,231	2,886,275	27,550	3,240,196
Traction and caterpillars (petrol) ,,	660	1,303,209	3,989	6,208,868	14,233	16,155,184
Kerosene Engines ,,	...	...	...	...	6,539	2,009,915

The Utilisation of Coal Dust for Heating Greenhouses. *P. Rivoire, Revue Horticole, Paris.*—In order to utilise coal dust, M. Reverchon, horticulturist of Moulin-à-vent, near Lyons, France, devised a method of consolidating it with lime, as tar cannot be obtained at present. He made bricks, using an iron mould such as that used by masons for making flag-stones. The mould is composed of two flat elbowed irons, joined at the edges by clamps. The mould is placed on a piece of sheet iron, with two handles, which enables it to be carried. The bricks are made with 5 kg. of lime, 20 litres of water, and 100 kg. of coal.

The lump quicklime must be slacked one or two days before use with an equal quantity of water. When making the bricks the lime is put in a wooden tub together with the required amount of water, and mixed vigorously with a trowel. The coal is placed on the ground near at hand. A hole is made in 100 lb. of the dust, and the contents of the lime poured into it two or three times. The mixture is stirred with a shovel to mix it well and distribute the moisture equally. The mould is then filled with the mixture by means of a trowel, and the contents pressed down The slight hollow formed is then filled up, the whole re-pressed, and levelled with a trowel. The bricks are taken from the mould by removing the clamps, and dried in the shade for about a week. If they are dried too rapidly in the sun the mixture remains powdery, and the bricks break up too easily. The bricks weigh 11 to 13 lb., so that 100 lb. of coal will make 9 bricks. With a little practice 22 bricks an hour may be made.

Effect of Grazing upon Western Yellow-Pine Reproduction in the National Forests of Arizona and New Mexico, U.S.A. *R. R. Hill.*—The present bulletin gives the results of a study undertaken to determine the character and extent of the damage to young growth of western yellow pine in the south-western United States due to the grazing of live stock, and to find out the best means of keeping such damage at a minimum while permitting proper utilisation of the range.

Of 8945 trees of a size subject to grazing, observed over a 3-year period, 1493 or 16·7 per cent. were severely damaged each year, and 1442 or 16·1 per cent. were moderately damaged. The most injured are the seedlings, 21 per cent. of which are seriously damaged. The damage gradually decreases with an increase in the size of the trees. Trees above 4·5 feet in height are free from severe injuries from browsing, but those between 3 and 6 feet in height are likely to be rubbed severely.

The greatest amount of damage occurs during the latter half of June and the first part of July, or when the effects of the spring dry period are most pronounced. The least damage occurs during the first few weeks of the growing period, or before June 15. A very considerable amount of damage is done during the main growing season and during the autumn drying period.

Under normal conditions of grazing, cattle and horses do an inconsiderable amount of damage to reproduction. Sheep under the same conditions may be responsible for severe injury to 11 per cent. of the total stand. On overgrazed areas all classes of stock are apt, however, to damage small trees severely. Cattle and horses may damage about 10 per cent. of all reproduction. When sheep are grazed along with them, however, at least 35 per cent. of the total stand may be severely damaged. Ordinarily sheep cause about seven and a half times as much damage as cattle.

The manner in which stock is handled has much to do with the severity of grazing damage. Cattle are likely to injure 22 per cent. of the trees between 3 and 6 feet in height that grow on areas where they are accustomed to congregate. Sheep severely injure reproduction along driveways and on bed grounds.

It appears that the permanent effects of grazing injuries upon the development of damaged trees are not serious, provided they have a chance to recuperate. If grazing is unrestricted, about 15 per cent. of the total stand is likely to be killed during the period required for reproduction to become established. Reproduction that has been impoverished greatly by grazing is more likely to be attacked by fungi and insects than uninjured and vigorous reproduction. However, the ordinary grazing injuries are not believed to increase seriously the danger of such attacks.

The Bark of Scotch Pine and Spruce. *J. E. Wretlind, Stockholm.*—This paper gives the results of a thorough study of the thickness of the bark of Scotch pine and of spruce made in forests in central Sweden.

The following conclusions were drawn from the many numerical data collected :—(1) the thickness of the bark of Scotch pine at breast height is in constant ratio with the diameter of the trunk, whatever the age of the plant; in the spruce, on the other hand, the ratio of the bark to the diameter decreases when the diameter is larger; (2) the bark of the spruce decreases appreciably in thickness during drying; thus, for example, the bark of a forty year old spruce with a diameter of 22·7 cm. at breast height, dried at the temperature of an enclosed space, decreased in thickness in 48 hours, passing from 4·4 mm. to 2·7 mm.; the decrease in the whole diameter, including the bark, was, in the same length of time, from 22·70 cm. to 22·55 cm.; apart from its commercial importance this fact calls for further investigation; (3) in the spruce, the bark is usually thicker at the base than at breast height; it decreases in thickness up to 20 or 30 per cent. of the height of the tree, and again thickens towards the top. None of these differences are very marked, and are such that, in practice, the percentage of bark at breast height may be applied to the whole trunk.

The author recommends that, when standing wood is sold, the measurement be taken under rather than outside the bark, and that the thickness of the bark should be determined for each station. He also proposes a formula to calculate its percentage of the cubic mass.

On the Life History of the Rose Blotch Fungus (Actinonema Rosæ) in Great Britain. *N. L. Alcock, Kew.*—Work on the control of *Actinonema Rosæ* which, according to Wolf, does not belong to the genus *Marssonia*, has till recently been hampered by lack of knowledge of its life cycle, and the origin of the new attack each season. This problem was solved for the United States by Wolf (1912), who found on dead rose leaves an ascigerous stage, for which he formed the genus *Diplocarpon*, belonging to the family *Microthyriaceæ*. The perithecia ripen in April, and the ascospores formed in them infect the young foliage as it unfolds. There did not appear to be an ascigerous stage in Great Britain, where repeated investigations into this subject had always given negative results. When pruning Juliet roses in the spring of 1918 a patch of discoloured tissue, apparently caused by a fungus, was noticed on the young wood of the previous season. A microscopical examination showed these patches to contain abundant mycelium and compact masses of fungus-tissues bearing spores of *Actinonema Rosæ*.

The season was well advanced before the infection on the young wood of Juliet was first observed. The roses in most of the gardens had already been pruned, and it was no longer possible to obtain much more material, or to make a complete list of the varieties affected. The fungus is scarce in the Royal Botanic Gardens, Kew, and appears to die soon if introduced into the neighbourhood. A visit to the Gardens of the Royal Horticultural Society at Wisley showed the wood of the following varieties to be attacked :—Madame Ravary, La Tosca, Mrs. David Jardine, Gruss an Teplitz, and Juliet.

It is not sufficient to collect and burn infected leaves, attention should also be given to the wood of the preceding years, and, if it be infected, it should be cut. Experiments in America have also shown that dusting eight times a year with a powder composed of 90 parts of finely ground sulphur, and 11 parts of arsenate of lead, is very effective in controlling blotch. Bordeaux mixture and lime sulphur are also satisfactory, but disfigure the plants. In badly-infected gardens it is advisable to use a fungicide even if the trees have been carefully pruned, because some postules are almost certain to have passed unnoticed, and spores may be carried from neighbouring gardens by the wind. It is most important to begin spraying early to prevent the fungus from entering the leaves, because, should this occur, the mycelium continues to grow in the tissues, and the blotches follow inevitably. American experiments have shown that, to protect the trees completely, it is necessary to spray at intervals of about a month.

The Artificial Feeding of Bees with Pollen. *J. Usay, Vienna.*—It is known that in spring bees use a large amount of pollen for feeding the hive. As, in many countries, flowers are rare at this period and the workers are

impeded by the bad weather, the author advises the provision of pollen for the bees. This was suggested to him by the fact that many beekeepers spread in front of their hives flour, which is eagerly gathered by the bees. At the flowering season of resinous trees, which produce abundant pollen, the author shook cones over a box cover, thus obtaining an abundant supply of pollen, which he kept in a dry room till the following spring. When this dust is spread on a board in front of the hive in fine weather the bees immediately collect it. The author has observed no ill effects as a result of this food.

The Fennec Fox in Captivity to Replace the Domestic Cat. *P. Crépin, Paris.*—The fennec fox (*Canis zerda*), so little known at present, is of a certain interest. This pretty little North African fox is easily tamed, and, though it is not common, would be of great service to agriculture could it be reared.

It destroys cockchafers, locusts and crickets, all kinds of injurious insects, rats ; it is as clean as the cat, requiring no previous training; it takes up little space, does not smell, eats almost anything, destroys less small birds than the cat, for it cannot climb trees, and is a pleasant companion, with a fine coat. It might well replace the cat, as it has more advantages without the serious defects of the latter.

The Preparation of Active Virus against Field Mice, and Method of Applying it in Fields Infested by these Rodents. *N. Mori, Naples.*—Of the various methods of controlling field mice that which, since Loffler's experiments in Greece (1893) and Danysz's in France (1903), has proved most efficient is the application of pathogenic bacteria in the fields with the aim of causing epizooties among the rodents.

There is much difference in opinion as to the efficacy of virus in controlling field mice and preventing the spreading of plague by rats. Failure must not always be ascribed solely to the kind of virus used, to the more or less rational method of preparing it, the preservation of its virulence or the method of applying it in the fields. In preparing active virus against rodents choice must be made of the bacterium best suited to the purpose, unless a micro-organism causing a natural epizooty among the rodents to be controlled and possessing the necessary virulence has recently been isolated. The bacterium isolated must be made virulent to the species against which it is to be used by keeping the experimental animals under conditions as natural as possible, as captivity, by weakening them, may influence the results. When a good virus has been obtained it should be kept so that its virulence will neither disappear nor decrease. It must be applied to the fields rationally. To do this it is necessary to know, not only the biology of the infesting bacterium, but also that of the field mice, which has hitherto been too neglected. The virus must be applied to the fields at a suitable period and hour in order to give the best results.

The author then studies the choice of bacterium, the keeping of mice in the laboratory for the preparation of the virus, the preparation of the virus, the preservation of the virulence of the bacterium in the laboratory, the choice of media in which to distribute virus to those requiring it, and the method of applying the virus in mice-infested fields.

Australian Inter-State Conference of Agricultural Scientists. *Jour. of Dept. of Agric. of S. Australia.*—A Conference attended by agricultural scientists from all the Australian States convened by the Federal Government at the instance of the Advisory Council of Science and Industry, was held in Melbourne from November 9th to November 16th, 1917. A number of papers dealing with different aspects of agricultural science were read and discussed. The following resolutions were carried by the Conference and forwarded to the Executive Committee of the Advisory Council of Science and Industry of the Commonwealth of Australia.

I.—That a "Seed Improvement Committee" be formed, which should, among other matters, deal with :—(*a*) The nomenclature of cultivated varieties of farm crops ; (*b*) the elimination of undesirable varieties of crops ; (*c*) the exchange and dissemination of seed samples for research work ; (*d*) the recommendation of money grants to approved State or other Institutions for work in connection with seed improvement and the introduction of improved varieties of crops.

II.—That in view of the benefits to be derived from the systematic introduc-

tion of seeds and plants into the Commonwealth, and to insure more economy of effort in this direction on the part of all the States, this Conference is of the opinion that as soon as practicable a Plant Introduction Bureau should be established, the functions of which would include:—(1) Arrangements for the introduction of new and useful agricultural plants from other countries into the Commonwealth; (2) the systematic testing of these introduced plants in co-operation with State Experiment Farms; (3) the systematic recording of the results of such tests.

III.—That each State Department of Agriculture should continue or initiate the work of improvement and selection of its cultivated crops as part of its regular work, and that such work of improvement be on uniform lines in all the States.

IV.—That the rust in cereals, particularly black rust in wheat, which is common in all the States, and in some seasons largely reduces the yields, be made the subject of a special investigation in connection with plant-breeding.

V.—That the Executive Committee of the Advisory Council be asked to arrange for an annual meeting of plant-breeders from the different States, with a view to co-ordinating their work and arriving at a uniform policy without interfering with individual methods. The meeting to be fixed at a convenient season of the year (July).

VI.—That an organisation should be established to deal with the collection, propagation, improvement, and cultivation in suitable areas of the most promising indigenous grasses and fodder plants.

VII.—That it is advisable to investigate closely the tobacco industry in Australia, both in the interests of the producer and with a view to retaining locally the profits of manufacture.

VIII.—That in view of the high prices ruling for fibre products and the desirability of making Australia self-contained in the production of fibre, a thorough investigation be made into the possibilities of fibre cultivation in Australia, particularly flax and sisal hemp, and the possibilities of producing these fibres for local manufacture or for export.

IX.—That the Advisory Council of Science and Industry be asked to ascertain whether the British Government would be prepared to purchase dew-retted flax fibre from Australia in 1919, and if so, what quantities and at what price f.o.b.

X.—The Conference is of opinion that the prospect of commercial production of power alcohol from certain crops is promising, and suggests that special experiments should be arranged by the Advisory Council of Science and Industry to determine the actual yields of alcohol obtainable from these crops, including sorghums in various stages of development.

XI.—That the Conference welcomes the proposal of the Advisory Council to investigate the utilisation of Australian phosphates, and suggests that this investigation should include manurial trials, particularly on pasture lands in those of the States which possess such phosphates.

XII.—That in view of the need for a supply of scientific investigators into agricultural and pastoral problems the Advisory Council of Science and Industry be requested to direct the attention of the various Australian Universities to the subject.

XIII.—In view of the prominent position occupied by the United States of America in scientific and practical agriculture, and of the similarity of the climatic and economic conditions of that country to those of Australia, this Conference recommends the early appointment of a permanent agricultural representative from Australia to the United States, whose duties should include keeping Australia in touch with improved scientific and practical methods in agriculture and the supply of promising varieties of cereals and other crops.

XIV.—That the Conference expresses its appreciation of the action of the Executive Committee of the Advisory Council of Science and Industry in calling it together, and is confident that the opportunity of meeting and consulting together thus afforded to agricultural scientists from the different States will be beneficial to agricultural progress in Australia.

The Return to the Land of Partially Disabled Men: France.—The Department of Agricultural Labour at the Ministry of Agriculture has formed a special section with a view to permitting partially disabled ex-soldiers to resettle in the country or to settle there for the first time. In order to provoke this return to the land the department has drawn up a programme which

comprises on the one hand an orientation of projects towards agricultural occupation by means of appropriate propaganda, and on the other the establishment of the men in the country.

The propaganda, accomplished by means of posters, pamphlets and cinematographic films, deflects the labour of partially disabled men towards rural occupations, and induces them to ask for the information with which the department must be able to supply them.

Some of them wish to enter a school of re-education and ask for information as to one in which they can be received. The Department of Agricultural Labour keeps up to date a list of available places in the various schools of re-education for agricultural trades, whether private or State schools, and directs a wounded man to the school nearest the district in which he establishes himself and having agricultural conditions like those of such district. It also takes the necessary steps to procure the man's admission to this school.

There are other partially disabled men who ask to work for a time on a farm, either instead of entering a school of re-education or in order to complete their training after they leave the school. The Department of Agricultural Labour has appealed to farmers through the medium of the great agricultural societies, and has asked them to receive these men and make them into good agricultural labourers or specialised experts. These apprentices cannot at the beginning of their time do work which is worth their board and lodging, and therefore apprenticeship bursaries, which partly repay the farmers for maintaining them, have been instituted.

It is, however, the chief aim of the propaganda to induce partially disabled men to settle in the country as cultivators or find places there as experts, as shepherds, cowmen, gardeners, bee or poultry experts, etc. To allow of their settlement land and working capital are needed. The land can be bought or leased. The Department of Agricultural Labour has been led to request the solicitors in the various districts in France to apprise it as to small farms for sale and farms to let, and the department is therefore able to supply information to partially disabled men who have no property in view.

When once a property has been chosen it must be bought or leased, and then the live and other stock necessary to farming it must be procured. The Department of Agricultural Labour is ready to inform partially disabled men as to the facilities in the matter of credit on real estate and chattels at their disposal, to advise them, and to take all the steps necessary to satisfying their desires and enabling them to carry out their plans.

The department is not, however, content merely to point out existing resources. It also endeavours to provoke initiative, either of a legislative or of a private character, and thus to facilitate as far as possible the settlement in the country of the partially disabled men.

We should notice finally the importance of the agricultural machines made to compensate for the various kinds of disability. They may be looked upon as supplements to artificial limbs, for they allow disabled men to undertake work of which they would otherwise be incapable. The Department of Agricultural Labour instructs the makers as to what machines they must construct, and endeavours to have stocks of them constituted, so that they can be placed rapidly, on good terms as regards price, at the disposal of the partially disabled men.

To direct the work of countrybred disabled men towards agricultural occupations, and to facilitate for them by every possible means the realisation of a plan which they have been induced to form; such is, in brief, the programme of the Department of Agricultural Labour.

Organisation of Public Professional Teaching of Agriculture in France.—The new French law of August 2, 1918, on the organisation of public professional teaching of agriculture in France, is intended, according to M. Viger, who presented the law to the Senate, to provide agricultural education no longer for 2000 youths and a few hundred girls, but for 1 million youths and 1 million girls.

(1) EDUCATION FOR YOUTHS.—*Agriculture* is taught (Art 1):—(1) at the "Institut national agronomique," which is the normal higher school for agriculture; (2) at the National Schools of Agriculture of Grignon, Montpellier, Rennes; (3) in the schools of agriculture, including (*a*) schools of practical agriculture, (*b*) the farm schools, (*c*) the technical schools, where some agricul-

tural speciality is taught; (4) in the winter or seasonal schools of agriculture; (5) in the agricultural continuation courses.

Horticulture is taught:—(1) At the National Horticultural School at Versailles, which is the higher school for horticulture; (2) in the schools of horticulture as in section *c* (technical schools).

In order to give a thorough practical training to the pupils leaving the National Agronomic Institute, wishing to take up an agricultural career, or become professors of agriculture, practical schools will be founded on the estates of the National Schools of Agriculture, at Grignon, Montpellier and Rennes. These schools could also be attended by students from the national schools wishing to specialise, and by free auditors (see Art. 3 of the Law). As regards the *practical schools*, owing to the bad results given by the way of run ning some of them as actual farms on which the director-farmer, obliged to make the greatest possible profit out of his farm, considers the students as labourers, in many cases, rather than real pupils, the law provides that save in exceptional circumstances the farm shall be run either on behalf of a commune, a department, or the State (Art. 10).

The really new part of this law is that tending to create aad spread everywhere in France the winter or seasonal agricultural schools and public continuation agricultural education.

Art 14.—The *winter or seasonal agricultural schools* are fixed or travelling. They are designed to give, during the bad season, professional instruction to the sons of farmers who cannot spend 2 or 3 years in a professional school of agriculture. They are controlled by the Minister for Agriculture.

According to Art. 20, *continuation agricultural instruction* can be given in public schools or in premises placed at the disposal of the State by the communes or private persons. In each commune the course is started either on request of the municipal council, or on request of the departmental commission provided for in Art. 23, and on a favourable report from the General Council. The course, according to Art. 22 of the Law, is paid for by the department.

(II.) EDUCATION FOR GIRLS.—Art. 26—Instruction in agriculture and housewifery for girls is given:—

(1) At the National Agronomic Institute; (2) in the National Schools of Agriculture; (3) in the agricultural housewifery schools; which may be fixed, temporarily fixed or temporarily travelling, and which will be known as "*Ecoles agricoles ménagères*," "*Ecoles agricoles ménagères temporaires*," and "*Ecoles agricoles ménagères ambulantes*;" (4) in the course of continuation instruction in agricultural housewifery.

The conditions under which the new law is to be applied will be fixed by the rules of public administration.

LEGAL DECISIONS AFFECTING AGRICULTURE.

Arbitration Proceedings under the Agricultural Holdings (Scotland) Act, 1908—*Viscountess Cowdray* v. *N. F. Ferries.*—This case was mentioned in Volume I. No. 2 of the JOURNAL, where the facts of the case are narrated. At that date the First Division of the Court of Session recalled the Lord Ordinary's Interlocutor and granted Interdict against the Arbiter proceeding with the Arbitration. The decision of the First Division was appealed to the House of Lords, and their Lordships have now reversed the Interlocutor appealed from. The immediate question which arose upon the Appeal was whether an Arbiter who had been appointed under Section 10 of the Agricultural Holdings (Scotland) Act, 1908, had power to deal with certain definite questions of controversy that existed between the parties. These questions were (1) whether a valid notice to quit had been given, (2) whether the Tenant had given sufficient notice of his claim for unreasonable disturbance, and (3) whether either of these two questions could properly be determined by an Arbiter appointed under Section 10 of the Act. The result of the decision of the House of Lords is that the questions of the validity of the notice to quit and of the sufficiency of the Tenant's notice of claim fell to be determined by the Arbiter. Lord Buckmaster in his judgment stated that it was his opinion that the whole of the matters in this dispute were properly for the Arbiter to determine, and he found himself unable to accept the view which found favour in the Inner House—that the

Arbiter ought to be restricted from acting because some of the conditions he was called upon to determine might result in showing that there was no claim for compensation on which he was required to arbitrate. He was therefore of opinion that this matter should be referred back to arbitration. Lord Dunedin in his opinion also stated that in a question where the real question underlying depended upon a question of law which had to be solved "then there is a procedure for getting an opinion of law, and it is a procedure which may be put into effect practically at the instance of either party, so that the Arbiter is not left hopelessly stranded with his agricultural knowledge, but he can get assistance from a Court of Law if he so wishes. For these reasons I must say I am clearly of opinion that here the question whether there was or was not a sufficient notice was a question which fell to be determined by the Arbiter, and that consequently the proceedings before him ought not to have been stopped by the Interdict which has been granted by the Court below."

Land Valuation Appeal Court—Grass Parks let for six months of the year.—*Duffus* v. *Assessor for Aberdeenshire.*—This case was raised at the instance of Alexander Duffus, Advocate in Aberdeen, as judicial factor on the trust estate of John Forbes Mitchell, of Thainstone, in the parish of Kintore and county of Aberdeen. The Home Farm of Thainstone consists of fields, the grazings of which are annually let to grazers for the grazing season, and also includes other five fields which were let in 1918 for a four years' course of cropping. The Valuation of the farm formerly entered in the Valuation Roll was £170, and in making up the Valuation Roll for the year ending Whitsunday 1919 the Assessor made separate entries at the gross rents stipulated to be paid therefor of the lands let for course of cropping, and entered the grass parks at the total rental received therefrom, under deduction of rates, etc., his total proposed valuation being £386, 10s. in place of the former valuation of £170. The judicial factor appealed to the Valuation Committee of the county of Aberdeen against these entries and asked that the total valuation should be reduced to £170. The Committee dismissed the Appeal, and the judicial factor craved a case to be stated for the opinion of the Land Valuation Appeal Court. The Court were of opinion that the determination of the Valuation Committee was right. Lord Salvesen stated that he was of opinion that the actual grazing rents for the six months must be taken as representing the true annual value for the year of valuation, and that if and when the grazing rents again fell to a normal figure, as they might do, the landlord would be assessed upon the actual return which he received from the lands, but that when he received a larger return from the lands it was appropriate that he should pay the rates applicable to that return.

As regards the question as to the entries to be made for lands formerly permanent pasture let to tenants on four years' leases for cultivation of cereals, the Appeal Court held that the annual value of such subjects during the currency of the leases was the rents set forth in the leases and that no deduction should be made in respect of prospective outlay at the end of the leases. It was contended for the Proprietor of the subjects that the Court should discount from the rent a part of it on the footing that if the Proprietor at the end of four years desired to bring the fields into the same condition as they were at the time when he let them he would have to incur an expenditure of six guineas per acre, which was the sum for manure and seed alone which it was stated would be required to restore the fields to permanent pasture. Lord Salvesen was of opinion that that contention was entirely out of the question. In regard to this point Lord Cullen also stated—"As regards the other fields, the information in the case is that they are let for four years to tenants at annual rents, and no good reason whatever has, in my opinion, been advanced why they should not be entered in the roll at these rents, which are rents paid for the fields in their actual lettable state. The prospective outlay by the proprietor at the end of the leases which is mentioned in the case does not furnish any legitimate ground at present for entering less than the actual rents received by him. It does not enter into the present contracts of tenancy as obligatory on the proprietor in order to earn the rents. It has, moreover, not been incurred, and it may conceivably never be. If and when it comes to be incurred, the question may arise, on which I express no opinion, as to how far outlay made for the purpose of reconverting the fields into a different lettable state will fall to be dealt with in fixing their annual values as these will then stand."

OFFICIAL ORDERS AND CIRCULARS.

Minimum Rates of Wages for Agricultural Workers.

The following is a summary of the minimum rates of wages for agricultura workers which, after having been fixed by District Wages Committees, have been passed by the Central Wages Committee, and are now in force under the Corn Production Act, 1917, section 4 of which renders an employer liable to a fine of £20 if he pays a worker in agriculture (man, boy, woman or girl) at a rate less than the minimum rate applicable to the case.

For a fuller explanation as to how the rates are to be calculated, reference should be made to the notices published in the newspapers by the different District Committees. The rates are inclusive of the value of any house or allowances received by the worker in part payment of wages, such value to be reckoned on a scale prescribed by the District Wages Committee.

Any worker who, owing to infirmity or injury, is incapable of earning the minimum rate applicable to his employment, may be granted a permit allowing him to be employed at less than that minimum rate on his applying for such a permit on a form to be obtained from the Secretary of the District Wages Committee within whose area he is or desires to be employed.

MINIMUM RATES NOW IN FORCE.

Wages District and Area to which applicable.	Class of Worker.	Rate.	Date from which the rate takes effect.
Northern Counties— Shetland.	*Men of 21 years and upwards ...	37/ per week	27 Feb. 1919
	Male workers from 18 to 21 years	30/ „	23 Nov. 1918
	„ „ „ 16 to 18 „ ...	25/ „	„
	Boys under 16 years	15/ „	„
	Women of 18 years and over ...	25/ „	„
	„ „ „ who are casually employed	5d. per hour	„
	Girls from 16 to 18 years	18/ per week	„
	„ under 16 years	12/ „	„
	* *Note.*—In the case of men of 21 years and upwards, the above rate to be increased by 2s. 6d. per week for each dog which the workman is required, by the conditions of his employment, to keep and feed.		
Orkney.	All male workers of 21 years and over	31/ „	27 Feb. 1919
	All male workers between 18 and 21 years	27/ „	„
	Boys from 16 to 18 years	18/ „	23 Nov. 1918
	„ under 16 years	12/ „	„
	Women over 18 years	20/ „	„
	„ „ „ „ who are casually employed	3/6 per day	„
	Girls from 16 to 18 years	17/ per week	„
	„ under 16 years	10/ „	„
Caithness.	All male workers, including ploughmen, shepherds in charge of a hirsel of sheep, cattlemen, barnmen and orramen, of 21 years and over, having not less than 3 years' experience as such	36/ „	27 Feb. 1919

MINIMUM RATES NOW IN FORCE.—*continued.*

Wages District and Area to which applicable.	Class of Worker.	Rate.	Date from which the rate takes effect.
Northern Counties—*continued.* Caithness.	Men between 18 and 21, including ploughmen, shepherds in charge of a hirsel of sheep, cattlemen, barnmen and orramen, having not less than 3 years' experience	32/ per week.	27 Feb. 1919
	Men of 21 years and over, other than those experienced workers above mentioned	30/ „	„
	Men between 18 and 21 years other than above	28/ „	„
	Boys from 16 to 18 years	18/ „	23 Nov. 1918
	„ under 16 years	12/ „	„
	Women over 18 years	20/ „	„
	„ „ „ who are casual workers	4½d. per hour	„
	Girls from 16 to 18 years	17/ per week	„
	„ under 16 years	10/ „	„
	Note.—In the case of shepherds and cattlemen the above rates to be increased by 2s 6d. per week for the first dog and 2s. for each other dog which the workman is required, by the conditions of his employment, to keep and feed.		
Sutherland.	Male shepherds of 21 years and over in charge of a hirsel of sheep, and requiring—		
	2 dogs for the work	44/6 per week	„
	1 dog „ „	42/6 „	„
	Experienced male shepherds between 18 and 21 years in charge of a hirsel of sheep, and requiring—		
	2 dogs for the work	42/6 „	„
	1 dog „ „	40/6 „	„
	*Experienced male workers, including ploughmen, cattlemen, barnmen and orramen	38/ „	„
	All male workers over 18 years, not otherwise dealt with	30/ „	„
	Boys from 16 to 18 years	20/ „	„
	„ under 16 years	15/ „	„
	Women of 18 years and over ...	20/ „	„
	„ „ „ who are casual workers	4½d. per hour	„
	Girls from 16 to 18 years	16/ per week	„
	„ under 16 years	12/ „	„
	* *Note.*—An experienced male worker shall be held to be one who has worked on a farm for 3 years before or 2 years after having reached the age of 18.		
Moray Firth— Ross :— Districts of Black Isle, Easter Ross and Mid-Ross (except the Parish of Lochbroom).	Qualified ploughmen, cattlemen or shepherds* of 21 years and over	36/ „	29 Oct. 1918
	Men over 18 years and under 21, having 3 years' experience as ploughmen, cattlemen or shepherds*	36/ „	„

† *Note.*—An additional allowance of 2s. 6d per week is to be made for each dog necessarily kept for the employer's business by the shepherd, when the dogs are not fed by the employer

MINIMUM RATES NOW IN FORCE.—*continued.*

Wages District and Area to which applicable.	Class of Worker.	Rate.	Date from which the rate takes effect.
Moray Firth—*continued.*			
Inverness :—	Other male workers over 18 years	30/ per week	29 Oct. 1918
Districts of Inverness, Aird, Badenoch.	Boys under 18 years	24/ „	„
	„ „ 17 „	20/ „	„
	„ „ 16 „	18/ „	„
Nairn.	„ „ 15 „	14/ „	„
Moray.	Women over 18 „	20/ „	„
	Girls under 18 „	16/ „	„
	„ „ 17 „	14/ „	„
	„ „ 16 „	12/ „	„
	Foresters, market gardeners and nurserymen :—		
	Men over 18 years with 3 years' experience	36/ „	21 Jan. 1919
	Men over 18 years other than above	30/ „	„
	Boys under 18 years	24/ „	„
	„ „ 17 „	20/ „	„
	„ „ 16 „	18/ „	„
	„ „ 15 „	14/ „	„
	Women over 18 years	20/ „	„
	Girls under 18 years	16/ „	„
	„ „ 17 „	14/ „	„
	„ „ 16 „	12/ „	„
North-Eastern Counties—			
Banff.	Male worker over 20 years ...	35/ „	19 Nov. 1918
Aberdeen.	„ „ from 18 to 20 years	30/ „	„
Kincardine.	Boys 16 to 18 years	20/ „	15 Oct. 1918
	„ 14 to 16 „	16/ „	„
	Women of 18 years and over ...	20/ „	„
	„ „ „ „ (casual workers)	4d. per hour	„
	Girls from 16 to 18 years ...	16/ per week	„
	„ „ 14 to 16 „ ...	12/ „	„
Forfar and Perth—			
Forfar.	Male workers over 21 years ...	Not fixed.	...
Perth :—	„ „ from 18 to 21 years	32/6 per week	23 Nov. 1918
Central District.	Boys under 18 and over 17 years	5d. per hour	17 „
Perth District.	„ „ 17 „ 16 „	4d. „	„
Blairgowrie District.	„ „ 16 „ 15 „	3½d. „	„
Western District—	„ „ 15 years	3d. „	„
Parishes of Ardoch, Dunblane and Lecropt, Kincardine, Kilmadock, Port of Menteith.	Women of 17 years and over ...	4d. „	„
	Girls under 17 and over 16 years	3½d. „	„
	„ „ 16 „ 15 „	3d. „	„
	„ „ 15 years	2½d. „	„
	Foresters :—		
	Men of 21 years and upwards...	30/ per week	18 Jan. 1919
	„ between 18 and 21 years...	27/6 „	„
	Market Gardeners :—		
	Men of 21 years and upwards...	35/ „	„
	„ between 18 and 21 years...	32/6 „	„
	Boys under 18 and over 17 years	5d. per hour	„
	„ „ 17 „ 16 „	4d. „	„
	„ „ 16 „ 15 „	3½d. „	„
	„ „ 15 years	3d. „	„
	Women of 17 years and upwards	4d. „	„

MINIMUM RATES NOW IN FORCE.—*continued.*

Wages District and Area to which applicable.	Class of Worker.	Rate.	Date from which the rate takes effect.
Forfar and Perth—*continued.*	*Market Gardeners :—continued.*		
	Girls under 17 and over 16 years	3½d. per hour	18 Jan. 1919
	„ „ 16 „ 15 „	3d. „	„
	„ „ 15 years	2½d. „	„
	Nurserymen :—		
	Men over 21 years	6½d. „	„
	„ between 18 and 21 years...	6d. „	„
	Boys under 18 and over 17 years	5d. „	„
	„ „ 17 „ 16 „	4d. „	„
	„ „ 16 „ 15 „	3½d. „	„
	„ „ 15 years	3d. „	„
	Women of 17 years and upwards	4d. „	„
	Girls under 17 and over 16 years	3½d. „	„
	„ „ 16 „ 15 „	3d. „	„
	„ „ 15 years	2½d. „	„
Fife and Kinross—			
Fife	Male workers over 18 years ...	Not fixed	...
Kinross.	Boys from 17 to 18 years ...	21/ per week	7 Dec 1918
	„ „ 16 to 17 „ ..	18/ „	„
	„ „ 15 to 16 „ ...	15/ „	„
	„ „ 14 to 15 „ . .	12/ „	„
	Women or girls over 16 years...	18/ or 3/ per day of 9 hours at 4d. per hour	„
	Girls from 15 to 16 years .	15/ per week	„
	„ „ 14 to 15 „ ...	12/ „	„
Lothians and Peebles—			
Linlithgow.	Male workmen of 21 years and		
Edinburgh.	upwards	36/ „	18 Jan. 1919
Haddington.	Male workmen between 18 and		
	21 years	30/ „	„
	Boys between 16 and 18 years...	22/ „	„
	„ under 16 years	12/ „	„
	Women of 18 years and over ...	20/ „	18 Oct. 1918
	Girls between 16 and 18 years. .	17/ „	18 Jan. 1919
	„ under 16 years	12/ „	„
Border Counties—			
Berwick.	Shepherds of 18 or over in charge		
Roxburgh.	of a hirsel	40/ „	7 Oct. 1918
Selkirk.	Experienced cattlemen or orramen		
	of 18 years or over	35/ „	„
	Able-bodied experienced plough-		
	men of 18 years or over	35/ „	„
	Other male worker of 18 years or		
	over	30/ „	„
	Boys under 18—		
	during fourth year	28/ „	„
	„ third „	22/ „	„
	„ second „	16/ „	„
	„ first „	10/ „	„
	Experienced women of 17 years or		
	over	20/ „	„
	Other women of 17 years or over...	18/ „	„

MINIMUM RATES NOW IN FORCE.—*continued.*

Wages District and Area to which applicable.	Class of Worker.	Rate.	Date from which the rate takes effect.
Border Counties—*continued.*	Girls under 17—		
	during third year...	18/ per week	7 Oct. 1918
	„ second „	14/ „	„
	„ first „	10/ „	„
	Note.—(1) An experienced cattleman, ploughman and orraman shall be entitled to the said minimum rate of 35s. when they have worked on a farm continuously for 3 years before or 2 years after having reached the age of 18. (2) A female shall be regarded as experienced only in the event of her having attained the age of 17, and having worked on a farm continuously for 1 year before or after reaching the age of 17.		
Dumfries and Galloway—			
Dumfries.	Ploughman, married or single, over 18 years	38/ „	1 Sept. 1918
Kirkcudbright.	Male workers over 18 years ...	33/ „	„
Wigtown.	Boys 16 to 18 years...	24/ „	„
	„ 14 to 16 „	3d. per hour.	„
	Cotwomen	20/ per week	20 Jan. 1919
	Dairymaids, capable of making butter and cheese	27/ „	„
	Women over 17 years, engaged for a term and boarded by employer	25/ „	„
	Experienced casual woman workers over 17 years with at least one years' experience...	4½d. per hour.	28 Nov. 1918
	Girls under 17 years	Not fixed.	...
Ayr—			
Ayr.	Male workers over 18 years ...	Not fixed.	...
	Boys from 16 to 18 years	24/ per week	28 Dec. 1918
	„ of 16 years and under ...	14/ „	„
	Women of 16 years and over ...	4½d. per hour	1 Nov. 1918
	Girls of 15 years but under 16 ...	16/ per week	28 Dec. 1918
	„ 14 „ „ 15 ...	13/ „	„
	„ under 14 years	12/ „	„
Clyde and Forth—			
Lanark.	Male workers of 21 years and over	38/ „	14 Oct. 1918
Renfrew.	„ „ 18 but under 21 years	36/ „	„
Dumbarton.	Boys of 16 but under 18 years ...	24/ „	„
Stirling.	„ 14 „ 16 „ ...	15/ „	„
Clackmannan.	„ under 14 years	2/ per day	„
	Female workers of 17 years and over	20/ per week	...
	Girls of 15 but under 17 years ...	16/ „	...
	„ 14 „ 15 „ ...	12/ „	...
	„ under 14 years	2/ per day	...
South-Western Highlands—			
Argyll.	Experienced shepherds, ploughmen		
Bute (including Arran).	and cattlemen of 21 years and		
Perth :—	over	36/ per week	1 Feb. 1919
Highland District.	Shepherds, ploughmen and cattle-		
Western District—	men of 18 years but under 21,		
Parishes of Callander, Aberfoyle, Balquhidder, Killin.	with *not* less than 4 years' experience as such	34/ „	„

MINIMUM RATES NOW IN FORCE—*continued.*

Wages District and Area to which applicable.	Class of Worker.	Rate.	Date from which the rate takes effect.
South-Western Highlands—*continued.*	Shepherds, ploughmen and cattlemen of 18 but under 21 years, with *less* than 4 years' experience as such	32/ per week	1 Feb. 1919
	Male workers of 21 years and over, other than the above	30/ „	„
	Male workers of 18 years and under 21, other than the above... ...	29/ „	„
	Byrewomen and dairymaids wholly or mainly employed in agriculture, of 16 years and over ...	25/ „	19 Oct. 1918
	Other females of 18 years and over	3/6 per day	„
	Girls of 16 years but under 18 (other than byrewomen and dairymaids)	18/ per week	„
	Girls of 14 years but under 16 ...	15/ „	„
	Boys of 16 „ „ 18 ...	20/ „	„
	„ 14 „ „ 16 ...	15/ „	„
North-Western Highlands— Inverness :— Lochaber Insular Districts. Ross :— Mid-Ross (Parish of Lochbroom only), Western, South-Western, Lewis Districts.	Man (*a*) married, or (*b*) widowed and having a family to support, or (*c*) widowed, or of 21 years and single, who may prove to the satisfaction of the Committee that he has one or more relatives to support	32/ „	22 Jan. 1919
	Man, single or widowed (without family or relative as above)— of 21 years and over... ...	27/ „	„
	over 18 and under 21 years...	25/ „	„
	Youths over 16 and under 18 years	20/ „	18 Oct. 1918
	Boys „ 14 „ 16 „	15/ „	„
	„ under 14 years...	13/ „	22 Jan. 1919
	Female workers of 16 years and over	Not fixed.	...
	Girls over 14 and under 16 years...	14/ per week	18 Oct. 1918
	„ under 14 years	11/ „	22 Jan. 1919
	Men engaged in Woods and Forestry :—		
	Class I.—Man (*a*) married, or (*b*) widowed and having a family to support, or (*c*) widowed or of 21 years and single, who may prove to the satisfaction of the Committee that he has one or more relatives to support	32/ „	„
	Class II.—Man, single or widowed (without family or relatives as in Class I.) of 21 years and over ...	27/ „	„
	Class III.—Man, single or widowed over 18 and under 21 years ...	25/ „	„
	Class IV.—Youth, over 16 and under 18 years	20/ „	„
	Class V.—Boy, over 14 and under 16 years	15/ „	„
	Boy under 14 years ...	13/ „	„
	Female workers of 16 years and over	Not fixed.	...
	Class X.—Girls over 14 and under 16 years	14/ per week	„
	Girls under 14 years ...	11/ „	„

Note.—All the foregoing rates, with the exception of those in force for the

Moray Firth area, are based on the customary hours worked in the district in which the workman is employed.

In the Moray Firth area the minimum rates are fixed on the basis that the working hours in each week shall be 60, inclusive of time for stable work.

MINIMUM OVERTIME RATES NOW IN FORCE.

Wages District and Area to which applicable.	Class of Worker.	Rate.	Date from which the rate takes effect.
Forfar and Perth— Forfar. Perth :— Central District. Perth District. Blairgowrie District. Western District— Parishes of Ardoch, Dunblane and Lecropt, Kincardine, Kilmadock, Port of Menteith.	Men of 18 years and upwards ...	9d. per hour beyond the customary hours worked in the course of an ordinary working week, and 1/ per hour for Sunday work.	18 Jan. 1919
	Women, boys and girls	Time and a half, *i.e.*, rate per hour already fixed, plus one half more.	„
	Note.—These rates apply to workmen in agriculture as defined in section 17, 1 (a) of the Corn Production Act.		
North-Western Highlands— Inverness :— Lochaber and Insular Districts. Ross :— Mid-Ross (Parish of Lochbroom only), Western, South-Western, Lewis Districts.	*Foresters, market gardeners and nurserymen :—*	Sundays: Per hour / Weekdays: Per hour	
	Class I.—Man, (*a*) married, or (*b*) widowed and having a family to support, or (*c*) widowed or of 21 years and single, who may prove to the satisfaction of the Committee that he has one or more relatives to support	1/2 / 1/	22 Jan. 1919
	Class II.—Man, single or widowed (without family or relatives as in Class I.) of 21 years and over ...	1/ / 10d.	„
	Class III.—Man, single or widowed over 18 and under 21 years ...	10d. / 9d.	„
	Class IV.—Youth, over 16 and under 18 years	8d. / 7d.	„
	Class V.—Boy, over 14 and under 16 years	6d. / 5d.	„
	Class X.—Girls over 14 and under 16 years	6d. / 5d.	„

Cereal Crop of 1919.

The prices guaranteed by the Government for 1919 grain crops are as follows :—

Wheat, 71s. 11d. per qr. of 480 lb. (or 75s. 6d. per qr. of 504 lb.).

Barley, 61s. 6d. per qr. of 400 lb. (or 68s. 10½d. per qr. of 448 lb.).

Oats, 44s. 1d. per qr. of 312 lb. (or 47s. 6d. per qr. of 336 lb.).

The guarantee applies to the proportion of the entire produce of each cereal normally sold ; and not in respect of the proportion consumed on the farm.

It has been decided to give effect to these guarantees by means of the machinery of Part I. of the Corn Production Act, 1917. This involves payment to growers of any difference between "average prices" and "guaranteed prices," on the basis of a yield per acre of 4 qrs. of wheat, 4 qrs. of barley, and 5 qrs. of oats respectively.

It has been decided to take four-fifths in the case of barley, and two-thirds in the case of oats, as the proportion normally sold. The grower of wheat will therefore be paid for each acre four times the difference between 71s. 11d. and the average market price ascertained for the seven months commencing September 1, 1919. The grower of barley will receive for each acre four times four-fifths of the difference between 61s. 6d. and the average price of barley similarly determined. The grower of oats will receive for each acre five times two thirds of the difference between 44s. 1d. and the average price of oats similarly determined.

These guarantees are subject to the provisions of Clause 2 (b) of the Corn Production Act, 1917, which states :—"If it appears to the Board that any such land has been negligently cultivated, the Board may either withhold altogether the payments to which the occupier would otherwise have been entitled or may diminish the amount of those payments to such extent as the Board think proper to meet the circumstances of the case."

Feeding Stuffs.

The supplies of cattle feeding-stuffs that will be available for consumption before the end of winter are estimated to suffice for the needs of live stock at the present rate of consumption, and the Food Controller accordingly does not propose to issue after March 15 any further certificates for oil cakes and meals. Dealers need not accept any certificates not deposited with them before April 1, nor are they bound to fulfil any orders under certificates so deposited unless such orders have been given before April 15.

Farmers and others may purchase supplies freely wherever they are available ; but, when supplies are not equal to all the demands, purchasers requiring supplies for milch cows will be given a preference.

Supplies of linseed cake are temporarily not equal to the demand, and the maximum prices for this class of feeding stuffs and for cotton cake have accordingly been retained. With this exception the maximum prices for home-manufactured, imported and compound cakes and meals were suspended on April 1. The Requisition Order in respect of cakes and meals has also been suspended, except as to cotton and linseed, and importing firms may therefore purchase and import these articles freely.

If prices rise above reasonable limits the Food Controller will reimpose immediately the original or reduced maximum prices. He has made arrangements to sell the Government stocks of seeds, nuts and kernels to crushers on such terms as will permit of a substantial reduction in the price of home-produced cattle cake at an early date.

Cattle Feeding Stuffs (Maximum Prices) Order, 1918 :—By a notice issued under this Order, certain alterations have been made in the prices fixed for Millers' Offals. The notice reads as follows :—

The Food Controller hereby orders that until further notice, the maximum price on a sale of flour millers' offals shall be—

(*a*) On a sale of fine flour millers' offals, £12 per ton ;
(*b*) On a sale of coarse flour millers' offals, £11 per ton.

Order Amending the Cattle Feeding Stuffs (Maximum Prices) Order, 1918 :—This Order embodies certain changes in the terms under which feeding stuffs may be sold by retail :—Retailers selling millers' offals in quantities of less than 28 lb. may add ½d. instead of ¼d. per lb. to the maximum price allowed by the Order. The charges allowed to be added for sacks and bags in the case of millers' offals and other feeding stuffs, except cakes and meals, have been reduced. 25s. per ton may be added when millers' offals are sold in bags of 1 cwt. or less and 20s. per ton when in bags of more than 1 cwt. In the case of other feeding stuffs, except cakes and meals, 25s. per ton if sold in twenty sacks to the ton, and so on in proportion to the number used per ton. These amendments came into force on February 10th, 1919.

The full text of the Order is as follows :—

In exercise of the powers conferred upon him by the Defence of the Realm Regulations, and of all other powers enabling him in that behalf the Food Controller hereby orders that on and from 10th February 1919 the Cattle Feeding Stuffs (Maximum Prices) Order, 1918 (hereinafter called the Principal Order), shall be amended as follows :—

1. Sub-clause (iii) of Clause 3 shall be deleted and the following sub-clause shall be substituted :—

(iii) (*a*) Where on a sale of millers' offals such quantity is less than 1 cwt., but more than 28 lbs., and the bulk is broken, a sum at the rate of ½d. per lb.

(*b*) Where on a sale of millers' offals such quantity is 28 lbs. or less, and the bulk is broken, a sum at the rate of ½d. per lb.

(*c*) Where on a sale of any other cattle feeding stuffs such quantity is less than 1 cwt. and the bulk is broken, a sum at the rate of ½d. per lb.

2. Clause 6 of the Principal Order shall be deleted, and the following clause shall be substituted :—

(*a*) Except as provided with reference to millers' offals in paragraph (*b*) of this clause, all cattle feeding stuffs for which a maximum price is prescribed by this Order, whether imported or made or produced in the British Islands, shall if sold in sacks or bags, be sold gross weight, sacks or bags included, and in the case of cattle feeding stuffs made or produced in the British Islands such charges in respect of sacks or bags as the Food Controller may from time to time by notice prescribe may be added to the maximum prices prescribed by this Order. Until further notice, the prescribed charges in respect of sacks or bags shall be :—

(i) On a sale of cake or meal a charge at the rate of 25s. per ton if sold in twenty sacks or bags to the ton, and so in proportion according to the number of sacks or bags used per ton.

(ii) On a sale of millers' offals a charge at the rate of 25s. per ton if sold in sacks or bags containing 1 cwt. or less and 20s per ton if sold in sacks or bags containing more than 1 cwt..

(iii) On a sale of any other cattle feeding stuffs a charge at the rate of 25s. per ton if sold in twenty sacks or bags to the ton and so in proportion according to the number of sacks or bags used per ton.

Provided that in any of the foregoing cases the buyer may by arrangement with the seller send his own sacks or bags to be filled, in which event the cattle feeding stuffs shall be sold net weight, sacks or bags excluded, and in that event no charge shall be added under this clause to the maximum price.

(*b*) (i) On a sale of millers' offals produced in the British Islands, and sold in sacks or bags bearing a miller's name or trade mark, the seller may at his option notwithstanding anything in paragraph (*a*) of this clause, sell net weight, sacks or bags excluded, and make a charge at the rate of 2s. 6d. per sack or bag, in which event the charge shall be shown as a separate item on the invoice and be repaid on the return within three months of the date of invoice of any sack or bag which bears the same name or trade mark and is in good condition.

(ii) On a sale of imported millers' offals sold in sacks or bags the seller may make a charge for such sacks or bags at the rate permitted by sub-clause (*a*) (ii) of this clause.

4. In paragraph (*b*) of Clause 17 of the Principal Order the word "article" shall be deleted and the words "cattle feeding stuffs" shall be substituted.

5. Copies of the Principal Order hereafter to be printed under the authority of His Majesty's Stationery Office shall be printed with the substitutions provided for by this Order, and the Principal Order shall on and after 10th February 1919 take effect as if it had been made with such substitutions.

Grain.

In view of the stocks of cereals in the country, restrictions on the use of grain have been largely removed.

The table given below shows the Orders that have been revoked, and the effect of the revocations on the sale and use of grain.

Order Revoked.	Effect of Revocation.
Feeding of Game Order, 1917	Grain which may be used for animal food may also be fed to game birds.
Oatmeal (Restriction) Order, 1918.	Oatmeal may now be used for purposes other than for human food or the manufacture into articles of human food.
Barley (Restriction) Order, 1917. Cereals (Restriction) Order, 1918.	All restrictions on the use of barley (except as regards the manufacture of malt), rye and dredge corn, and tailings and dressings of wheat, oats, barley, rye and dredge corn, are now removed.
Horses (Rationing) No. 2 Order, 1918.	Restrictions on the amount of cereals allowed to horses are removed.
Dealings in Oats (Restriction) Order, 1917.	Dealings in oats outside of the United Kingdom are now permitted.
Deer (Restriction of Feeding) Order, 1918.	The restrictions on the feeding of cereals to deer are removed.
Growing Grain Crops Order, 1918.	Thin growing crops may now be cut before maturity for feeding to live stock.

It should be noted however, that the restrictions imposed on the prices of cereals by the Grain (Prices) Order, 1918, and on oatmeal by the Oats Products (Retail Prices) Order, 1918, still remain in force.

Potatoes.

Wart Disease of Potatoes (Scotland) Order, 1918:—The full text of this Order was given in the last issue of the JOURNAL, when it was stated that other districts would be added to the list of "infected areas" if the prevalence of wart disease in them should make such a course necessary. The Board have now issued a notice under the Order certifying that certain areas in Perthshire and Lanarkshire have been added to the schedule of "infected areas." The full text of the notice reads as follows.

CERTIFICATION OF INFECTED AREAS.

(1) The Board of Agriculture for Scotland, by virtue and in exercise of the powers vested in them under the Destructive Insects and Pests Acts, 1877 and 1907, and of every other power enabling them in that behalf, and for the purposes of Article 2 (1) of the Wart Disease of Potatoes (Scotland) Order of 1918, hereby certify that as from the 1st February 1919 the areas described in the Schedule annexed hereto shall, unless and until the Board otherwise certify, be infected areas for the purposes of the said Order: Provided that the provisions of the said Order so far as they relate to infected areas shall not apply

to holdings exceeding half an acre in extent situated in the areas described in the said Schedule except—

(*a*) Holdings exceeding half an acre in extent or parts of them to which, because of an outbreak of Wart Disease or for any other reason, the aforesaid provisions already apply; or

(*b*) Holdings exceeding half an acre in extent or parts of them which may, subsequent to the date of this Certificate, be found to be infected with Wart Disease or to which, in the opinion of an Inspector, Wart Disease is likely to spread, and in respect of which a notice applying the provisions of the Wart Disease of Potatoes (Scotland) Order of 1918 may be served by an Inspector of the Board or of the Local Authority.

(2) In this Certificate the terms "Inspector," "The Board," "The Local Authority," "Holdings" and "Wart Disease" shall have the same respective meanings as in the Wart Disease of Potatoes (Scotland) Order of 1918.

In witness whereof the Board of Agriculture for Scotland have hereunto set their Official seal this twenty-eighth day of January nineteen hundred and nineteen.

CHAS. WEATHERILL, *Secretary.*

SCHEDULE.

DESCRIPTION OF INFECTED AREAS.

(1) An area comprising the civil parishes of Cadder, Glasgow (Landward), Rutherglen, Blantyre, Bothwell, Cambuslang, Cambusnethan, Dalserf, Dalzell, Hamilton (Landward), New Monkland (Landward), Old Monkland and Shotts, all in the Administrative County of Lanark and the Municipal Burghs of Rutherglen, Airdrie, Coatbridge and Hamilton.

(2) An area comprising the civil parishes of Dunning, Auchterarder, Glendevon and Muckart, in the Administrative County of Perth.

(3) An area comprising the civil parishes of Callander, Port of Menteith Kilmadock, Kincardine, Dunblane, Ardoch, Muthill and Crieff, in the Administrative County of Perth.

(4) An area comprising the civil parishes of Scone, Aberdalgie, and Perth (Landward), in the Administrative County of Perth, and the Municipal Burgh of Perth.

The Wart Disease of Potatoes (Scottish Seed Potatoes) Order, 1919:—In view of the spread of Wart Disease in England and Wales, the Board of Agriculture and Fisheries have deemed it essential to enforce further precautionary measures against the introduction of potatoes which might be infected with the disease. These measures have been embodied in the Wart Disease of Potatoes (Scottish Seed Potatoes) Order, 1919, which came into force on the 10th March. This Order prohibits any person in England and Wales from receiving consignments of seed potatoes grown in Scotland which are not of an approved immune variety unless he has previously obtained:—

(1) A declaration signed by the grower of the potatoes that to the best of his knowledge, information and belief the potatoes are not affected with Wart Disease, and that Wart Disease has not occurred on the farm where the potatoes were grown; and

(2) A certificate issued by the Board of Agriculture for Scotland not more than seven days before the potatoes are consigned to England or Wales that, so far as they are aware, Wart Disease has not existed on the farm on which the potatoes were grown or within 1 mile of the farm.

Responsibility for compliance with the provisions of the Order has been placed on the buyers and agents in England and Wales, and accordingly any orders which they may place with merchants and farmers in Scotland for supplies of seed potatoes of non-immune varieties will be conditional on the seller providing the required declaration and certificate. The Board of Agriculture for Scotland are anxious to assist dealers and growers in Scotland in meeting the requirements of their English and Welsh customers in this respect, and are prepared to issue certificates with the least possible delay.

Forms of application for certificates may be obtained on application to the Board, and in order that there may be no difficulty in determining whether a certificate should be issued, all the particulars required on the form should be furnished

The full text of the Order reads as follows —

The Board of Agriculture and Fisheries, by virtue and in exercise of the powers vested in them under the Destructive Insects and Pests Acts, 1877 and 1907, do order, and it is hereby ordered as follows .—

Commencement.

1 This Order shall come into operation on the tenth day of March, nineteen hundred and nineteen

Restrictions on dealings in Scottish Seed Potatoes.

2 —(1) Any person who shall bring or cause to be brought into England or Wales, any seed potatoes grown in Scotland and purchased by him shall be liable on conviction to a penalty not exceeding ten pounds (*a*) unless the potatoes are sold to him as potatoes of an approved immune variety, or (*b*) unless he has previously obtained a declaration, signed by the grower or purporting to be so signed, that to the best of his knowledge, information, and belief the potatoes are not affected with Wart Disease, and that Wart Disease has not occurred on the farm where the potatoes were grown, and also obtained a certificate issued by the Board of Agriculture for Scotland not more than seven days before the potatoes are consigned to England or Wales that, so far as the Board of Agriculture for Scotland are aware, Wart Disease has not existed on the farm on which the potatoes were grown or within one mile of such farm

(2) Any person in England or Wales to whom seed potatoes grown in Scotland have been consigned for sale on behalf of the consignor or other person, whether before or after the commencement of this Order, shall be liable on conviction to a penalty not exceeding ten pounds if, after the commencement of this Order, he sells the potatoes or any of them (not being potatoes of an approved immune variety) before he has obtained a declaration and certificate as prescribed by the preceding sub section

(3) An approved immune variety is a variety approved for the time being by the Board of Agriculture and Fisheries as being immune from Wart Disease

Production of Declarations and Certificates

3 Any person or agent for sale by this Order required to obtain a declaration and certificate shall, if so required by an officer of the Board, produce the same for his inspection, and if he fail to do so without reasonable cause shall be liable on conviction to a penalty not exceeding ten pounds

Offences

4 Any person who shall make a false declaration for the purposes of this Order shall be liable on conviction to a penalty not exceeding ten pounds

Definition

5 In this Order the expression "Wart Disease" means the disease affecting potatoes which is known as Synchytrium endobioticum, or Wart Disease of Potatoes, or Black Scab or Cauliflower disease, and the expression "person" includes a corporation.

Short Title

6 This Order may be cited as the Wart Disease of Potatoes (Scottish Seed Potatoes) Order of 1919

Potato Prices —The Food Controller announces that the maximum growers' prices for ware potatoes in Scotland will be increased as from 1st March 1919 as follows —

For potatoes delivered during March -	£7	15	0 per ton f.o.r.
Do. do April -	8	5	0 do
Do. do. May and subsequent Months - - -	8	15	0 do.

In each case the price at which the Food Controller will purchase Scottish potatoes from growers for export to England and elsewhere will be 15s. per ton less than the maximum price.

These increases correspond with the increases which have been granted to growers in England and Wales.

With regard to the 1919 potato crop the following announcement has been made:—The Food Controller does not propose to take over the 1919 potato crop, and hopes that it will not be necessary either to fix prices or to interfere with the normal methods of its distribution. If, however, it becomes necessary in the national interest to fix any maximum prices, the maximum growers' prices for ware potatoes in the United Kingdom will not be less than those obtaining during the present season.

Live Stock.

Prices of Live Stock:—An Order amending the Live Stock (Sales) Order, 1918, fixes maximum prices payable to farmers for fat cattle and sheep sold for slaughter during the months February to September, 1919 inclusive. The prices of fat cattle show a progressive increase upon present prices, until May and June, when the price of the first grade bulls, bullocks and heifers reaches 85s. per cwt. live weight. The highest price for sheep is reached in May, with an average increase of 10s. per sheep as compared with the price in October last. From June onwards prices fall gradually until September, when the level ruling in October 1918 is again reached.

The following schedule gives the prices in each month for cattle of each grade:—

BULLS, BULLOCKS AND HEIFERS.

	1st Grade.	*2nd Grade.*	*3rd Grade.*	*4th Grade.*
February ...	80s.	75s.	70s.	55s.
March ...	81s.	76s.	71s.	55s.
April	83s.	78s.	73s.	55s.
May	85s.	80s.	75s.	55s.
June	85s.	80s.	75s.	55s.
July	82s.	77s.	72s.	55s.
August ...	79s.	74s.	69s.	55s.
September ...	75s.	70s.	65s.	55s.

COWS.

	1st Grade.	*2nd Grade.*	*3rd Grade.*	*4th Grade.*
February ...	75s.	67s.	58s.	45s.
March ...	76s.	68s.	59s.	45s.
April	78s.	70s.	61s.	45s.
May	80s.	72s.	63s.	45s.
June	80s.	72s.	63s.	45s.
July	77s.	69s.	60s.	45s.
August ...	74s.	66s.	57s.	45s.
September ...	70s.	62s.	53s.	45s.

The following shows the *average* increase per head on sheep as compared with prices in October last:—

SHEEP.

February	5s.
March	6s.
April	8s.
May	10s.
June	8s.
July	4s.
August	*nil*
September	*nil*

The new price to farmers will not involve any increase in the cost of meat to the public.

It has been decided to remove all the present restrictions on sale and distribution of livestock for slaughter on September 30, the date up to which prices to the farmers have been announced.

Assuming that supplies are sufficient, no rationing restrictions will be imposed after June 30 upon the public demand for meat. There is, however, a limit to the transport and slaughtering facilities available ; and, in the event of a rush of cattle to the markets, it may be necessary to place a restriction on the number marketed in any particular district. In any case, during the last month or two before the removal of control, instructions will be given to the Grading Committees in the markets to accept only stock that is either fully mature or incapable of improvement by further keep.

Throughout the period of livestock control every step has been taken to put the farmers in Great Britain and Ireland on an equal footing, and in any such restrictions imposed this policy will be followed strictly, involving, if necessary, definite limits upon the amount of stock accepted from Ireland at each of the ports.

Defence of the Realm Regulations—Sale of Hares (Scotland) Order, 1919 :— Order applicable to Scotland, dated 1st March 1919, made by the Board of Agriculture for Scotland under Regulation 2R of the Defence of the Realm Regulations :—

The Board of Agriculture for Scotland, in pursuance of the powers conferred on them by the above-mentioned Regulation, do hereby authorise the sale and the exposing for sale of blue or mountain hares and leverets in Scotland during the month of March nineteen hundred and nineteen, by any person who would be otherwise entitled to sell or expose the same for sale, and that notwithstanding anything contained in the Hares Preservation Act, 1892.

Eggs.

The Egg (Prices) Order is revoked. There is no reason why the price of eggs should not fall still lower. Traders are expected to charge no more than they should, and so to obviate the reimposition of the Order with a schedule of greatly reduced maxima.

STATISTICS.

INCREASED FOOD PRODUCTION.

TABLE I.—Estimated Produce of Crops in the United Kingdom during the Years 1914 and 1918.

Crop.	Country.	1914.	1918.	Difference.	Percentage, Increase or Decrease.
		Thousands of Quarters.			
Wheat.	Scotland	320	402	+ 82	+ 25·6
	England and Wales	7,307	10,534	+ 3,227	+ 44·2
	Ireland	177	711	+ 534	+301·7
	United Kingdom ...	7,804	11,647	+ 3,843	+ 49·2
Barley.	Scotland	923	677	− 246	− 26·7
	England and Wales	6,174	6,085	− 89	− 1·4
	Ireland	969	1,003	+ 34	+ 3·5
	United Kingdom ...	8,066	7,765	− 301	- 3·7
Oats.	Scotland	4,619	6,457	+ 1,838	+ 39·8
	England and Wales	9,554	14,336	+ 4,782	+ 50·1
	Ireland	6,491	10,400	+ 3,909	+ 60·2
	United Kingdom ...	20,664	31,193	+10,529	+ 51·0
		Thousands of Tons.			
Potatoes.	Scotland	1,077	1,150	+ 73	+ 6·8
	England and Wales	2,953	4,209	+ 1,256	+ 42·5
	Ireland	3,446	3,863	+ 417	+ 12·1
	United Kingdom ...	7,476	9,222	+ 1,746	+ 23·4
Turnips and Swedes.	Scotland	6,311	5,464	− 847	− 13·4
	England and Wales	13,451	12,018	− 1,433	− 10·7
	Ireland	4,434	5,303	+ 869	+ 19·6
	United Kingdom ...	24,196	22,785	- 1,411	− 5·8
Mangolds.	Scotland	42	49	+ 7	+ 16·7
	England and Wales	7,919	8,231	+ 312	+ 3·9
	Ireland	1,562	2,041	+ 479	+ 30·7
	United Kingdom ...	9,523	10,321	+ 798	+ 8·4
Hay.	Scotland	869	818	− 51	- 5·9
	England and Wales	7,265	6,785	− 480	− 6·6
	Ireland	4,269	4,728	+ 459	+ 10·7
	United Kingdom ...	12,403	12,331	− 72	− 0·6

TABLE II.—Estimated Numbers of Live Stock in the United Kingdom during the Years 1914 and 1918.

	Class of Stock.	1914	1918	Difference.	Percentage Increase or Decrease.	Class of Stock.	1914	1918	Difference.	Percentage Increase or Decrease.
		Thousands.					Thousands.			
Scotland	Dairy Herd.	453	452	- 1	- 0·2	Sows.	20	16	- 4	- 20·0
England and Wales		2,482	2,578	+96	+3 9		340	290	- 50	- 14·7
Ireland		1,639	1,557	- 82	- 5·0		133	105	- 28	- 21·5
United Kingdom...		4,574	4,587	+13	+0·3		493	411	- 82	- 16·6
Scotland	Other Cattle.	762	758	- 4	- 0·5	Other Pigs.	133	112	- 21	- 15·8
England and Wales		3,396	3,622	+226	+6·7		2141	1407	- 734	- 34 3
Ireland		3,413	3,306	- 107	- 3·1		1173	869	- 304	- 25·9
United Kingdom...		7,571	7,686	+115	+1·5		3447	2388	- 1059	- 30·7
Scotland	Total Cattle.	1,215	1,210	- 5	- 0·4	Total Pigs.	153	128	- 25	- 16·3
England and Wales		5.878	6,200	+322	+5·5		2481	1697	- 784	- 31·6
Ireland		5,052	4,803	- 189	- 3·7		1306	974	- 332	- 25 4
United Kingdom...		12,145	12,273	+128	+1·1		3940	2799	- 1141	- 29·0
Scotland	Ewes.	2,975	3,015	+40	+1·3	Agricultural Horses (including Mares)	136	137	+1	+0·7
England and Wales		6,838	6,487	- 351	- 5·1		791	822	+31	+3·9
Ireland		1.408	1,449	+41	+2·9		394	414	+20	+5·1
United Kingdom...		11,221	10,951	- 270	- 2·4		1321	1373	+52	+3·9
Scotland	Other Sheep.	4,051	3,863	- 188	- 4·6	Other Horses on Farms.	73	73	...	...
England and Wales		10,422	9 988	- 434	- 4·1		609	554	- 55	- 9·0
Ireland		2,192	2,178	- 14	- 0·6		152	157	+5	+3·3
United Kingdom...		16,665	16,029	- 630	- 3·8		834	784	- 50	- 6·0
Scotland	Total Sheep.	7,026	6,878	- 148	- 2·1	Total Horses.	209	210	+1	+0·5
England and Wales		17,260	16,475	- 785	- 4·5		1400	1376	- 24	- 1 7
Ireland .. .		3,600	3,627	+27	+0·8		546	571	+25	+4·6
United Kingdom...		27,886	26,980	- 906	- 3·2		2155	2157	+2	+0·1

PRICES of AGRICULTURAL PRODUCE and FEEDING STUFFS in January, February, and March 1919.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	JANUARY.			FEBRUARY.			MARCH.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l w. s. a.	per cwt. l.w. s. d.	per cwt. l w s. d.	per cwt. l.w. s d.
Aberdeen-Angus ...	78 5	72 5	67 6	80 7	74 5	69 4	81 9	75 7	70 9
Shorthorn ...	79 0	72 10	67 10	81 0	74 0	69 6	81 3	75 6	71 0
Galloway	79 0	72 6	67 6	81 0	75 6	68 0	82 6	76 0	68 0
Ayrshire	77 8	70 6	61 0	78 10	72 6	62 9	79 6	72 9	64 10
Cross-bred	78 0	72 3	66 6	80 2	74 3	68 5	81 6	75 2	69 6
Blue Grey	79 0	73 0	68 0	81 0	75 4	68 0	82 0	76 0	68 0
Highland	77 0	72 0	...	81 0	74 6	...	...	...	...
VEAL CALVES	per lb. d. ...	per lb. d. 9½	per lb. d. 8½	per lb. d. ...	per lb. d. 9½	per lb d. 8½	per lb. d. 10	per lb. d 8½	per lb. d. 8
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb d.	Ewes per lb. d.
Cheviot	17	16⅜	16¼	17½	17¼	16⅜	17½	17½	17¼
Half-bred .. .	16⅜	16½	16¼	17¼	17	16⅜	17½	17¼	17
Blackface	16½	16	15¾	17	16⅜	16¼	17¼	17	16½
Greyface	16¾	16½	16	17	16⅜	16½	17⅜	17½	17
Down Crosses ...	17	16¾	16	17½	17¼	...	17⅜	17½	...
PIGS—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d	per stone s. d.
Bacon Pigs	17 11	17 7	16 0	17 10	17 7	16 0	17 10	17 6	16 0
Porkers	17 11	17 7	16 1	17 11	17 10	16 0	17 11	17 10	16 0

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description.	JANUARY.			FEBRUARY.			MARCH.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
STORE STOCK:—									
STORE CATTLE—									
Aberdeen-Angus:	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Yearlings ...	25 17	18 18	13 15	24 11	16 13	12 12	24 2	18 3	13 10
Two-year-olds ...	37 11	25 13	18 0	34 10	27 19	21 1	34 2	26 1	22 3
Shorthorn:									
Yearlings ...	...	...	...	...	...	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	31 1	29 10	26 0
Galloway:									
Yearlings	18 10	16 10	14 7	...	...	...	...	...	...
Two-year-olds ..	31 10	25 18	22 0	...	...	...	24 10	21 10	21 10
Ayrshire:									
Yearlings	...	...	...	...	...	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	...	...	...
Cross-bred:									
Yearlings	20 12	15 18	13 9	19 9	15 7	11 15	20 13	16 3	12 1
Two-year-olds ...	32 16	25 3	20 1	32 16	25 6	20 14	32 19	23 18	21 2
Blue Grey:									
Yearlings	...	...	...	...	...	...	...	...	...
Two-year-olds . .	31 10	25 18	...	...	...	...	...	25 0	...
Highland:									
Yearlings	...	...	...	...	...	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	...	...	...
Three-year-olds ...	...	...	...	...	...	...	...	...	...
DAIRY COWS—									
Ayrshire:									
In Milk	47 10	38 13	24 12	46 13	34 12	21 18	43 16	30 17	20 3
Calvers	49 10	38 9	25 13	48 1	36 1	23 11	41 11	32 6	20 14
Shorthorn Crosses:									
In Milk	61 0	47 16	33 11	58 19	45 16	31 16	56 1	41 11	29 3
Calvers	55 6	43 0	32 9	52 15	40 10	30 4	48 9	35 18	21 14
STORE SHEEP—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Cheviot Hoggs ..	48 0	39 0	...	50 0	43 2	...	56 1	47 8	35 5
Half-bred Hoggs ..	64 8	52 2	43 6	72 8	58 11	36 0	78 11	61 6	49 2
Blackface Hoggs ...	52 6	41 8	30 6	...	36 6	24 0	48 7	34 8	30 8
Greyface Hoggs ...	...	42 4	35 9	58 0	45 0	36 3	59 5	49 0	40 10
STORE PIGS—									
(6 to 10 weeks old)	48 3	32 10	...	57 10	39 3	...	50 9	38 5	...

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	JANUARY.			FEBRUARY.			MARCH.		
		Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF :—										
		per lb.	per lb.	per lb	per lb.	per lb.	per lb	per lb.	per lb	per lb.
Home-fed—		d.	d.	d.	d.	d.	d.	d.	d.	d.
Bullock or Heifer ...	1	14½	14½	14½	14½	14½	14½	12½	12½	12½
	2	...	..	.		...		12½	12½	...
Bull	1	14½	14½	14½	14½	14½	14½	12½	12½	12½
	2	...	...	...	..	..		12½	12½	..
Cow	1	14½	14½	14½	14½	14½	14½	12½	12½	12½
	2	13½	11⅛	12½	13½	11⅛	12½	12	11⅛	12
Irish—										
Bullock or Heifer ...	1	...	...	14½	..	...	14½	...	..	12½
	2	..	...	...	...	...	.	...		...
Bull	1	...	.	14½	...	...	14½	...	..	12½
	2	...		13	...		.		..	...
Argentine Frozen—										
Hind Quarters ...	1	15⅜	15⅜	15⅞	15⅜			...	14½	...
Fore ,, ...	1	12½	12⅜	13⅜	12⅜	...		...	1C⅞	...
Argentine Chilled—										
Hind Quarters ..	1	...	...	...	.	..		.	...	...
Fore ,, ...	1	...	..	...	.	...	..	...	.	..
MUTTON :—										
Hoggs, Blackface ...	under 60 lbs.	15	15	15	15	15	15	13¼	13¼	13¼
	60 lbs. and over.	15	15	..	15	15	...	13¼	13¼	. .
,, Cross	under 60 lbs.	15	15	15	15	15	15	13¼	13¼	13¼
	60 lbs. and over.	15	15	..	15	15	..	13¼	13¼	...
Ewes, Cheviot	1	15	15	15	15	15	15	13¼	13¼	13¼
	2	...	...	...	...	..	...	13¼	...	...
,, Blackface ..	1	15	15	15	15	15	15	13¼	13¼	13¼
	2	..	...	...	...	...	...	13¼	...	...
,, Cross	1	15	15	15	15	15	15	13¼	13¼	13¼
	2	...	..	..	..	.	...	13¼	...	...
Argentine Frozen ...	1	15	..	...	...	..	..	..	13¼	...
LAMB :—										
Home-fed	1	15	..	15	15	..	..	13¼	...	...
	2	...	...	...	...	..	...	13¼	...	...
Argentine Frozen ...	1	...	...	...	...	...	...	...	...	...
	2	...	...	...	...	...	...	..	..	...

AVE .GE PRICES OF PR(IONS AT GLASGOW.

Compiled fro: Reports received fro: e Board's Market Reporter.

Description.	Quality	Jan.	Feb.	Mar.
		s. d.	s. d.	s. d.
BUTTER:				
Irish Creamery ... per cwt.	1	252 0	252 0	252 0
„ „ (Unsalted) „	1	252 0	252 0	252 0
Canadian ... ... „	1	252 0	252 0	252 0
„ (Unsalted) ... „	1	...	252 0	...
Australian ... ... „	1	252 0	252 0	252 0
„ (Unsalted) . . „	1	252 0	252 0	252 0
New Zealand ... ... „	1	252 0	252 0	252 0
„ (Unsalted) „	1	252 0	252 0	252 0
Argentine ... . . „	1	252 0	252 0	252 0
„ (Unsalted) . . „	1	252 0	252 0	252 0
CHEESE:				
Cheddar ... ... „	1	163 4	163 4	163 4
Cheddar Loaf ... . . „	1	...	...	...
Dunlop ... ... „	1	163 4	163 4	163 4
Canadian ... .. „	1	163 4	163 4	163 4
New Zealand ... ... „	1	163 4	163 4	163 4
BACON:				
Ayrshire (Rolled) ... „	1	222 6	222 6	222 6
Irish (Green) ... ... „	1	...	...	...
„ (Dried or Smoked) „	1	214 0	214 0	214 0
Wiltshire (Green) ... „	1	...	...	...
„ (Dried or Smoked) „	1	...	...	. .
American, Long Clear Middles (Green) ... „	1	189 0	189 0	189 0
American, Short Clear Backs ... ... „	1	150 0	150 0	150 0

Description	Quality.	Jan.	Feb.	Mar.
		s. d	s. d.	s. d.
BACON (*continued*)				
American, Bellies per cwt.	1	150 0	150 0	150 0
„ Sides ... „	1	176 6	176 6	176 6
„ Cumberland Cut „	1	174 0	174 0	174 0
Canadian, Sides ... „	1	176 6	176 6	176 6
„ Cumberland Cut „	1	174 0	174 0	174 0
Danish, Sides . . „	1	...	...	...
HAMS				
Irish (Smoked) . . „	1	...	...	...
American, Long Cut (Green) ... ... „	1	170 0	170 0	170 0
American, Short Cut „	1	170 0	170 0	170 0
Canadian, Long Cut „	1	170 0	170 0	170 0
EGGS				
Country ... ... per 120	1	50 0	50 0	41 6
	2	...	...	40 0
Irish... ... ... „	1	50 0	47 3	32 8
„ (Duck) . „	1	...	...	40 4
„ (Pickled) . . „	1	40 0	...	...
„ (Cold Stored) „	1	...	40 0	...
American ... ... „	1	40 0	40 0	...
Danish (Fresh) ... „	1	...	...	34 0
	2	...	...	32 0
„ Pickled ... „	1	40 0	...	...
Egyptian ... „	1	26 8	26 8	16 8

AVERAGE PRICES OF POTATOES AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

JANUARY.

MARKETS.	Quality.	Second Earlies.	Late Varieties.			
			Red Soils.		Other Soils.	
		British Queen.	Langworthy.	Other.	Langworthy.	Other.
		per ton. £ s. d.	per ton £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Dundee	First ...	...	...	...	...	7 8 0
	Second ...	...	...	...	...	...
Edinburgh	First ...	8 0 0	9 2 6	...	9 0 0	8 5 0
	Second ...	...	...	...	...	...
Glasgow	First ...	...	...	...	7 0 0	7 7 6
	Second ...	...	...	...	...	...

FEBRUARY.

Dundee	First ...	...	...	...	...	7 10 0
	Second ...	.	...	...	...	...
Edinburgh	First ...	...	9 5 0	9 5 0	...	8 5 0
	Second ...	...	...	...	...	...
Glasgow	First ...	...	...	...	...	7 11 3
	Second ...	...	..	...	...	...

MARCH.

Dundee	First ...	...	...	7 10 0	..	7 10 0
	Second ...	...	...	...	...	...
Edinburgh	First ...	...	7 15 0	...	7 0 0	...
	Second ...	...	.	...	...	...
Glasgow	First ...	...	...	7 10 0	...	8 0 0
	Second ...	...	...	...	...	...

AVERAGE PRICES OF ROOTS, HAY, STRAW AND MOSS LITTER AT DUNDEE, EDINBURGH AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

JANUARY.

Markets.	Quality.	Roots. Carrots.	Roots. Yellow Turnips.	Roots. Swedes.	Hay. Ryegrass and Clover.	Hay. Timothy.	Straw. Wheat.	Straw. Barley.	Straw. Oat.	Moss Litter.
		per ton. s. d.	per ton s d	per ton. s. d.	per ton s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d	per ton s. d.	per ton. s. d.
Dundee ...	1	...	44 8	51 2	...	...	...	...	..	55 6
	2	...	..	47 7	...	...	...	...	...	...
Edinburgh	1	..	...	51 8	174 0	...	80 0	...	87 0	50 0
	2	..	...	..	144 0	...	...	...	...	...
Glasgow ...	1	...	..	...	.	...	...	...	..	50 0
	2	..	...	...	...	...	...	...	...	...

FEBRUARY.

Dundee ...	1	...	39 4	49 6	...	...	75 0	...	90 0	54 0
	2	...	...	43 0	...	...	...	...	...	...
Edinburgh	1	...	...	50 0	175 0	...	75 0	...	86 11	50 0
	2	...	...	...	145 0	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	50 0
	2	...	...	...	...	...	...	...	...	...

MARCH.

Dundee ...	1	...	38 0	45 6	...	...	75 0	..	90 0	54 0
	2	...	36 0	39 9	...	...	...	...	...	...
Edinburgh	1	...	..	...	177 6	..	71 3	...	81 3	50 0
	2	...	...	...	143 9	...	...	...	...	...
Glasgow ...	1	...	...	...	..	...	...	...	...	50 0
	2	...	...	...	...	...	...	...	...	...

AVERAGE PRICES OF FEEDING STUFFS AT GLASGOW AND LEITH.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	JANUARY.		FEBRUARY.		MARCH.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton. £ s. d.	per ton £ s. d	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d	per ton. £ s. d.
Linseed Cake—						
Home	...	19 0 0	19 0 0	19 0 0	19 0 0	19 0 0
Foreign	19 5 0	...	19 1 8	...	...	...
Soya Bean Cake ...	...	...	...	...	...	...
Decorticated Cotton Cake	...	...	22 0 0	...	...	...
Undecorticated Cotton Cake—						
Bombay ...	...	...	...	...	...	...
Egyptian ..	14 15 0	14 15 0	*14 15 0	*14 11 3	*14 15 0	*14 10 0
Coconut Cake ...	...	...	15 0 0	...	...	...
*Palmnut Kernel Cake	...	. .	...	13 15 0	...	13 15 0
Groundnut Cake (Decorticated) ...	...	...	21 15 0	13 15 0	...	...
Beans (Brazilian) ..	37 10 0	...	25 7 6	...	20 0 0	...
Maize Meal ...	...	...	...	...	...	...
Rice Meal	...	...	...	...	...	...
Paisley Meal ...	‡3 10 0	...	22 2 6	...	16 0 0	...
Distillery Meal ...	...	...	...	...	...	...
Beans (English) ...	‡3 10 6	...	‡3 7 6	...	23 7 6	...
Peas (English) ...	‡3 11 0	...	‡3 7 6	...	25 0 0	...
Locust Bean Meal	...	36 16 0	...	28 15 0	...	25 0 0
Maize	...	...	...	...	...	...
Oats	...	16 6 0	...	15 10 0	...	14 0 0
†Flour Millers' Offals	16 5 0	16 0 0	15 2 6	...	13 15 0	...
Malt Culms ...	15 0 0	13 0 0	*15 0 0	*13 3 4	...	...
*Distillery Mixed Grains—						
Dried	18 10 0	. .	18 10 0	14 15 0	...	...
*Brewers' Grains						
Dried	. .	...	...	13 16 8	..	14 0 0
Wet	...	...	...	...	...	...
Distillery Mixed Grains—						
Wet	. .	...	...	...	...	...
*Wheat—						
Middlings (Fine Thirds or Parings)	...	15 16 3	...	14 16 3	...	14 0 0
Sharps (Common Thirds)... ...	...	15 16 3	...	15 1 8	...	...
Bran (Medium) ...	..	15 16 3	...	14 1 3	...	13 0 0
Bran (Broad) ...	...	...	...	...	...	...
Feeding Treacle ...	...	22 0 0	22 0 0	16 5 0	...	10 0 0
Crushed Linseed ...	...	...	...	...	...	...
Fish Meal	27 10 0	27 10 0	25 12 6	26 7 6	23 0 0	24 0 0

* Fixed price excluding price of bags and authorised transport charges.
† Sold in 2-ton lots, sacks included, ex-Mill and ex-Distillery.
‡ Price per 252 lbs.

Printed under the authority of His Majesty's Stationery Office
By J SKINNER & CO., LTD., 27 THISTLE STREET, EDINBURGH.
(11331.) 7997/189. 3500. 4/19.—J.S.&Co.Ltd. (E.)

The Scottish Journal of Agriculture.

VOL. II.—No. 3.] JULY 1919. PRICE 6d.

THE CULTIVATION OF FORAGE CROPS IN SCOTLAND.

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THE cultivation of forage crops has not been practised to any great extent in Scotland, except under very special conditions, as in the early potato districts, where catch crops are taken after the potatoes are lifted.

No doubt the prevailing climatic conditions are in great measure responsible for this state of matters, as they limit very much the range of forage crops that can be successfully grown as compared with what is possible in England; but though that is the case, there are great possibilities in this direction, and the introduction of forage crops into the ordinary rotation would often have far-reaching and very beneficial effects.

In recent years we of necessity adopted the "Plough Policy," but if it is to be effectively pursued, there will be a place, and a very important one, for forage crops, for, by the growth and utilisation of crops of that nature, it is possible to maintain a large head of stock with a limited area under grass.

Soiling during summer is pretty widely practised on the Continent, but for some reason or other that method of feeding has never become popular in this country. That is very much to be regretted, as it has been pretty clearly demonstrated that the productivity of land under forage crops for soiling purposes may be as much as three times, and sometimes even more, that of the same land under grass.

If forage crops are to be successfully grown and utilised to the best advantage, a very great deal of extra labour will be essential. That to some may appear to be a serious stumbling block, but from the national point of view, instead of being a drawback, it is a decided advantage, as it would provide employment for, and make it possible to absorb into agriculture, a greatly increased number of workers without materially affecting existing conditions.

At present where forage crops are grown in Scotland it is very often for the production of autumn forage. Such crops prove invaluable at the time pastures begin to fail, particularly for the economical feeding of dairy cows and for sheep, but that does not nearly exhaust the possibilities in connection with these crops, as they may be grown for the production of green forage to supple-

ment the regular ration in the early part of the year before there is a full "bite" of grass, or for soiling purposes to take the place wholly or in part of pasture throughout the regular grazing season.

In the case of certain forage crops, the surplus over what can be used to the best advantage in the green stage may be made into hay provided the weather is suitable, but the real solution here is to convert it into ensilage just when it is in the best stage for so doing; although the "silo" is not an absolute essential in the successful scheme of forage cropping, once the practice of ensilage making becomes more common, there is no doubt but that the forage cropping will be adopted on a greatly extended scale.

Apart from the utilisation of certain grasses and clovers for green forage, the following crops are probably the most suitable for cultivation in Scotland, taking into account the yield, feeding value and palatability of the crop, and also the soil and climatic conditions. It will be observed that several crops such as Lucerne, Sainfoin, Trifolium, commonly grown in England, particularly in the south, have not been referred to, but that is because these crops have not proved suitable for cultivation in Scotland.

Leguminous Crops.—*Vetches.*—This crop has been cultivated in this country for a very long time, although the acreage under it has never been extensive. It constitutes one of the most valuable of the forage crops, and can be grown successfully under very varying conditions. It does well on strong, medium, and even on light soils, provided these contain a fair proportion of lime, but like most other crops of the same family, it does not succeed so well on peaty or mossy soils.

The vetch family is a very large one, there being in all about one hundred species, but the great majority of these are of the nature of weeds. The species most commonly cultivated is *Vicia Sativa* (common vetch or tare). Of this species there are two varieties, viz.:—the winter and the spring or summer variety. The difference between the two is mainly one of hardiness, and has been brought about by sowing seed in autumn in the one case, and in spring or summer in the other. The winter variety has now acquired a much greater degree of hardiness than the spring variety.

Provided the ground is clean and thoroughly cultivated, vetches may be taken at almost any stage in the rotation. The spring variety may take the place of a cereal or root crop. The winter variety on the other hand may follow a cereal and precede a root or another forage crop.

It is often a little late to take a crop of turnips after a crop of winter vetches have been removed or consumed, but there is always plenty of time to take a crop of rape or even of Thousandheaded Kale, particularly if the latter crop is for consumption in the early part of the following year.

If spring vetches are sown along with grass and clover seeds, a good deal of care must be exercised, as they are apt to smother out the young plants, particularly if the vetches go down. This can be avoided by sowing a mixture of vetches and a cereal crop and restricting the quantity of vetches in the mixture.

The winter variety should be sown in Scotland before the end of September to get it well established before frost sets in. It is better sown along with winter rye or winter wheat, as these crops keep the vetch off the ground, afford some degree of protection, and altogether give the crop a better chance.

For the successful cultivation of winter vetches, sheltered fertile fields should always be selected, as the crop suffers from severe frost in winter, and in exposed situations is liable to be killed out entirely.

The Siberian vetch is rather hardier and more suitable for cultivation in Scotland than the ordinary winter variety. It has the further advantage that it is ready for consumption earlier in the year, which is a feature of special importance, but seed of this variety is very difficult to obtain at the present time.

The ground intended for the vetch crop should be clean, or if not, it must be cleaned prior to seeding. It should contain a fair amount of lime, as vetches, like all other leguminous crops, respond to a dressing of lime. Farmyard manure should be applied at the rate of from 12 to 15 tons per acre, and ploughed in but not buried too deeply. In addition 3 cwts. of superphosphate should be applied at the time of sowing. The superphosphate encourages root development and enables the crop better to withstand a severe winter. This method of treatment contributes greatly to the successful cultivation of the winter variety.

The seed is best drilled in, and, in the case of the winter variety especially, should be deposited at a depth of from one and a half to two inches. When pure vetches are sown, the rate of sowing should be three bushels per acre when the seed is drilled in, and four bushels when broadcasted, but as already indicated, it is better to sow winter rye or other suitable cereal along with the winter vetches; in view of this the seeding should consist of about one and a half bushels vetches and one and a half bushels rye when drilled in, and correspondingly more if broadcasted. The winter rye rarely fails, but the winter vetches are a more precarious crop to raise.

In the case of the spring variety there may be a succession of sowings to provide green forage during the summer and autumn. Under favourable conditions sowing may take place at the end of February, and this may be followed by successive sowings up to the middle of summer. In this way, if both winter and spring vetches are grown, it is possible to have a supply of green food for use from about the end of May in a favourable season right on until late autumn.

The rate of sowing for the spring variety should be very similar to that recommended for the winter variety. If desired, a crop of pure vetches may be grown, but even in the case of the spring variety, it is generally wise to include a little seed of one or other of the cereals or a few beans to keep the crop better off the ground.

As regards the utilisation of the vetches, one of the main difficulties is to have the crop consumed just when it will supply the maximum amount of nutriment in the most suitable form. It is best when utilised just at the flowering stage and when the pods are begin-

ning to form, but in order that the produce from any single sowing may provide food for a period of three or four weeks, a start with the cutting (if for soiling) must be made before the crop is at its best; even then, by the time it is all consumed, some of it will have become over-mature and a little hard and fibrous.

When immature, or when past its best, it gives better results if chaffed and mixed with hay, and in this way the produce from a single sowing may be made to serve for a longer period.

Vetches form an excellent and wholesome food for all classes of farm livestock, horses, cattle, sheep and pigs, and being rich in digestible protein they are specially suitable for feeding along with other home-grown produce of a more starchy nature. Apart from other benefits attending their use, they lessen our dependence on purchased feeding stuffs rich in protein. Vetches are used to a fair extent at present by ram breeders to bring out the rams in good condition at the autumn sales, and are highly prized for that purpose, but it is in connection with the feeding of cattle, and particularly dairy cows in milk or fattening cattle, that the greatest benefits are to be derived from an extension of the area under vetches. In addition to other useful functions, vetches being a leguminous crop enrich the ground in nitrogen.

Peas.—The ordinary field pea is grown to a small extent as a leguminous grain crop, but peas may also be grown for forage purposes, and they constitute another crop of considerable value in that respect, particularly when grown in a mixture with oats. If sown pure they cannot be recommended so strongly. This crop is one which succeeds particularly well on the higher classes of soils provided these contain a fair amount of lime, but it can be successfully grown for forage purposes on a wide range of soils.

Although closely related in certain respects, the development of peas and vetches is in others quite different. The main stem of the pea grows during the greater part of the life of the plant, but the side branches are not very vigorous. In the vetch, on the other hand, the main stem soon stops growing, but strong side branches are developed from the base. In the case of the winter vetch these side branches do not develop until the spring, but they come away quickly then.

Peas are not endowed with the hardiness of the winter vetch and are unsuitable for sowing in autumn. On the whole, they are best sown in March and April for the production of succulent forage in June and July, but the crop may be seeded as late as the end of June or beginning of July, as is the custom on certain farms where early potatoes are grown, a mixture of peas and oats being sown just after the potatoes are lifted. The crop is one which responds well to manure, and that is specially noticeable on the lighter soils. A dressing of 10 to 12 tons "well rotted" or "short" farmyard manure should be applied, as peas, like all other leguminous crops, benefit greatly therefrom. This should be supplemented with two or three cwts. of superphosphate at the time of sowing.

The seeding should be at the rate of 2½ to 3 bushels of oats and 1 to 1½ bushels of peas per acre, according to whether the crop is drilled or broadcasted. Unless the quantity of peas in the mixture

is restricted, the oats are apt to be smothered. The seed is best drilled in, and that method of seeding should be adopted whenever possible.

The resulting forage from the mixture referred to is particularly satisfactory as regards both quantity and quality. It is best consumed early and while it is in the green state, for as the peas mature and the pods fill up the mixture must be fed with greater caution, as it then has a somewhat binding effect on the animals consuming it.

Other cereals may take the place of the oat in the above mixture, but, all things considered, the oat is the most valuable cereal for sowing mixed with peas, and by its inclusion the value of the produce is enhanced. The pea, like the vetch, being a leguminous crop, has an enriching effect on the land.

Cereal Crops.—Although cereals are often sown in mixture with leguminous forage crops, some of them, when sown alone, can also be relied on to provide very valuable forage.

Rye.—This crop fills a very useful and important place as a forage crop. It is very hardy and capable of standing a severe winter without damage, it comes away vigorously in spring, produces a large amount of green food while pastures are still bare, and, with the exception perhaps of Italian Ryegrass which has been specially fostered, is really the crop first ready for "soiling." Reference has already been made to the sowing of winter vetches along with winter rye under suitable conditions, and to the value of such a crop, but rye alone will succeed under conditions much less favourable. It can be successfully grown on almost any kind of soil, including sandy, gravelly and peaty soils, but it is on the richer soils that the surest and best return is obtained.

It should be sown in September or early in October so that it may be well established before winter sets in, otherwise it does not make such rapid progress in the early spring. The seeding should be fairly thick, the minimum amount being 3 or 4 bushels per acre according to the manner of sowing. The crop benefits greatly from the application of artificial manures, and 3 cwts. superphosphate or 5 to 6 cwts. slag should be applied at the time of sowing, and in the early spring the growth can be pushed on with dressings of nitrate of soda at the rate of 1 cwt. per acre.

One drawback this crop has for forage purposes lies in the fact that the produce, though abundant, remains in a succulent state for a relatively short period. After shooting it soon tends to become hard, less palatable and less nutritious, and to get the full benefit it requires to be consumed while still in the green state.

The period over which this crop furnishes green food may be materially lengthened by applying the top dressing of nitrate of soda to different portions of the area under this crop at intervals of a fortnight or thereby. Under normal conditions the section first top dressed is sufficiently far advanced for cutting or for consumption on the ground several days before the next treated section, and in this way more of the rye can be utilised while at the most valuable stage and the period for which the crop is available materially lengthened.

For the feeding of dairy cows the value of rye is scarcely fully appreciated; it can be relied upon to provide valuable succulent food at the period most difficult to bridge over, namely, late spring and early summer. Moreover it is off the ground in time for another crop to follow it.

Rye may also be sown from February on to mid-summer for the production of green food later in the year, but for summer and autumn forage, unless in a mixture, it is not quite so good as other forage crops that may be grown for the same purpose. When sown in a mixture, however, with a leguminous forage crop, it proves very valuable, and in some trials at the College Farm with various mixtures for forage purposes, rye and summer vetches proved one of the most suitable for the feeding of dairy cows.

Altogether it is one of the crops that scarcely ever fails.

Barley.—This constitutes another very useful crop for the production of green forage, and it is one which at present is fairly widely grown in some districts.

The barley may be sown in autumn for the production of forage in early summer, or it may be sown in spring and early summer for consumption later in the year.

The varieties of barley most suitable for autumn sowing either pure or in mixture with vetches or other crop are of the six rowed type (*Hordeum sativum hexastichon*), and of the four rowed type (*Hordeum sativum vulgare*), commonly known as Bere.

The autumn sown crop is little behind rye in hardiness, and it may be sown in September or October for the production of early summer forage. It is somewhat slower in developing than the winter rye, but forms a very important crop where a succession of green forage is wanted, as it is ready for consumption by the time the rye is finished.

When sown in spring or early summer barley also provides much useful forage.

As regards the type of soil, the crop is one which is, on the whole, best suited for the medium and lighter soils, but it succeeds well on a wide range of soils, provided these are clean and in good condition. The crop responds well to manure, and applications at the rate per acre of 2 cwts superphosphate, 2 cwts. kainit and 1 cwt. sulphate of ammonia or 1 ½ cwts. nitrate of soda, give good results. In the case of spring and summer sown barley the manures should be applied at the time of sowing unless sulphate of ammonia is replaced by nitrate of soda, in which case the latter manure should be applied as a top dressing just after the crop brairds. In the case of autumn sown barley, the nitrogenous dressing is best withheld until the early spring.

Barley for forage purposes may follow a grain crop or a potato or root crop, or if sown in summer, it may succeed another forage crop.

On some of the early potato farms in Ayrshire barley is very often grown as a catch crop, being sown as soon as the potatoes are lifted. In an early season, when there is a prospect of the crop ripening, it is allowed to stand for grain, but for this purpose it requires to be sown at the latest by the first week in July. Foreign barley, particularly Californian or Oregon, has been found

most suitable for this particular purpose. In the majority of cases, however, there is little prospect of the crop ripening, and it is cut and utilised as green forage, being highly prized for that purpose, particularly for the feeding of dairy cows in milk, as it is found to be an excellent milk producer, and comes in at the time when the grass fails.

Barley should be consumed fairly early, not being of the same feeding value or so much relished by stock when the awns appear; consequently, this crop provides green forage for a relatively short period unless where there have been successive sowings or manurings.

Oats.—This crop is so well known that one is rather apt to overlook its merits for forage purposes. For spring and early summer sowing it is, in fact, the best of all the cereals for that purpose. Though oats are commonly grown in mixtures with vetches or peas, that is chiefly because they come in at a time when they can be successfully grown in this way, but they may if desired be grown pure, and can be relied on to provide a large amount of valuable green forage. Rather more nitrogenous manure should be applied than when grown for grain, as that materially increases the yield of leaf and stem.

One point in favour of this crop, whether grown in mixture or pure, is that the period during which the green forage can be successfully fed is relatively longer than in the case of the other cereals. The oats retain their feeding value and keep in a fairly succulent state right on till the ripening stage is reached.

By successive sowings, commencing in February under favourable conditions, and by judicious manuring, oats can be relied on to provide green forage of high feeding value from the beginning of June till well through the season.

Wheat.—This, the most important cereal in many respects, is very little known as a forage crop, but sometimes, especially after a mild open winter, wheat is much too luxuriant and uneven in growth in the spring, and it is then eaten down by sheep. The wheat tillers very readily and comes away again freely after being grazed, and not only does the grazing prove useful for sheep at the time, but as a result of the grazing a more even and profitable crop is obtained.

It is difficult to understand why wheat has not been used to a greater extent for forage purposes either in mixture with winter vetches or alone. There is no doubt but that it would form a very useful crop, particularly if sown in autumn and early winter and stimulated in early spring by top dressings of nitrate of soda. Wheat, though best adapted for the heavier soils, can be grown successfully on all good soils, and on these it is capable of giving a large yield of green forage. Moreover, it remains in a palatable and succulent state for a considerable period, and relatively longer than is the case with barley and rye. It might occupy quite a prominent place in a scheme of forage cropping, and its merits for that purpose have not been fully exploited.

Grasses.—Of the grasses most suitable for cultivation as forage crops, *Westernwolth Grass* and *Italian Ryegrass* are worthy of

special mention. The former is a rapid growing grass very similar in many respects to Italian ryegrass, but famed for rapidity of growth. If sown in spring by itself on a fine clean seed bed at the rate of 2½ bushels per acre, and encouraged by judicious manuring, it is ready to cut in July, and a second cutting may be obtained later in the season. Unfortunately this grass is short lived and does not stand the winter. All the same, Westernwolth Grass gives a large yield of nutritious forage, greatly relished by stock, and specially valuable for the feeding of dairy cows. It might thus fill a very useful place.

Italian Ryegrass can be utilised to greater advantage as green forage than almost any other crop. It may be sown in the usual way with a cereal crop or with rape, but after the removal of the cereal or the consumption of the rape, the Italian ryegrass should be stimulated by manuring, so that it may be ready for cutting early in the year when pastures are still bare. For this purpose a dressing of farmyard manure which has both a manurial and a protective effect, of liquid manure, or failing these, of artificials, is invaluable.

With a little care and fostering the crop may be ready for the first cutting early in May in a favourable season. It thus rivals winter rye in regard to earliness, but has the great advantage that from three to four cuttings may be obtained in a single season, particularly if liquid manure can be applied after each cutting. Failing that, quick acting artificials such as superphosphate and nitrate of soda should be applied.

A large yield is obtained at each cutting, and the cumulative yield in a single season under good management is often enormous. The produce is of superior feeding value and is greatly relished by stock.

Cruciferous Crops.—*Rape.*—This, though not a crop like the majority of these already considered, is nevertheless a very useful forage crop particularly for sheep feeding and also for cattle feeding, especially when used as a supplement to some of the other crops.

On many of the farms in the early potato districts in the West of Scotland it is grown in conjunction with Italian ryegrass and is often consumed on the ground by sheep, but it is sometimes cut and fed to dairy cows indoors. It is greatly relished and is an excellent food for milk production.

The details of the cultivation of this crop are so well known that there is no need for comment in that connection, but it should be pointed out that, as it can be successfully sown from April onwards, it may either alone or with Italian ryegrass follow one of the other forage crops previously referred to, and thus serve as a catch crop as well as a forage crop and keep the ground always covered.

Thousandheaded Kale.—This crop, which is a little like rape in certain respects and quite distinct in others, belongs to the cabbage family, but as it is specially valuable for green forage purposes reference is made to it here.

It may be sown at the end of April or early in May for consumption from September on to the New Year, or in June and July for consumption after the New Year and on to the month of May. It is particularly hardy and can stand a severe winter without damage. The crop generally succeeds best if the seed is

drill-sown like turnips. The rate of sowing should be about 5 lb. per acre. It responds to liberal manuring, particularly to good dressings of farmyard manure supplemented with superphosphate and sulphate of ammonia, and a top dressing of nitrate of soda in the early spring.

The plants should be spaced out to not less than 2 feet apart. They should be given plenty of room, as they branch out in a most remarkable manner and justify the name—Thousandheaded.

Thousandheaded Kale can be relied on to produce a large amount of nutritious produce, and in addition to a selection of the other crops already mentioned, it furnishes the link required to make it possible to provide a supply of green forage throughout the entire year.

OATS: THEIR MILLING AND BY-PRODUCTS.

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THE great scarcity of the usual concentrated food stuffs which was experienced during the war led to the appearance on the market of a variety of substances for feeding purposes. The majority of these substances in pre-war days probably went to help in forming compound cattle foods. Amongst them the different by-products produced in the milling of oats are much more frequently met with than was formerly the case.

The great variation found in the chemical composition of these by-products, although sold under the same name, and the scarcity of any literature bearing on the actual milling of oats, led the writer to carry out an investigation into milling processes and the by-products produced. This paper does not pretend to be an exhaustive description of oat milling, but aims only at giving a short account of the different operations in the manufacture of oatmeal, and the stages thereof at which the by-products are obtained.

These by-products are not so well known to farmers as those produced in the milling of wheat, for the percentage of home-grown and imported oats that is milled is exceedingly small. The supply of the by-products is consequently limited, and only farmers in the immediate neighbourhood of oat mills are at all familiar with them. As food stuffs, oat by-products suffer when compared with those produced in the milling of wheat on account of the high percentage of husk they contain.

Type of Grain suitable for Milling.—The type of grain favoured by the miller for grinding into oatmeal is a short plump grain with a thin husk. A variety for which he has a great predilection is the Potato Oat. This was accidentally discovered in 1728 growing in a potato field in Cumberland; it quickly came into favour, and for over a century has been extensively cultivated in Scotland.

Millers do not look with favour upon the newer varieties, their objections to them being that they are too thick in the husk, that the oatmeal obtained from them is not of such fine quality as that obtained from the older types, and that owing to one and the same spikelet often yielding grain of varying size the sample produced is

far from uniform. Another objection that some millers have to these varieties is that their machinery is not suited for the milling of them. With regard to the first of these objections, it is generally recognised that certain varieties are thicker in the husk than others; that soil, season and manuring have an influence on the growth of the kernel contained within the husk, and that a variety with 8–10[1][1] per cent. of husk in excess of the normal amount is affected in its meal-yielding properties.

When, however, the proportion of the husk to kernel is determined in the newer varieties and compared with that of the proportion of husk to kernel in older varieties, the difference is seen to be but slight, and not always in favour of the latter. A number of experiments [2, 2*a*, 2*b*, 2*c*, 2*d*] have been conducted at different centres in various parts of the country, and these go to show that if the proportion of husk to kernel is taken as an indication of the milling properties of a variety, then both Waverley and Newmarket are superior to the Potato Oat.

Actual milling tests [1, 3] which are the only safe guide to the milling properties of a variety, prove that several cross-bred and foreign oats are quite equal, if not superior, to the older varieties, and that when the total quantity of meal produced per acre is considered, the comparison is all in favour of the newer varieties.

The second of the millers' objections to the newer varieties appears to be a more valid one, for in the Aberdeen Experiments [2*d*] the composition of the kernels of the older, when compared with the composition of the kernels of the new varieties, shows that the older varieties would produce an oatmeal somewhat richer in quality than that yielded by the newer.

The following table gives the result of the chemical analysis of the dry kernels of some of the varieties of oats grown at the Edinburgh and East of Scotland College Farm, Dreghorn, in seasons 1914–15 [4]. The kernels, after the removal of the husks—which was done by hand—were dried, ground into a finely divided state, and analysed.

TABLE I.

COMPOSITION OF OAT KERNELS (DRY.)

VARIETY.	SEASON 1914.					SEASON 1915.				
	Oil.	Albuminoids.	Fibre.	Ash.	Soluble Carbohydrates.	Oil.	Albuminoids.	Fibre.	Ash.	Soluble Carbohydrates.
Potato	8·48	16·31	2·84	2·93	69·44	8·85	15·62	2·92	3·18	69·43
Leader	7·59	15·62	3·11	2·97	70·71	7·00	14·40	2·89	3·60	72·11
Record	7·38	15·50	3·01	3·03	71·08	7·51	14·06	2·90	3·26	72·27
Golden Rain . .	6·67	15·94	2·51	3·09	71·79	6·09	15·00	3·20	3·16	72·55
Crown	7·09	15·06	2·57	3·02	72·26	7·36	13·75	3·00	2·84	73·05
Victory	6·03	15·00	3·00	2·98	72·99	6·49	15·31	3·25	3·20	71·75

[1] Figures in square brackets apply to list of references at end of article, page 323.

Season 1914 at Dreghorn was a better oat-growing season than 1915, and the land on which the 1914 Oat Experiment was carried out was superior in quality to that on which the Oats were grown in 1915. The table shows that of the varieties analysed the kernels of the Potato Oat in both seasons were the richest in the three most important feeding constituents. In addition, the analyses serve as a guide to the composition and quality of the oatmeal that would be produced by the milling of each of these varieties, and, as was the case in the Aberdeen Experiment, show that so far as chemical composition goes the Potato Oat is still able more than to hold its own with the latest varieties found on the market.

The chief objections of the miller to an uneven sample of grain are the difficulties experienced in kiln drying the oats satisfactorily, and in removing the husk from the kernel. The small pickles with little or no kernel, when heated to the temperature at which the oats are dried in the kiln, fall to a powder, and go to increase the dust that is normally produced in oat milling. When an uneven sample comes to have its husk removed in the older type of mill the difficulty is in setting the stone, for, if set for the larger sized grain, the smaller ones are missed, and when set for the smaller the larger are broken. Both these difficulties, as will be seen later, are overcome in modern mills by the machinery made use of for cleaning, grading and removing the husks from the grain.

MILLING, COMPOSITION AND YIELD.

Cleaning.—On arrival at the mill the oats pass through a series of operations in preparation for grinding into oatmeal.

Consignments at times arrive in a very dirty condition. More especially is this the case with foreign oats, but millers complain very much of the state in which home-grown samples are occasionally marketed. Whatever the country of origin the oats all contain an admixture of more or less extraneous matter in the form of pieces of straw, small stones, weed seeds, etc., and the first process they go through is one designed to remove all foreign matter, and to prepare as clean a sample as possible. The importance attached to the cleaning is seen in the costly plant erected for the purpose, and in the care taken that it is carrying out its work efficiently, for the effect on the finished product of the non-removal of a few weed seeds, such as those of dock and charlock, is out of all proportion to their number.

The cleaning is accomplished by passing the oats over and through a combination of riddles, sieves and indented rotating cylinders. At various stages of the process the lighter particles are removed from the sample by exposing it in aspirators to the action of strong currents of air generated by fans. The riddles remove the larger particles present, such as straw, chaff, etc.; the sieves remove all other substances larger than normal sized oat grains, such as large oats and small stones. After passing over the riddles and sieves, the oats are conveyed to the indented rotating cylinders (see Fig. 1); these cylinders are slightly inclined, and as the grains travel down the slope the rotary motion of the cylinder causes them to spread out, and, being larger than the indents, they pass over them, making their way down to the lower

end of the cylinder. The weed seeds on the other hand, together with the broken grain, fall into the indents and are carried up until the indents are inverted, when they fall into a trough running the length of the cylinder, and are removed by means of a worm conveyer working in the trough. The cylinders are worked in

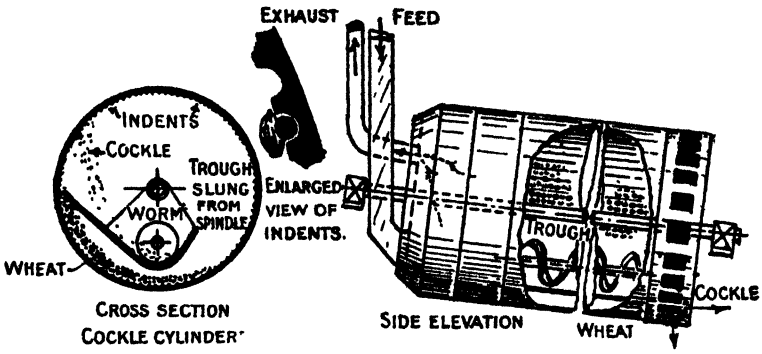


FIG. 1.—Indented Cylinders.

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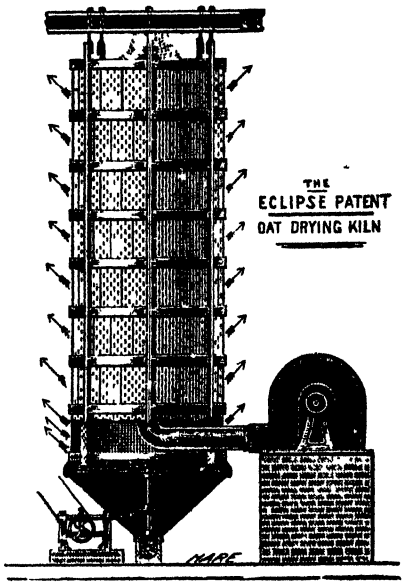


FIG. 2.—Upright Kiln.

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sets, the number comprising a set varying with the quantity of grain dealt with in the mill. The substances removed by the indented cylinders go under the name of "corn cockle," and are generally sold to either poultry food or cattle food manufacturers.

An examination of the substances removed by these different means from a number of samples of commercial oats showed them

to consist of pieces of straw and the stems of umbelliferous plants, Knapweed inflorescences, pods of Vetch, Vetch Straw, Charlock pods, the lomentum of Runch, pieces of twigs, small stones, some broken wheat, oat and barley grains, with the seeds of Vetch, Charlock, Bindweed, Runch, Dock, Spurrey, Flax, Soy Bean, and animal excreta. By examination of the weed seeds and cultivated seeds present in a sample of commercial oats it is often possible to identify the country of origin of the sample [5].

Kiln Drying.—When cleaned the oats are next kiln-dried. Two methods of kiln-drying oats are in common use. The older method is to dry the oats on a kiln floor with heated air. The floor of the kiln is made either of steel wire or of perforated steel plates. The roof of the kiln is constructed in the form of a pyramid having an outlet at the top for carrying off the vapours, the outlet being surmounted by a moveable cowl. The depth at which the oats are spread upon the kiln floor, the temperature to which they are heated, the length of time they are exposed to the drying temperature, and the number of times they are turned while on the floor vary according to the practice in the different mills.

Generally speaking it may be said that the air is heated to a temperature of 250/260° F. by passing it over an open fire placed beneath the kiln floor, the temperature being regulated by the draught. The oats are spread on the floor to a depth of 6 to 8 inches, and remain on the floor exposed to the drying effect of the hot air for two-and-a-half to three hours, being turned over every half hour during that time to ensure their drying evenly.

In the second method the drying is effected in upright cylindrical kilns (see Fig. 2), standing from 18 to 20 feet high and having a holding capacity of about 18 quarters of oats. The kilns are built of fire clay tiles, and are heated with hot air drawn or forced through them by a powerful fan. The wall of the kiln has a number of upward-slanted holes in it for the escape of the vapour that is given off during the drying. The air is heated as already described in the previous method to a temperature of between 250/260° F. and is conducted to the bottom of the kiln, where it enters a large inner cylinder, clothed with punched steel sheets, that passes through the length of the kiln. The oats enter at the top of the kiln and pass through the space between the steel cylinder and the inner fire clay wall, this space being from 3 to 4 inches wide. During the drying process the cylinder is always full of oats, and by means of an arrangement fixed between the two cylinders the oats are turned from inside to out, and *vice versa*, a number of times before they are discharged at the bottom, this movement corresponding to the turning of the oats on the kiln floor. The oats fall on to a fixed plate at the bottom of the kiln, where revolving arms slowly working round on the plate carry them off. The rate at which they pass out at the foot of the kiln is from 7 to 8 quarters per hour, this quantity having taken from two-and-a-half to three hours to pass through the kiln. Several advantages are claimed for the second method of kiln-drying, the chief of which appears to be a saving of labour, floor space and

coal. As a result of kiln-drying the oats, the whole of the subsequent operations in their milling are greatly facilitated; thus the separation of the husk from the kernel is more readily brought about, the grinding of the kernel into oatmeal is more effective, the oatmeal itself keeps better, and the drying gives to the meal its characteristic flavour.

The effect of kiln-drying on the moisture content of the oats is shown in the table below, which gives the percentage of moisture in the oats before and after kiln-drying.

TABLE II.

Percentage of Moisture in Oats.	Percentage of Moisture in Oats after Kiln-drying.
13·38	2·72
12·84	2·22
13·93	2·01
14·06	2·51
10·22	2·42
13·65	2·16
Average ... 13·01	Average .. 2·34

Some of the above samples were dried on kiln floors, others in the upright form of kiln. The kiln-dried samples when taken were placed in tight-fitting glass stoppered bottles; those dried in the upright form of kiln were taken as they left the kiln, the others as they were being removed from the floor, and the moisture was determined in all as soon as they reached the laboratory. For the moisture determination both the undried oats and the kiln-dried oats were ground into a finely divided state in a mill, and the moisture was determined in the finely ground sample in the usual way. The table shows that in all of the mills from which the samples were taken the drying of the oats in the kiln is carried to nearly the same stage, and that the oats in kiln-drying lose on an average about 80 per cent. of the moisture they contain.

In some mills it is the custom after kiln-drying the oats to pass them through the indented rotating cylinders. The seed coats of the small weed seeds in kiln-drying are puckered or corrugated, and in this state do not so readily slip out of the indents and are more readily removed.

Shelling.—When dried, the oats are stored for from four to seven days before "shelling," for it is found that if shelled without standing this time an excessive amount of dust is produced. After standing the requisite time the oats are next shelled or husked. There are two methods in use for this purpose. In the first the oats are passed between two circular stones made of Derby Peak stone. The stones are about 4½ feet in diameter and are enclosed in a box or case. The lower one—known as the bed stone—is stationary and set in a horizontal position; the upper one is mounted on a vertical axis on which it rotates, and the face of this rotating stone may be set at any desired distance from that of the lower stationary stone by means of a screw.

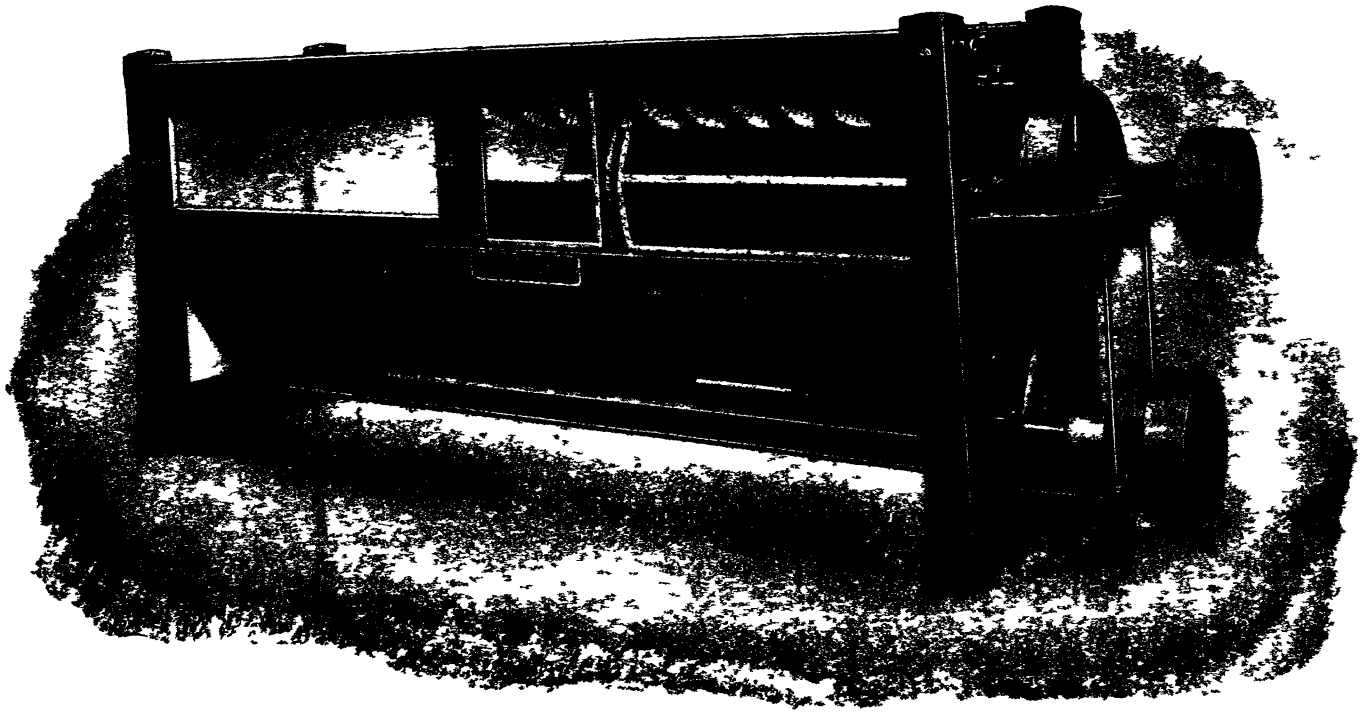


FIG 3 —Centrifugal

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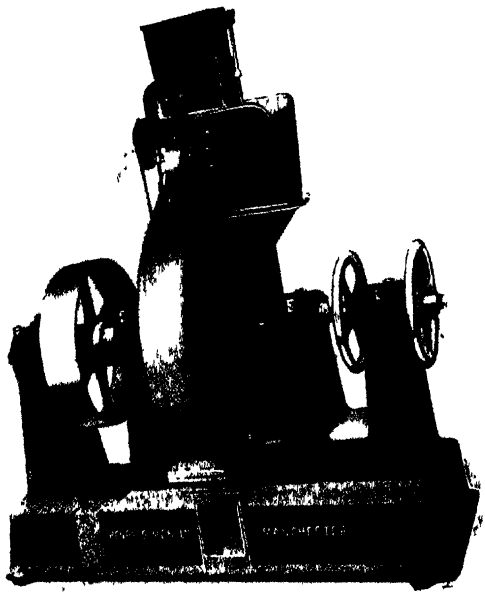


FIG. 4.—Shelling Mill.

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The oats are conveyed to the stones by a shoot, and pass between them through a hole in the upper stone known as the "eye." By the attrition to which they are subjected between the rough faces of the stones, the husk, depending upon the size of the grain, is either partly detached or removed from the kernel, the centrifugal action of the rotating stone causing the husk and kernel to travel outwards until they fall over the edge of the stone. The mixture, consisting of husks, kernels, dust and small oat grains that have not been husked, is from here conveyed to the Centrifugal (see Fig. 3). This is an apparatus for removing the dust, and consists of a cylindrical sieve rotating in a horizontal position and furnished inside with a number of beaters, the whole being enclosed in an air-tight compartment. The beaters are so fixed that when they rotate on a central spindle running through the length of the Centrifugal they throw the contents both against the sieve and in a forward direction. The sieve allows the dust and small particles of husk to pass through it; the kernels, small oat grains and husks are retained and travel along towards the tail end of the Centrifugal. Here they meet with a strong current of air generated by a fan, and this removes the husk. The kernels and oat grains are once more passed between the stones, which are this time not so closely set. The small oat grains, in passing through the stones when thus set, rise on their ends and are shelled. The product, consisting of kernels, husk and any unhusked oats, is once more passed through the Centrifugal and separated into its different constituents as already described. The composition of the material, known as scree-dust, which passes through the mesh of the sieve of the Centrifugal is shown in Table IX.

In the second method for the removal of the husks from the kernels, the oats are passed between emery discs. These are two metal discs about $3\frac{1}{2}$ feet in diameter, fitted with roughened surfaces made of emery, combined with a preparation which acts as a cement. The mixture is applied to the faces of the discs and may, when worn, be removed. The discs can then be redressed with new facings. One of the pair of discs is mounted on a horizontal axis on which it rotates, with its rough surface facing the rough surface of the second disc, which is stationary. The discs are encased in an air-tight compartment (see Fig. 4), and by the aid of a screw the rotating disc may be adjusted to any desired distance from the stationary disc. The emery discs are arranged in batteries of two or three pairs, the only difference between them being in the distances apart at which the faces are set. The oats, before they are passed between the discs are first "sized" or graded by being passed through indented rotating cylinders or over sieves. They are generally graded into two sizes. From the sizer they are conveyed to the particular pair of discs appropriately set for that size, being delivered between the discs by a shoot, the mouth of which fits into a hole at the back of the stationary disc. In passing between the emery discs, the husk, as was the case when the oats were passed between the stones, is removed from the kernel; the separation of the husks, kernels and the dust produced in the process is carried out by the Centrifugal and aspirator as already described above.

Scouring.—The kernels when shelled and passed through the Centrifugal are next scoured. The scourer is a stationary cylindrical skeleton placed in a horizontal position and fitted with a perforated steel cover and furnished with beaters that rotate on a horizontal axis—the whole apparatus being encased in an air-tight compartment. The beaters in the scourer are so set that they rotate close to the steel cover, with the result that in addition to any adhering husk and dust a small quantity of the external tissues of the kernel itself is removed. The dust passes through the perforations of the steel cover, the husks and kernels travel along inside the scourer to the tail end, where the husk is separated from the kernel by an aspirator.

The table below shows the average percentage composition of three samples of kernels taken as they enter the scourer and after passing through.

TABLE III.

	Average percentage composition of Kernels on way to Scourer.	Average percentage composition of Kernels after Scouring.
Moisture	8·20	8·30
Oil	8·25	8·38
Albuminoids	15·67	16·05
Fibre	3·04	2·12
Ash	2·12	1·95
Soluble Carbohydrates ...	62·72	63·20
	100·00	100·00

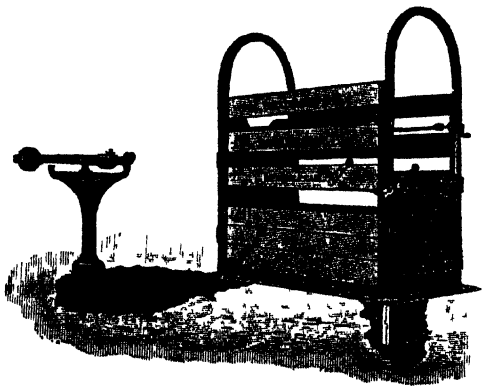
The difference in the percentage of any one constituent of the kernels before and after passing through the scourer is seen to be but small. The one constituent in which the difference is at all appreciable is the fibre, which in the scoured kernels is about one per cent. less than in the unscoured.

The composition of the dust removed in the scouring of the kernels and known as oat dust is shown in Table X. When scoured, the kernels—the production of which free from husk and dust is the chief care of the miller—are now ready for grinding into oatmeal.

Grinding into Oatmeal.—The grinding is done by mill-stones which, in olden times, were made from the grits of the Silurian, Old Red Sand Stone, and Carboniferous formations (Mill-Stone Grit). In Britain at the present time the stone generally used is the French Burrstone, a stone of world-wide repute as a mill-stone. It is obtained from the Tertiary deposits of France (Seine-et-Marne), and is a porous siliceous rock with just sufficient calcareous matter to give it the requisite toughness so that no appreciable amount of sandy particles is given off from it to the meal. The stone is brought over from France in blocks of one foot or more square, which are dressed, built up and clamped or hooped into mill-stones of varying sizes, as many as twelve blocks often going to make one stone. The dressing, fitting and building up of these blocks to form a mill-stone requires much skill and labour, for when com-

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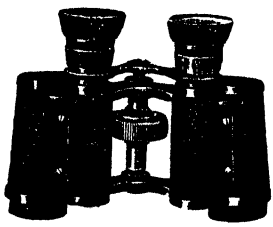
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pleted the joints are hardly perceptible, the whole surface being rendered true and even. The stones when built are about four feet in diameter, and weigh about 25 cwts. The surfaces of the stones are furrowed. The furrows, known as the "Roads," radiate from the centre and are cut on a slant, being five-eighths of an inch at the deepest part; the outstanding portions of the stones are known as "Lands." The object of the furrows is to ventilate the working parts, though they doubtless assist in the cutting of the kernels. The lower stone—known as the bed stone—is stationary, and set with great care in a horizontal position, with its furrowed surface facing the furrowed surface of the upper stone or "Runner," which is mounted on a vertical axis on which it rotates. The upper stone, by the aid of a screw, may be raised or lowered and set at any desired distance from the bed stone. Both stones are enclosed in a wooden or tin case.

The scoured kernels are conveyed to the grinding stones and pass between them through a hole in the upper stone. They are ground, and the product is then passed over a series of sieves known as the sifters. These are made of perforated tin, the perforations varying in diameter. The tin sieves forming the sifters are fitted in pairs on what is termed the "box" or carrier, with the arris or raised surface of the perforations uppermost. The carrier has a motion resembling that of a hand sieve, and is placed with a gentle slope towards one end. The ground kernels are conveyed to the upper end of the sifters, the motion and slope of which cause them to travel slowly towards the lower end. The portion passing through the mesh of the sieve is oatmeal, and is termed Round Oatmeal, Medium Cut or Fine Cut, according to the mesh through which it passes. The portion retained by the sieves is again passed between the grinding stones, and the product once more passed over the sifters. The material retained by the sieves in this their second passage over the sifters is known as meal seeds, and is made up of the husks of the small oat grains together with small particles of the kernel attached to the husk. The composition of meal seeds is given in Table VIII.

The Chemical Composition of Oats, Oat Husk and Oat Kernels.—The following table gives the average percentage composition of a number of samples of oats, oat husks and oat kernels, and for purposes of comparison these are also given calculated to dry matter.

TABLE IV.

	Average Percentage Composition.			Average Percentage Composition Dry Matter (Calculated).		
	Oats.	Husks.	Kernels.	Oats.	Husks.	Kernels.
Moisture	13·39	6·32	8·29	...	...	...
Oil	5·62	1·36	7·65	6·48	1·45	8·34
Albuminoids	11·76	2·57	15·32	13·34	2·74	16·70
Fibre	9·65	32·91	2·42	11·14	35·13	2·63
Ash	2·70	3·87	2·00	3·11	4·13	2·18
Soluble Carbohydrates	56·88	52·97	64·32	65·93	56·55	70·15
	100·00	100·00	100·00	100·00	100·00	100·00

The outstanding difference between the whole oat grain and the oat kernel is in their fibre content, over 76 per cent. of the fibre of the oat grain, chiefly in the form of husk, being removed in the production of the kernel. The fibre is still further reduced when the kernels are ground and sifted into meal, the latter on an average containing 1·5 per cent. of fibre (see Table VI.). Although the oat grain itself is not suitable for human consumption, the removal of the husk in the milling process alters the whole character of the remainder and furnishes us with one of the most valuable of human foods, for, as the table shows, the oil and albuminoids of the oat grain is almost entirely found in the kernel of the grain.

The Yield of Meal from Oats.—An important consideration to the miller—coming next to that of the quality of meal produced by a sample of oats—is the yield of meal from a given weight of the sample. Amongst the more important factors that influence the yield are the percentage of moisture the grains contain and the care with which they have been dressed.

Millers generally estimate that to produce a bag of oatmeal weighing 280 lbs., 12 bushels of oats (42 lbs. to the bushel) are required, representing a yield of about 55·5 per cent. In this connection the following results are of interest, being the yield of meal obtained in the milling of commercial oats at a mill where careful records are kept of the meal and the different by-products produced:—

TABLE V.

YIELD OF OATMEAL, HUSKS, MEAL SEEDS AND SCREE DUST IN THE MILLING OF COMMERCIAL OATS.

WEIGHT IN TONS.					PERCENTAGES (Approx.).			
OATS.	Oatmeal.	Husks.	Meal Seeds.	Scree Dust.	Oatmeal.	Husks.	Meal Seeds.	Scree Dust.
315·5	191·5	53·	12·4	14·1	60·6	16·7	4·0	4·5
231·5	136·8	41·3	12·1	10·1	59·	17·8	5·2	4·3
158·	94·	27·9	6·9	7·5	59·5	17·6	4·3	4·7
			Average		59·7	17·4	4·5	4·5

When the weight of oats milled, together with the close agreement of the results are taken into consideration, the average percentage figures may be taken as fairly representative of the yield of meal and by-products produced in the milling of commercial oats.

Oatmeal.—The composition of a number of samples of oatmeal ground to varying degrees of fineness is given in the table following:—

TABLE VI.

THE COMPOSITION OF OATMEAL GROUND TO VARYING DEGREES OF FINENESS.

	Moisture.	Oil.	Albuminoids.	Fibre.	Ash.	Soluble Carbo-hydrates.
Round Cut Oatmeal.	8·57	8·03	14·50	1·70	1·88	65·32
	8·26	9·47	13·44	2·18	1·80	64·85
	6·61	9·00	12·81	1·30	1·53	68·75
	9·12	8·49	15·94	1·60	1·83	63·02
	9·25	8·60	13·75	2·15	1·56	64·69
	8·34	8·75	15·18	1·82	1·64	64·27
Average ...	8·36	8·72	14·27	1·79	1·44	65·15
Medium cut Oatmeal.	8·26	8·75	17·50	2·04	2·01	61·44
	10·41	8·13	14·56	2·15	1·86	62·89
	8·07	8·83	13·44	1·50	1·68	66·48
	6·82	9·50	11·87	0·85	1·87	69·09
	8·10	8·65	13·20	1·22	1·93	66·90
	7·92	8·21	14·16	1·41	1·63	66·67
Average ...	8·26	8·68	14·12	1·53	1·83	65·58
Fine Cut Oatmeal.	8·84	8·77	16·56	1·63	2·03	62·17
	10·38	9·46	14·06	1·04	1·83	63·23
	8·28	10·17	13·44	1·49	1·76	64·86
	7·43	9·90	12·50	0·72	1·61	67·84
	8·21	8·91	13·20	1·22	1·80	66·66
	8·63	9·02	14·01	1·32	1·62	65·40
Average ...	8·63	9·37	13·96	1·23	1·77	65·03

The average figures giving the composition of the different cuts of meal show that there is little, if any, difference between Round, Medium and Fine Cut.

An examination of the table shows that the constituents liable to the greatest variation are moisture and albuminoids. With regard to the moisture content, it is well known that freshly ground oatmeal rapidly takes up moisture from the atmosphere, and that the percentage of moisture in oatmeal is to a large extent dependent upon how recently the meal has been ground and the conditions under which it has been stored since grinding. The following will illustrate the rapidity with which oatmeal absorbs moisture from the atmosphere. A sample of freshly ground medium cut oatmeal was obtained and all precautions were taken to prevent the sample absorbing moisture before analysis; on the moisture content being determined it was found to be 3·21 per cent. A weighed portion of the same sample was left in the month of July exposed to the atmosphere of the laboratory for twenty hours. At the end of this period it was again weighed when the moisture content was 4·11 per cent.; on being left exposed for a still further period of twenty hours it was found to have increased to 6·41 per cent., and at the end of sixty hours to 6·78 per cent. Thus a sample of freshly ground meal containing 3·21 per cent. moisture,

at the end of sixty hours, contained 9·99 per cent. It should be pointed out that the oatmeal was spread in a comparatively thin layer in a dish, and that by turning the meal over as large a surface as possible was exposed to the atmosphere. Oatmeal tightly packed in a bag or sack will not take up moisture at this rapid rate. A bag of freshly ground oatmeal will absorb moisture at the rate of about 1 lb. per day for the first week, after which the rate of increase will be considerably reduced. It will take about four months to gain a stone in weight.

The chief factors that appear to influence the percentage of albuminoids in oats are climate and manuring. Oats grown in warm, dry climates, or with nitrogenous manures, or following such a crop as clover [6], are generally rich in albuminoids. A comparison of the analyses of the different samples of oatmeal in the same group, or the same cut of oatmeal, show that they vary amongst themselves quite as widely as do individual samples taken from different groups when compared with each other.

Oatmeal has a higher percentage of both oil and albuminoids than wheaten flour, yet only about 5 per cent. [7] of the total weight of oats grown in and imported into the United Kingdom during the years 1909 to 1913 was consumed as human food. When it is remembered that oatmeal is amongst the cheapest and most valuable of food stuffs this percentage is exceedingly small, and might with advantage be very considerably increased.

Except for special purposes, such as calf-rearing, when it is used with separated milk, oatmeal—owing to its cost—is not much used in the feeding of stock.

Oat Flour and Rolled Oats —In addition to being ground into meal, oat kernels are also ground into Oat Flour, and rolled into Rolled Oats. Oat flour is manufactured from medium cut oatmeal. This is passed between steel rollers and ground into a finely divided state. From the rollers it passes to a centrifugal, the action of which is similar to the centrifugal made use of in the removal of dust from the kernels The cover of the centrifugal used in the manufacture of oat flour is made of silk, and allows only the finest particles to pass through it. All that passes through is flour, that retained by the silk is sold as oatmeal

Rolled oats are made from the whole oat kernels. These after passing through the scourer are first steamed with the object of softening them, and then are passed between smooth steel rollers where they are bruised. After passing between the rollers they are dried by means of steam.

The following is the average percentage composition of three samples of oat flour and three samples of rolled oats :—

	Oat Flour.	Rolled Oats.
Moisture,	8·70 per cent.	8·34 per cent.
Oil,	8·68 „	8·07
Albuminoids,	15·01 „	15·04
Fibre,	0·85 „	1·18
Ash,	1·22 „	1·60
Soluble Carbohydrates,	65·54 „	65·77
	100·00 „	100·00

As would be expected, their chemical composition is very similar, and closely agrees with the composition of the different "cuts" of oatmeal.

The By-Products produced in the Milling of Oats.

These are oat husks, scree dust, oat dust and meal seeds, and the (approx.) percentage weight of each of these produced in milling is shown in Table V.; as the yield of oat dust is small in comparison with that of the others it has been included under that of scree dust. A comparison of the analyses of the same by-products obtained from different mills brings out very strikingly what has already been stated when describing the different processes in the milling of oats, namely, the lack of standardisation of the various processes in oat milling. The result of this is that the composition of the by-products varies within wide limits when samples of the same by-product from different mills are compared, and it is almost impossible to give figures that represent the average composition of any by-product with the possible exception of oat husks, the composition of which appears to be liable to least variation. The constituent liable to widest variation is fibre, and this is very pronounced in the case of the samples of scree dust and oat dust. Possible explanations for this variation are given in the following short notes on each of the by-products.

Oat Husks.—When oats are milled, about 17 per cent. of the grain is removed in the form of husk, as shown in Table V. The composition of the husks is given in the following Table.

TABLE VII.

Percentage Composition of Oat Husks.

	1.	2.	3.	4.	5.	6.
Moisture	5 60	6·95	7·54	4·93	6 60	8·99
Oil	1·15	0·76	1·32	2·00	1·60	0·83
Albuminoids	1·87	2·68	2·96	3·12	2·25	1·87
Fibre	34·75	35·65	33·02	29·50	31·63	36·14
Ash	3·76	4·12	3·50	4 02	3·95	3·81
Soluble Carbohydrates ...	52·87	49·84	51·66	56·43	53·97	48·36
	100·00	100·00	100·00	100·00	100·00	100·00

Up to comparatively recent times the value placed upon husks was so low that at a number of mills they were thrown upon the kiln fire and burned. At one time a quantity of oat husks was shipped from England to America, where they were used for packing bacon and hams for export from that country.

In breweries and distilleries great difficulty is experienced in the draining of the liquor from the mash, owing to the latter settling at the bottom of the tun in the form of a colloidal mass, and offering great resistance to the proper drainage of the liquor; it has been found that the incorporation of oat husks in the mash

increases the pore space, and in this way facilitates the draining. Large quantities of oat husks are used in these industries for this purpose, and later find their way on to the market as a constituent of brewers' and distillers' grains.

As a food stuff, oat husks are characterised by their high fibre content and poverty in oil and albuminoids, and are rarely, if ever, fed alone to stock in this country. In a finely ground state they are mixed with other food stuffs to form compound cattle foods, poultry foods and poultry spices; occasionally in this form they are found as an adulterant in barley meal and middlings.

Meal Seeds.—Meal seeds are the husks of small oat grains with a varying amount of the kernel still attached to them. The small grains, owing to their size, escape having their husk removed when passing through the process designed for the purpose. They accompany the kernels in their passage between the grinding stone, with the result that they are crushed and broken, but the husk and kernel of the grain are only partially detached one from the other. When they pass over the sifters the husks are separated from the meal produced by the grinding of the kernels, as well as from any meal produced by the crushing of the small grains.

As it is clearly to the advantage of the miller to obtain the maximum yield of meal from the oats milled, and to leave any by-product formed as free as possible from what would produce meal, viz., kernel, it is not surprising to find that the composition of meal seeds is subject to much wider variation than oat husks, and that to a large extent their composition depends upon the type of mill from which the sample is obtained. Generally speaking, it may be said that the more modern the mill the more complete the removal of the kernel, and consequently the poorer the meal seeds produced and the closer their approach to oat husks in composition.

TABLE VIII.

PERCENTAGE COMPOSITION OF MEAL SEEDS.

	1.	2.	3.	4.	5.	6.
Moisture	10·99	6·18	8·91	8·00	7·29	8·52
Oil	4·56	3·20	1·39	1·89	2·63	1·90
Albuminoids	5·31	5·00	2·50	7·37	6·21	5·83
Fibre	17·94	27·85	32·62	32·96	30·52	29·64
Ash	2·96	2·91	4·10	4·47	3·81	4·51
Soluble Carbohydrates ...	58·24	54·86	50·48	45·31	49·54	49·60
	100·00	100·00	100·00	100·00	100·00	100·00

The feeding value of meal seeds depends entirely upon the amount of kernel left attached to the husks, the larger this is in amount the more valuable are the meal seeds, and *vice versa*. Reference to Tables VII. and VIII., giving the composition of samples of oat husks and meal seeds, shows that there is little difference in composition between some of the samples included in

the two Tables, and that certain of the meal seeds would be more correctly described as oat husks.

Where obtainable, meal seeds are generally fed mixed with maize meal to pigs. The maize is said to lie too compactly in the stomach to be readily attacked by the digestive fluids, while the mixture of meal seeds and maize meal forms a loose mass more easy of digestion.

Table V. shows that on an average about 4½ per cent. of meal seeds are produced in the milling of oats. It is from meal seeds that the once well-known Scottish dish "Sowens" is prepared. The meal seeds are steeped in water until they become sour. The liquid extract is then separated from the seeds by means of a fine sieve or by filtering through linen, and the liquid thus prepared is known as "Sowens." A somewhat similar dish is prepared in Wales—the starting point in its preparation, however, is oatmeal and not meal seeds. The oatmeal is steeped in water until sour and then strained or filtered. The liquid extract is boiled, and on cooling sets into a jelly which is known as "Llymru," and is eaten with milk.

Scree Dust.—Scree dust is the substance removed from the kernels when, after shelling, they are passed through the centrifugal. It consists of dust and small particles of husk which are fine enough to pass through the mesh of the sieve of the centrifugal. As shown in Table V., the average amount of the scree dust formed is about 4½ per cent.

The composition of scree dust is given in Table IX.

TABLE IX.

PERCENTAGE COMPOSITION OF SCREE DUST.

	1.	2.	3.	4.	5.	6.
Moisture	7·38	6·01	7·11	7·50	7·65	6·99
Oil	4·32	5·67	6·13	7·78	7·52	5·85
Albuminoids	9·69	10·25	10·94	12·00	8·94	8·75
Fibre	26·32	23·52	15·61	21·27	16·68	23·40
Ash	5·20	6·19	4·46	4·86	5·84	5·24
Soluble Carbohydrates ...	47·09	48·36	55·75	40·59	53·37	49·77
	100·00	100·00	100·00	100·00	100·00	100·00

Some of the samples are seen to contain a high percentage of fibre, and a comparison of the amount of this constituent present in the different samples shows that it varies more than any other. This variation is almost wholly due to the different amounts of husk present in the samples, for even a superficial examination of the samples shows that some contain much more husk than others. One reason for this great variation in the amount present in scree dust has already been referred to when speaking of the shelling of oats. It was then pointed out that if the oats are shelled too soon after kiln-drying the proportion of dust is increased, due to the husk

being brittle and breaking into small particles fine enough to pass through the sieve of the centrifugal, thus adding to the weight of dust produced and at the same time to the fibre content of the scree dust.

Samples of scree dust at times contain excessive amounts of sand. The highest percentage found in the samples given in Table IX. was 3·22 per cent., and the average percentage 2·81.

The light and fluffy nature of scree dust renders it unsuitable for feeding alone,—it is mixed with other foodstuffs, generally meals, and fed to pigs.

Oat Dust—Oat dust is the by-product obtained from the kernels when they are passed through the scourer. It will be remembered that the centrifugal and scourer, although similar in many parts, differ in one or two essentials, *e.g.* the cover or sieve of the centrifugal rotates whereas that of the scourer is stationary. Further, the beaters of the scourer work closer to the sieve, with the result that, as already mentioned when describing its action, some of the external tissues of the kernel are removed, and this adds very considerably to the value of the oat dust, which, on reference to Table X., is seen to be particularly rich in oil and to contain a fairly high percentage of albuminoids. The percentage of fibre in oat dust, as is the case with scree dust, varies within wide limits, three of the samples closely approaching in fibre content the percentage found in scree dust. This high percentage of fibre in the samples is probably due to the faulty working of part of the plant, though in some samples found on the market it is more likely due to the mixing of scree dust with oat dust.

TABLE X.

PERCENTAGE COMPOSITION OF OAT DUST.

	1.	2.	3.	4.	5.	6.
Moisture	8·52	6·74	8·89	7·06	8·45	6·28
Oil	9·20	9·50	10·16	11·07	11·00	11·50
Albuminoids	10·60	13·00	11·87	14·69	11·25	10·00
Fibre	19·70	9·27	15·09	6·17	10·87	15·50
Ash	4·80	3·15	3·80	3·47	3·62	3·96
Soluble Carbohydrates . .	47·18	58·34	50·19	57·54	54·81	52·76
	100·00	100·00	100·00	100·00	100·00	100·00

Where a supply of this by-product can be obtained it is generally mixed with other meals and fed to pigs, and, provided the percentage of fibre is not excessive, it is an excellent food, judged by its chemical composition and by the feeding results obtained.

The information contained in this paper in connection with the actual milling of oats was gathered during many visits to a number of Oat Mills in the neighbourhood of Edinburgh, where every opportunity and facility was given by the owners and management for the examination of the plant, as well as for taking the samples.

To these gentlemen, to Messrs. Longmans, Green & Co., to Henry Simon & Co., Manchester, to James Walworth & Co., Bradford, the writer desires to express his thanks.

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RECENT INVESTIGATIONS ON FRIT-FLY IN CORN CROPS.

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THERE is reason to believe that Frit-Fly (*Oscinis frit*) is widely distributed in Scotland, and that its ravages amongst oat crops are more widespread and more serious than farmers as a whole have realised. Examination of a limited area in Scotland leaves no doubt as to the extent of the damage or as to its importance from a monetary point of view; but the fly itself is minute—its head and body measure scarcely more than one-twentieth of an inch in length—and the actual damage done may easily escape an unobservant eye or may be attributed vaguely to "blasting" or "blight." Apart from present damage there is a danger that, if no effort be made to checkmate the pest, fresh outbreaks may lead to a general infestation which would endanger the yield of the country's staple corn crop It is therefore desirable that some attempt should be made to discover the actual range and severity of Frit damage throughout Scotland, and that all facts bearing thereon and on the problem of controlling the pest should be collected. The following notes are written with a view to focussing attention upon the plague in order that fresh information may be gained as to its standing in Scotland.

Amount of Damage caused by Frit.—That the spring attack of Frit on growing oats is economically serious needs no emphasis. As early as June the general results are obvious to the careful observer, and are to be traced in the thinness of the crop, in the lack of strong, upstanding, healthy plants, and in the occurrence of low-

growing, rank shoots on the plants that survive. The poor condition of the crop becomes more marked towards harvest, and the spring attack alone, as its results have been pointed out to me in the Lowlands, is accountable for a serious deficiency in the number of earing shoots over wide acreages. On one farm in 1917—a particularly bad year, although the pest is almost constantly present—large patches were seen to be practically bare of crop.

On experimental plots at Inveresk, where the oats were attacked by Frit, Dr W. G. Smith and Mr. T. Anderson found that the number of ears gathered from plots of 100 plants ranged from a number equivalent to the number of plants to no more than five. A Gloucester farmer, writing in 1917 (his letter is quoted by Mr. J. E. Collin[1]) stated that "Two of the [last] ten years I lost the entire crop, and the remaining eight I lost more than half, entirely through Frit-fly. . . . The loss to the country I consider is very much greater than that caused by Anthrax, Sheep-scab or Swine Fever. In 1913-1914 numbers of farmers in the district turned stock into their oat fields just before harvest as they found it was not worth cutting." Another Gloucestershire farmer tells me that ten years ago Frit was unknown amongst his oats, but that since its appearance shortly after that time it has been gradually spreading. There is much further evidence to the same effect.

Such statements refer specially to the visible damage to crops done by the spring attack of Frit, but recent investigations have shown that the unobtrusive summer attack is also serious in its results. The grubs of a summer brood attack the grain during its early formation, and prevent its development or destroy it. Mr. Collin found that five acres of Garton's "Abundance" sown in 1917 and attacked by Frit produced only 40 sacks of corn "very light in weight." In an undressed sample of this crop, consisting of 358 grains, 214 were sound and 144 were obviously or presumably damaged by the fly-larvæ. Professor T. H. Taylor and Mr. Percival in their excellent observations on Frit[2] found that in one sample of oats grown in Yorkshire 21 per cent. of the grains were damaged and in another 65 per cent. were unsound. In a letter Mr. Collin informs me that in a wide series of samples examined by him he found that the "average infestation for England worked out at about 8 per cent., and in a few cases amounted to over 40 per cent. of the grain." He has also found that whereas the average yield of oats in England during the ten years 1901 to 1910 was 42·07 bushels per acre, the yield in a bad Frit year, 1912, was only 35·56 bushels—a falling off of 6½ bushels per acre, or, since the acreage under oats in that year was 1,865,569, a total loss of 12,126,198 bushels, presumably due to the unwonted abundance of Frit.

For the following excellent Scottish illustration of the cumulative damage attributable to the attacks of Frit on oats, I am indebted to a well-known lowland farmer. The figures refer to the crop of 1918, in which year as well as in previous years I had opportunity of seeing the effects of the presence of the pest on the

[1] *Annals of Applied Biology*, vol. v., Oct. 1918, p. 82.

[2] "The Frit-Fly on Oats," 1918, Pamphlet No. 108, University of Leeds and the Yorkshire Council for Agricultural Education.

farm in question. For more ready comparison the data have been arranged in tabular form.

Index Number.	Size of Field.	Previous Crop.	Variety of Oats.	Bushels Sown per Acre.	Frit.	Yield in Bushels per Acre.	Relation to Average Yield.
1	24 Acres	Lea Grass	"Yielder"	6	Not noticeable	47¼	+3
2	30 „	Oats and Lea	"Potato"	5	Not noticeable	45⅝	+1·13
3	8 „	Turnips	"Potato"	5	Not noticeable	41½	−2·7
4	8 „	Turnips	"Potato"	5	Common	33½	−10·7

Average yield over all = 44·2 bushels per acre.

In field No. 4 the Frit attack was moderately severe, but was by no means equally developed throughout the field. In spite of this partial development, the results given above show that the average for the whole field was 13⅔ bushels per acre short of the average in No. 1, the most successful field. The fact that, as a rule, "Yielder" gives a heavier crop suggests that the contrast is not altogether a fair one, but the Frit field yielded 10·7 bushels per acre less than the average over all. Further, no objection can be taken to an absolute comparison between fields 3 and 4, both of "Potato" oats, both following turnips, and both with similar soil; the result is in no doubt, the yield of the "fritted" field being poorer by 8 bushels an acre. I think it highly probable that even this deficit does not reveal the full damage done by Frit, for a careful examination of these fields made early in June of the present year has shown a very general presence of the flies,[1] and it would be fair to assume, even though the damage may have escaped notice, that the oat crops in those fields, regarded in 1918 as free from Frit, must certainly have suffered to some extent and had their average lowered by the pest.

Such statistics, incomplete and local in application as they may turn out to be, furnish a strong first case for the development of active measures against the Frit-fly in Scotland.

The Recognition of a Frit Attack.—The presence of a Frit attack is not apparent in the growing crop until the young corn has reached a length of 4 or 5 inches, but warning of an attack is given by the occurrence of numbers of tiny, shining-black, two-winged flies (little more than $\frac{1}{20}$ of an inch long), which on bright days sun themselves upon the corn leaves or on stones, and which avoid capture by alert, short, hopping flights. These flies appear in numbers in lowland Scotland, in the locality I have been specially interested in, early in the second half of May, and by the beginning of June damaged plants are noticeable in the fields. Such plants are marked by the failure of the main shoot to develop, and often by a rank growth of tillering shoots which generally do not ear. The spring attack spreads over at least three weeks, for a field examination on June 4th of the present year showed many damaged plants, one of which yielded a larva

[1] Since these notes were written Mr. Percy H. Grimshaw has kindly made a critical examination of the specimens and has confirmed the opinion that they belong to the species *Oscinis frit.*

on the point of pupation, and therefore at least a fortnight old, while at the same time adult flies were plentiful. The continuance of the attack over a period is of some importance, for it means that tillers which otherwise would have made up for the loss of the main shoot may also be liable to attack. Examination has confirmed this possibility, for on various occasions two and three Frit larvæ of different ages have been found in one plant, the older in the main shoot and the younger in side tillers.

The abnormal development of side shoots gives rise to a thickened base on the oat plant, resembling the "tulip-root" caused by eel-worm, but the two pests have been associated in many of the specimens I have examined, so that it is difficult to say to what extent this particular appearance is due to one and not the other. The safe determination of the presence of a spring Frit attack depends ultimately upon the discovery of the white grub of the fly in the soft inner tissues at the base of the plant. When full-grown this grub measures only about $\frac{1}{10}$ of an inch in length, and in its earlier stages is by no means easy to detect by the unaided eye.

After the spring attack in May and June, the flies give no sign of their presence (except in the damaged plants, within which the development of the insect is proceeding) until July, when fresh hordes of flies, the progeny of the spring brood, make their appearance. These for the most part hang about the tops of the oat plants, and lay their eggs so that the grubs penetrate and destroy the undeveloped ear or the young grain. It is desirable that the extent of this second or summer attack throughout Scotland should be ascertained.

Within the ear or the grain fresh development proceeds, the grub becomes a pupa, and the adult flies emerge about harvest time, and may sometimes be seen in great numbers in ripe corn fields. The females of the autumn brood have been found to lay their eggs upon certain wild grasses, and within these the majority of the larvæ are said to exist throughout the winter, ready to give rise to a new adult brood in the following spring.

Remedies which have been suggested.—As no remedy has yet been shown to be universally reliable, and as these notes are meant to do little more than draw the attention of Scottish farmers to the presence of Frit-fly, only the merest indications of the measures which have been employed or suggested against Frit will be given here. Further explanation is the less necessary as experiments are at present being carried out by the scientific staff of the Food Production Department of the Board of Agriculture and Fisheries, and these, it is hoped, may in a short time lead to a satisfactory solution of the problem.

Remedies may be divided into two broad classes: those which attempt to reduce the numbers of the pest, and those which, while not interfering with the insects directly, endeavour to checkmate their destructiveness.

Lethal methods may be directed against the larvæ or the adults of the fly. Deep ploughing may possibly bury the insects in their young stages so deeply that they perish. But a Russian experiment has shown that the flies can hatch from pupæ buried 8 inches

deep in rammed soil, and can successfully reach the surface; so that spring ploughing when the larvæ are full-fed or have pupated would seem to be ineffective. It remains to be seen whether deep ploughing in the early autumn when the larvæ are very immature would have better results—a simple experiment ought to be sufficient to decide the question.

Professor T. H. Taylor of Leeds University successfully attacked the adult Frit-flies which emerged after oats had been harvested and stacked by covering the stack immediately after erection and leaving the canvas sheet in place for seven weeks, when all the flies had emerged and were found dead.

Methods adopted for limiting the activities of the Frit-fly have mainly followed three distinct lines, emphasising the need of selecting a special variety of oats, the desirability of early sowing, and the use at an early stage of a forcing manure. Scottish experiments carried out at Inveresk by Dr. W. G. Smith and Mr. T. Anderson, indicated that freely tillering varieties of oats, such as Potato and Hamilton, survived an attack with greater success than less vigorous varieties; but the deficit of 10·7 bushels per acre recorded above occurred in a field of Potato oats. Experiments carried out by the Food Production Department in 1918 indicate very clearly that in England early sown oats suffer less damage than a late sown crop, owing apparently to the fact that if the young plant has reached a certain stage of development it is less susceptible to the attack of the fly. But Smith and Anderson in Scotland were led to the conclusion from their Inveresk experiments that early sown oats suffered as severely as late sown, and in any case, in Scotland, oats are as a rule sown as soon as the tilth is ready for the reception of the seed. Lastly, experiments carried out by the Government of Petrograd in 1911 indicate that the successful application of a forcing manure at an early stage may carry the plant past the danger period before the flies have emerged. The manures used were superphosphate, about 267 lbs. an acre, and sodium nitrate, 80 lbs. an acre, and the plants killed were reduced from 21 per cent. on an unmanured plot to 5½ per cent. on a manured plot, while the plants not producing normal grain were reduced from 48½ per cent. on an unmanured plot to 16 per cent. on a manured plot. But on the Scottish farm where I have watched the effects of Frit-fly, top-dressing with nitrate at the time of sowing has been followed by a miserably depleted crop.

On account of the vague and contradictory conclusions which have been reached so far, the results of the fresh experiments of the Board of Agriculture and Fisheries will be looked forward to with special interest.

STOCK PRODUCTION IN ABERDEENSHIRE: Relative to Size of Holding.

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IN the absence of official statistics regarding the productivity of large and small holdings respectively, there is probably no more

reliable source of information than that of stockraising, the mainstay of Aberdeenshire farming.

Aberdeenshire holds a unique position with regard both to the number of its stock and to the number of its agricultural holdings, possessing of the latter nearly one-seventh of the total holdings in Scotland. In the matter of small farms ranging from fifty to a hundred acres the proportion is even higher, one-fourth to one-fifth of the total number being located in the county.

For the purpose of comparison the official returns are here reproduced :—

TABLE I.

AGRICULTURAL HOLDINGS IN ABERDEENSHIRE.[1]

	Total Holdings.	Above 1 and not exceeding 5 Acres.	Above 5 and not exceeding 50 Acres.	Above 50 and not exceeding 100 Acres.	Exceeding 100 Acres.
Scotland	76,754	17,984	32,985	10,093	15,692
Aberdeenshire ...	10,827	1,320	5,217	2,227	2,063

The total number of stock (cattle and horses), according to the returns for 1918, represents more than one-seventh of the entire stock of Scotland, while the number of cattle per 100 acres of agricultural land is shown to be much above the average for this country.

This superiority in the matter of stock production, while clearly reflecting the industry and intelligence of the farmer, is mainly attributable to the fact that most of the agricultural land in Aberdeenshire is under arable cultivation, and that the main effort is directed towards meat and milk production. Thus in 1918 there was only 4·6 per cent. of the agricultural land under permanent grass, the lowest figure recorded for any county in Scotland. The following table readily indicates the high position held by Aberdeenshire in the important field of stock production.

TABLE II.

NUMBER OF STOCK PER 100 ACRES OF CULTIVATED LAND.

	HORSES.		CATTLE.		PIGS.	
	Total No. (thousands).	No. per 100 Acres.	Total No. (thousands).	No. per 100 Acres.	Total No. (thousands).	No. per 100 Acres.
England and Wales, 1914 2,711,000 Acres.	1,399	5·2	5,887	21·7	2,481	9·2
Germany, 1913[2] ... 82,274,000 Acres.	4,516	5·5	20,153	24·5	21,885	26·6
Scotland, 1916 ... ... 4,775,506 Acres.	207	4·3	1,226	25·6	146	3·6
Aberdeenshire, 1916 ... 627,066 Acres.	32	5·1	177	28·2	11	1·8

[1] 1916, Cd. 9130.

[2] Imperial Statistical Office, Berlin.

The statistics of stock on large and small holdings in Aberdeenshire, which are tabulated below, have been compiled from the Returns obtained by the District Agricultural Executive Committees, and refer to the winter of 1918. In preparing the statistics the writer excluded all holdings on which sheep were stocked, so as to obtain a fairer comparison of the different holdings on a basis of the stock common to arable farming.

TABLE III.

NUMBER OF STOCK PER 100 ACRES ON CULTIVATED LAND ON VARIOUS SIZES OF HOLDINGS IN ABERDEENSHIRE.

Size of Holding.	Percentage under Crops other than clover and grass.	No. of Horses per 100 Acres.	No. of Cattle per 100 Acres.	No. of Cows per 100 Acres.	No. of Cattle under 1 year per 100 Acres.	Cattle 1 year and over per 100 Acres.	No. of Pigs per 100 Acres.
5 acres to 10 acres inclusive	54·9	3·2	40·1	21·6	15·3	3·3	4·6
10 acres to 20 acres exclusive	55·6	6·0	36·2	13·9	15·6	6·6	3·3
20 acres to 50 acres inclusive	57·2	6·5	32·3	8·9	12·2	11·1	2·7
50 acres to 100 acres exclusive	55·5	5·3	31·4	6·3	10·4	14·6	2·0
100 acres to 200 acres inclusive	55·6	5·2	29·4	6·3	8·1	15·1	1·3
200 acres upwards ...	54·5	4·5	28·0	6·4	7·2	14·4	0·5

The above figures show that for large and small holdings alike the percentage of land under crops other than clover and grass is fairly uniform. This would indicate that the small holdings are not worked on a more intensive rotation than are the larger farms. It is difficult to say, however, to what extent the figures may have been affected by war conditions.

The number of stock per 100 acres of cultivated land is in itself no absolute criterion of the productivity of different holdings, but in the absence of a complete census of production its value in arriving at any decision on the subject may prove considerable. It appears that small holdings under 10 acres in extent are devoted almost entirely to milk production and the raising of young stock, 50 per cent. of the cattle consisting of cows. On holdings exceeding 50 acres, meat production becomes predominant, a fact indicated by the comparative numbers of cattle over one year old.

The figures recorded above for small holdings may prove deceptive unless due regard is had to the age, kind and quality of animals they represent. To anyone conversant with stock production in Aberdeenshire, however, there will appear little doubt that the number of cattle and horses on holdings from 50 to 100 acres, viz. 36·7 per 100 acres, represents a considerably higher value and a higher standard of production than that on holdings from 5 to 20 acres, where the number is 43 animals per 100 acres.

It is noteworthy that pig-rearing occupies a very minor position on all holdings in the general scheme of management, and that the average for the whole county is only one-half that for Scotland.

Of late, reference has frequently been made to the favourable position of small holdings on the Continent, and particularly in Germany. There is no doubt that much attention has been devoted in Germany to securing reliable statistics concerning production on various sizes of holdings. The statistics relating to stock on different farms, large and small, are here produced.

TABLE IV.

NUMBER OF STOCK PER 100 ACRES OF CULTIVATED LAND ON HOLDINGS IN GERMANY, 1907.

Size of Holding.	Horses per 100 Acres.	Cattle per 100 Acres.	Cows per 100 Acres.	Pigs per 100 Acres.
4·9 to 12·3 acres	2·9	38·6	24 8	38·0
12·4 to 49·3 acres	5·1	30·5	15·5	24·6
49·4 to 247 acres	5·2	23·0	9·9	15·8
247 acres upwards	3·7	13·3	5·7	7·9

It is evident that small holdings in Germany are primarily devoted to milk production and pig-rearing, two branches of the farming industry most suited to small cultivated areas. Thus in 1907 on small holdings from 1 to 5 acres in extent 67 per cent. of the land was under potatoes, while the number of pigs kept, per 100 acres, amounted to 220. On holdings ranging from 5 to 12 acres approximately 20 per cent. of the land was put down to the same crop. It is difficult to form a comparison between small holdings in this country and those in Germany, since in the latter country pig-rearing displaces cattle-rearing, and potato-growing displaces other crops to a very considerable extent. While it appears probable that production on small holdings in Germany is higher than on those in Aberdeenshire, it does not necessarily follow that production in the latter place is too low. There are three standards which must always be applied in any judgment of the results of the respective systems of agriculture, namely, the return per unit of land, the return per unit of capital and the return per unit of labour. Judged from those three standards it is quite probable that the higher economic return is obtained by the Aberdeenshire small holder. At the same time there would appear to be abundant scope for the small cultivator in Aberdeenshire to extend the area under potatoes and to direct more attention to pig-rearing.

It is generally assumed that small holdings, even where mixed farming is adopted, are more intensively worked than larger holdings, but in Aberdeenshire this does not appear to be the case. It seems to the writer, judging from personal observation and from the data herein produced, that the cultivator with 50 to 100 acres displays more knowledge and skill and secures a larger output per acre than the man with 5 to 20 acres. If this continues to be the case, as it probably will, the road to increased production will not be through an extension of the system of small holdings.

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Even where small holdings are worked intensively or on co-operative lines they do not reap the advantages which the organisation of labour, material and machinery confers.

The statistics for horses in Table III. demonstrate the fact that on holdings not exceeding 20 acres the greater part of horse labour is hired, and consequently the small holder has to labour under an additional disadvantage. Mixed farming cannot be highly efficient where horse labour has to be hired, nor can holdings where this is necessary be considered self-supporting.

The individual attention and willing labour which the cultivator on a small scale can give to his holding are certainly important factors in production, but they do not counterbalance the disabilities under which he labours.

For the county of Aberdeen it would appear that—

(1) the rate of production per acre is higher for agricultural holdings exceeding 50 acres than for those below that figure; and

(2) that holdings from 50 to 100 acres compete effectively with larger farms, having regard to present methods of farming.

While the potentialities of small holdings as media of production are to a certain extent limited, it does not follow that an extension of the system is undesirable. In fact, for small holdings in the neighbourhood of 50 acres a favourable case can be presented on a purely productive basis. But it is chiefly on national and social grounds that such holdings will always occupy an important position in the general scheme of land distribution. There are good grounds for believing that they produce a better type of person than many grades of urban industry, and that they confer a higher degree of stability and recuperative power on a country in times of stress or national depression; and it is generally agreed they help to solve the labour problems peculiar to agriculture which may become more acute with the organisation of the labour interest.

A PURE MILK SUPPLY.

ALEXANDER LAUDER.

AN adequate supply of pure milk at a reasonable price has, for many years, been recognised as of vital importance from the public health point of view, and increased knowledge of the properties of milk and of its relation to the transmission of certain diseases has emphasised the serious nature of the problem.

The prospect of the new "Milk and Dairies (Scotland) Act, 1914," becoming operative during the course of next year makes this an opportune time for a general consideration of the whole question of a pure milk supply, and for a review of the more recent investigations on this important subject.

It is at once obvious that no detailed discussion of the many problems involved or of all the investigations carried out is possible

in an article of this length, but it is hoped that it may serve to direct attention to some of their more salient features, and to indicate the more important conclusions which have been arrived at.

For many years local authorities have devoted much attention to the "quality" of the milk supply as regards its freedom from adulteration, either by the addition of water or by the removal of cream. Hardly a week passes but milk vendors in the larger towns are prosecuted for selling milk, the composition of which is below the standard laid down by the Board of Agriculture. With this aspect of the subject, important as it is, it is not proposed to deal in this article, attention being directed to what many authorities regard as an even more important question, the means necessary to ensure a really clean and wholesome supply of milk to the public.

Conveyance of Disease by Milk.—It has been known for many years that diseases, such as diphtheria, typhoid fever, scarlet fever, and infective sore throats may be transmitted by milk, and more recently it has been proved that tuberculosis may in the same way be conveyed to human beings. The sources of infection may be either (1) direct human infection, *i.e.* infection from persons handling the milk who are suffering from one of the diseases in question, perhaps in a mild form which is not recognised; infection may also be conveyed by persons who, while not suffering actively from the disease, are yet carrying the germs of disease about them—such "carrier causes" are extremely important and obviously difficult to detect; (2) infection of the milk due to a defective water supply, the disease being human in its origin; (3) contamination of the milk by the germs of diseases, such as tuberculosis, from which the cow is suffering.

This third source of infection is probably of most direct interest to the dairy farmer. With the diseases to which the cow is occasionally subject, and which may possibly be transmitted to man, it is not necessary to deal here. Savage (Milk and the Public Health) from a careful review of the evidence concludes that, excluding tuberculosis, the great majority of bovine udder and teat lesions are not harmful to man. Other workers are perhaps not quite so definite, and the question may well be left to await the results of further investigation.

By far the most important disease of cows is tuberculosis, not only on account of its wide prevalence, but because the bacilli of the disease frequently gain access to the milk, and because the disease can, in this way, be transmitted to man through the milk. The important report on "Milk and its Hygienic Relations" (Lane-Claypon, 1916), published under the direction of the Medical Research Committee (National Health Insurance), deals exhaustively with this aspect of the subject, and gives a valuable summary of all recent investigations.

That milk may contain tubercle bacilli of bovine origin has been demonstrated with the utmost certainty. There is the further point that the presence of these bacteria may bring about the disease in young children, although adults are much less susceptible to infection from this source. The cause of the presence of the bacilli is most commonly a tuberculous lesion in the udder or teats,

but cases are recorded in which the milk contained tubercle bacilli, even although no tubercular lesions could be detected in the udder. The source of infection in this case was probably manure of infected cows.

The widespread prevalence of tuberculosis in cattle and the methods by which it may be reduced is one of the most difficult problems which the agricultural authorities have to face. Various suggestions have been made, such as regular inspection of herds and complete separation of the infected and the non-infected animals. To consider these methods in detail is rather beyond the scope of this paper, but it is evident that until this problem has been successfully dealt with, milk, notwithstanding the utmost care in its production, will be liable to be infected.

The number of samples found to contain the tubercle bacillus is no indication of the number of cows affected, since the milk of one tuberculous cow will serve to infect a much larger quantity of milk.

The Medical Officer of Health of the London County Council during the period from 1907 to December 1913 examined for the presence of tubercle bacilli 13,321 samples of milk forwarded from places outside the county. Of these, 1323 samples or 9·9 per cent. were found to contain tubercle bacilli as shown by the inoculation of guinea pigs. During the year 1913, 9·3 per cent. of the samples examined were found to contain tubercle bacilli.

Delépine, dealing with the milk supply of Manchester, examined 7681 samples of milk between the years 1897 and 1913, and found that 8·7 per cent. contained the tubercle bacilli. The figures given show that there has been a considerable fall in the percentage of positive samples since the commencement of the investigation, the percentage for the first two years having been 17·2 per cent. Delépine traced the source of the tubercle bacilli in a large number of samples of milk and obtained the following results (Lane-Claypon, p. 252):—

	Per cent. of cases.
1. Tuberculous udders the cause of infection in	78·6
2. „ probably „	16·0
3. Nothing definite to connect infection with the state of the cow in	5·2

These figures were obtained after investigating the milk from 276 farms.

Mitchell (The Prevalence of Tubercle Bacilli in the Edinburgh Milk Supply, *Journal of State Med.*, 1915, xxiii., 44), investigated the presence of tubercle bacilli in mixed milk obtained from milk shops in Edinburgh between November 1913 and May 1914. Four hundred and six samples were tested, of which 82 or 20 per cent. were found to be capable of producing tuberculosis when inoculated into guinea pigs.

Many other similar investigations have been carried out, but the examples quoted are sufficient to show the very serious extent to which the ordinary milk supply is contaminated with the tubercle bacilli. It should be noted, however, that the "infectivity" of the milk, when consumed in the ordinary way, would not be nearly so

high, especially in the case of healthy adults, as in the method of inoculation employed in testing.

The Royal Commission on Tuberculosis, as a result of the evidence obtained by them, state: "Bovine tubercle bacilli are apt to be abundantly present in milk as sold to the public when there is tuberculous disease of the udder of the cow from which it was obtained . . . but these bacilli may also be present in the milk of tuberculous cows presenting no evidence whatever of disease of the udder, even when examined post-mortem. Further, the milk of tuberculous cows not containing bacilli as it leaves the udder may, and frequently does, become contaminated with the fæces or uterine discharges of such diseased animals."

The Infectivity of Milk from Tuberculous Cows.—The question as to whether the bovine tubercle bacilli present in milk can give rise to tuberculosis in man has caused much controversy. The most extensive observations are those which have been carried out by the workers for the Royal Commission on Tuberculosis already quoted, and it will be necessary here only to refer to the findings of the Commission. Dealing with the subject they state :— "Of young children dying from primary abdominal tuberculosis, the fatal lesions in nearly one half of the cases can be referred to the bovine bacillus and to that type alone." They further state that "the evidence which we have accumulated goes to demonstrate that a considerable amount of the tuberculosis of childhood is to be ascribed to infection with bacilli of the bovine type transmitted to children in meals consisting largely of the milk of the cow." Mitchell ("A Bacteriological Study of Tuberculosis of the Lymph Glands of Children," *Journal of State Med.*, 1915, xxiii., 1) examined eighty consecutive cases of tuberculous cervical glands in children. Of these eighty children forty-two resided in Edinburgh, and thirty-eight came from the neighbouring country districts. The bovine bacillus was present in 88 per cent. of the cases, and the human bacillus in 12 per cent. Mitchell states that "without exception the cases were those of children twelve years of age and under. The maximum incidence occurred during the second year of life. This is not surprising when it is recalled that the large majority of children of this age are nourished in whole or in part on cows' milk. I found that in my series of cases 84 per cent. of the children of two years and under had been fed with unsterilised cow's milk since birth. Whatever may be the case in other countries, the mode of feeding children in Britain, especially Scotland, is such as to favour bovine infection."

As already noted, the danger of infection is greatest in children, but cases of abdominal tuberculosis of bovine origin in adults are also well known.

Contaminated Milk.

In addition to the cases considered above, where the contamination is due to the unhealthy state of the cow producing the milk, there is always the risk of contamination of the milk after it has been drawn from the cow. The milk from a perfectly healthy cow may thus be rendered unfit for consumption. By taking proper precautions, however, this contamination can very largely be

avoided. The various sources of contamination and the methods of dealing with them will, therefore, be considered in some detail.

Contamination of the milk after it is obtained from the cow may take place (1) in the byre; (2) during transit to the consumer; (3) in the consumer's house.

Contamination in the Byre.—The results of numerous investigations have shown that by far the most serious contamination takes place in the byre. The elaborate investigations carried out by Orr in 1908 for the Joint Committee of the East and West Ridings of Yorkshire and certain county boroughs proved this most conclusively.

The possibility of an infectious disease being communicated from the person of the milker or other worker handling the milk has already been alluded to. This is only an occasional danger, but the necessity of a high standard of personal cleanliness on the part of the milkers must always be insisted upon.

Probably the greatest contamination takes place during the operation of milking, by dirt—and that always means bacteria—dropping into the milk. How serious this contamination may be when the cows are not regularly groomed, but allowed to have their flanks plastered with manure, is easily understood, and has been abundantly proved. Grooming the cows at an unsuitable time, *i.e.*, just before milking, so that the dust has not had time to settle down, greatly increases the contamination. In short, any work likely to cause dust, such as foddering the cows or removing manure, should never be done near the time of milking. The following figures bearing on these points will be of interest (Lauder and Cunningham, "Some factors affecting the Bacteriological Content of Milk," Report XXVIII. *Edinburgh and East of Scotland College of Agriculture*, 1913).

In Table I. the effect on the bacterial content of milk of grooming once a day as compared with twice a day is given.

TABLE I.

No. of Cow.	Number of Bacteria per Cubic Centimetre in Milk.	
	Cows Groomed once a day —about 14 hours before Milking.	Cows Groomed twice a day —about 1 hour before Milking.
21	1,400	1,200
24	15,250	1,420
25	6,900	4,170
26	36,000	4,200
27	8,750	1,260
29	10,350	4,620
30	1,770	2,000
32	9,650	2,570
37	5,900	1,750
60	2,300	1,450
Average	9,827	2,464

As the cows experimented with were never allowed to become really dirty, samples of milk from cows which were never groomed at all were obtained for comparison. The results are as follows:—

TABLE II.

Cow.	Number of Bacteria per Cubic Centimetre in Milk.	
	Cows never Groomed.	Average of 10 Cows Groomed twice a day about 1 hour before Milking.
A	11,250	
B	12,750	
C	195,500	
D	217,250	
E	189,000	
Average ...	125,150	2,464

Cleaning the Udder.—The effect of brushing the udder on the bacterial content of the milk was also tried, but was found to increase the contamination. This is undoubtedly due to the brush loosening the dirt particles on the udder, so that, when milking begins, they fall into the milk pail, carrying the bacteria with them.

TABLE III.

No. of Cow.	Number of Bacteria per Cubic Centimetre in Milk.	
	Cows Groomed about 1 hour before Milking.	Cows Groomed 1 hour before Milking, and Udders Brushed.
24	1,420	3,320
25	4,170	7,250
26	4,200	1,000
27	1,260	14,000
29	4,620	10,370
30	2,000	15,950
57	2,150	3,050
58	17,100	2,320
61	10,050	427,400
Average ...	5,219	53,851

In order to give some idea of the numbers of bacteria in ordinary cow dung, Orr, in the investigation already referred to, found in old dung adhering to the udder and legs of dirty cows as many as 7,000,000,000 bacteria per gram. This is a very moderate estimate, the numbers being frequently much higher.

Washing the udders with soap and water and leaving them moist was found to effect a large reduction in the bacterial content of the milk as is seen from the following figures:—

TABLE IV.

No. of Cow.	Number of Bacteria per Cubic Centimetre in Milk.	
	Cows Groomed 1 hour before Milking.	Cows Groomed 1 hour before Milking. Udders Washed and left Moist.
41	7,470	1,380
57	2,150	1,050
58	17,100	1,240
61	10,050	830
Average ...	9,192	1,125

Another method of testing the effect of cleaning the udder was also employed. Sterile "plates" containing a medium on which bacteria will grow were exposed under the udder of the cow for 15 seconds, and the plate incubated for 72 hours at 22° C. The results are shown in Figs. 1 and 2.

Effect of Foddering and Grooming Cows, and of Removal of Manure from the Byre, on the Bacterial Content of the Air of the Byre.—The effects of the above operations were tested by exposing sterile plates to the air of the byre under varying conditions as described above. The number of bacteria falling from the air on to the plates in one minute was determined. This method gives a fairly accurate figure for the bacterial content of the air at any time. When the air of the byre was quite still during the dinner interval an approximately constant figure for the bacterial content was obtained. During the grooming and foddering of the cows and the removal of manure from the byre, however, the bacterial content of the air was found to have greatly increased. The results are given in Table V.

TABLE V.

Number of Bacteria per Plate, exposed 1 Minute in each case, during			
Dinner Interval.	Removal of Manure.	Grooming.	Foddering.
340	815	435	1310
331	642	376	1185
233	615	860	600
190	570	480	510
201	531	915	462
245	517	944	429
241	565	430	365
241	620	425	323
Average 253 ...	609	608	648

Photographs of two of the plates are shown in Figs. 3 and 4.

Milking Machines.—With the object of saving labour, the use of milking machines has been greatly advocated in recent years, and many machines are now in use. At first sight it would seem that by their use the contamination of the milk in the byre would be greatly reduced, since the milk is not exposed to the air of the byre during the whole process of milking. Unfortunately it has been found that owing to the great difficulty of keeping the machines, and the rubber tubes through which the milk passes, perfectly clean, the milk is in most cases more contaminated with bacteria than milk obtained by hand milking. The following figures illustrate this point. Samples of milk were obtained from a cow, first by hand milking and then with a milking machine, the fore-milk being rejected in each case. The milking machine was looked after by a very careful dairyman, and was kept as clean as it could be under ordinary commercial conditions. After suitable dilution and incubation on agar, the milk obtained by hand milking yielded 33 bacterial colonies, while the milk from the same cow obtained by the milking machine yielded no less than 2323. (See Figs. 5 and 6.)

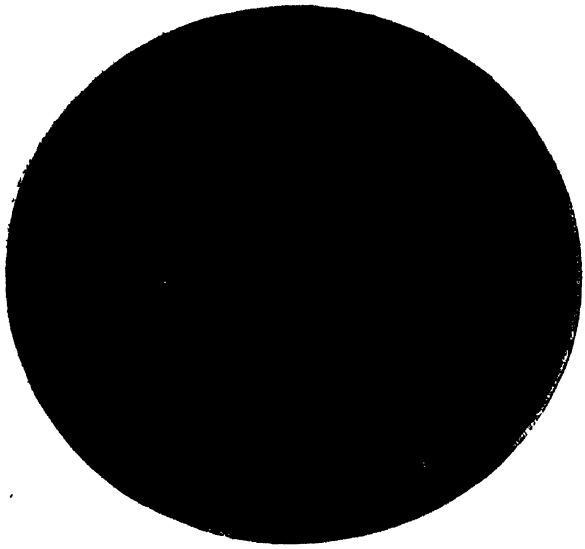
The contamination of milk from dirty cows is greatest in winter when the cows are indoors all the time; in summer, when the cows are on grass, they are naturally cleaner, and the contamination is less. The use of milking pails which are partially hooded over, tends to reduce the amount of dirt which falls into the milk from the cow.

Two other possible sources of contamination in the byre may be mentioned, strainers and imperfectly cleaned churns.

It is not properly realised by dairymen that while strainers keep out the larger particles of manure they do not keep out bacteria. If the filtering material is not properly cleaned and sterilised the strainer may add to, instead of reducing, the bacterial content of the milk. Probably the safest and most efficient filtering medium is a pad of clean cotton wool in a properly constructed strainer, the cotton wool not being used more than once and a fresh pad taken for each milking. It cannot be too strongly emphasised that the aim of the dairyman should be to prevent the entrance of impurities into the milk, rather than to rely on methods for their removal.

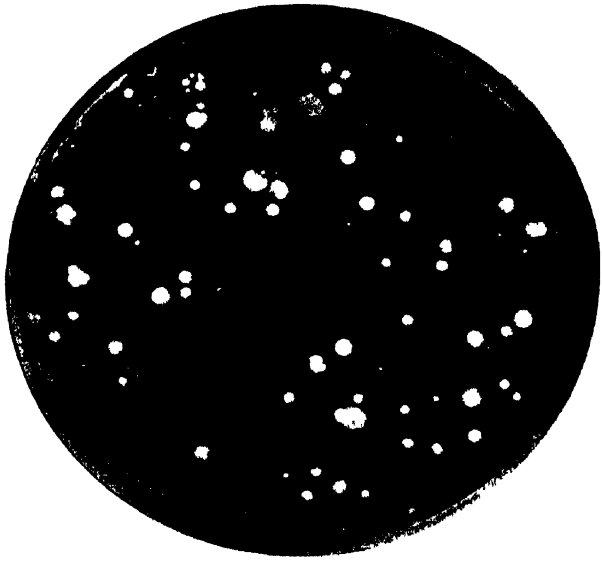
Imperfectly cleaned churns, as a source of contamination, are responsible, especially during the summer months, for the loss every year of large quantities of milk, which becomes sour before reaching the consumer. In this case the fault is probably that of the town dairyman, who does not clean the churns with sufficient care before returning them to the farmer. In a paper recently read before the Farmers' Club (*Journal of the Farmers' Club*, May 1919) Stenhouse Williams states that the losses due to bad methods of milk production and handling on a supply of 90,000,000 gallons, valued at one shilling per gallon, were not less than £536,000, and the loss due to souring alone on another supply of 75,000,000 gallons was not less than £37,500. These very striking figures show the importance to the milk trade of proper methods of handling and distributing milk, quite apart from any question of the public health.

FIG. 1.



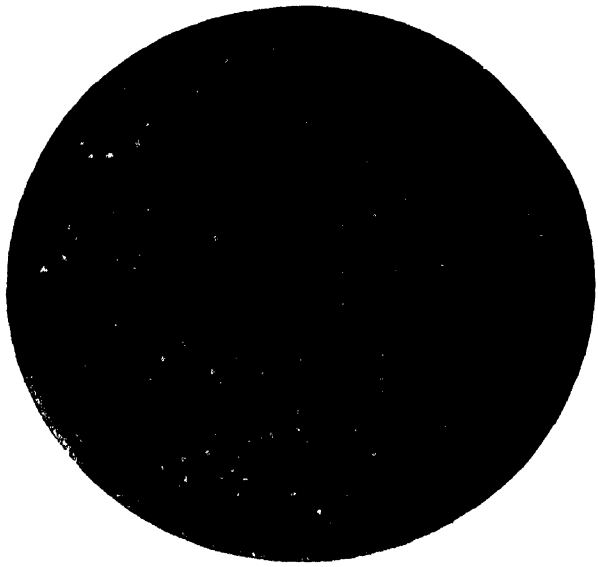
Agar plate, exposed for 15 seconds under the udder of Cow No. 42 during milking. Incubated for 72 hours at 22° C. Cow groomed about 14 hours before milking. Number of colonies = 1350.

FIG. 2.



Agar plate, exposed for 15 seconds under the udder of Cow No. 42 during milking. Incubated for 72 hours at 22° C. Cow groomed about 1 hour before milking, and udder washed with soap and water and left moist. Number of colonies = 93.

FIG. 3.



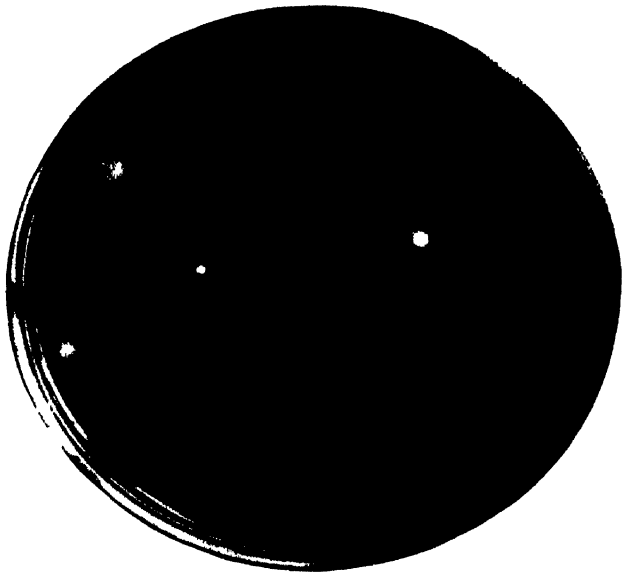
Agar plate, exposed for 1 minute in the byre. Incubated for 72 hours 22° C. Air of byre still; cows resting. Number of colonies = 340.

FIG. 4.



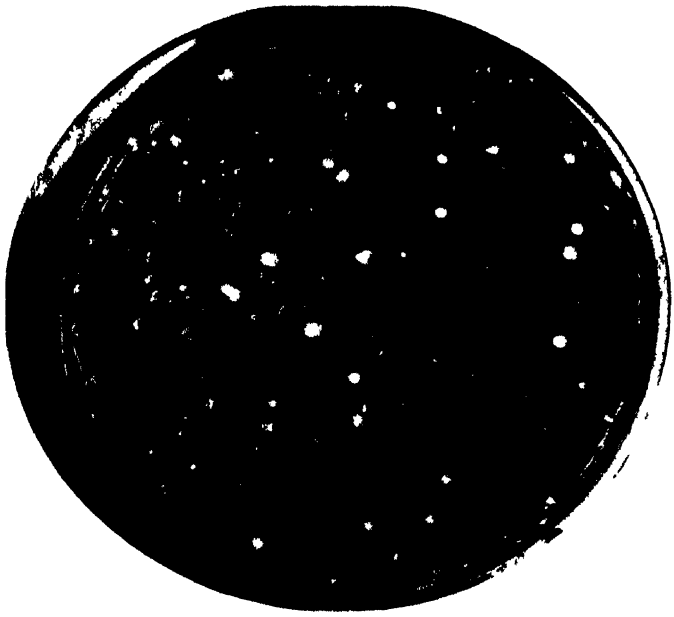
Agar plate, exposed for 1 minute in the byre during foddering of cows. Incubated for 72 hours at 22° C. Number of colonies = 1310.

FIG. 5.



Cow No. 10.—Fore-milk rejected. Cow milked by hand. Dilution of milk, 1 in 100. Number of colonies = 33.

FIG. 6.



Cow No. 10.—Fore-milk rejected. Cow milked by machine. Dilution of milk, 1 in 100. Number of colonies = 2323.

Contamination during Transit.—The main causes of contamination during transit are the use of improperly constructed churns, the carriage of milk in unsuitable railway vans along with other miscellaneous goods, and undue exposure to dust and sun at railway stations, or in roads where dust is blowing about.

Churns.—The construction of the churn, and especially of the lid, is of great importance. The lid should be so constructed as to prevent the splashing out of milk and the entrance of dust or rain water. A lid which overlaps the edge and protects it from getting dirty is good and is very effective in keeping the milk clean. It was formerly believed that ventilating the churn improved the keeping qualities of the milk. This idea was probably due to the fact that dirty milk kept in a tightly closed churn has a more unpleasant smell when the churn is opened than milk kept in a churn with ventilating holes. Careful experiments have shown, however, that ventilating a churn does not improve the keeping qualities of the milk in any way (Goulding and Stenhouse-Williams, *Journal Board of Agriculture*, xxiii. (1916) 353). On the contrary, ventilating holes have the distinct disadvantage that they admit dust or allow milk which has been splashed out on to the lid and has become dirty to run back again into the churn. It is satisfactory to note that ventilated churns are no longer used by the best dairymen, and are generally passing out of use. Churns should not be too large, as this makes proper washing and inspection of the inside difficult, besides making them too heavy for convenient handling when full. All churns should be locked or sealed to prevent tampering during transit.

Railway Vans.—It will be seen later that keeping the milk cool is a factor of the highest importance. Milk should be carried in properly refrigerated railway vans and should not, if possible, be carried along with other goods from which it may receive contamination.

Distribution to the Consumer.—The ideal method is to send out the milk in bottles closed with a disc and covered with a capsule which cannot be removed without tearing. The disc alone can be so easily removed that it is not a sufficient safeguard against tampering. It is hardly necessary to add that the bottles must be most carefully cleaned and sterilised; this sterilisation can be effected by dry heat, which is more convenient than steam.

Contamination in the Consumer's House.—The extent of the contamination which the milk may receive after delivery to the consumer is difficult to estimate. The obvious precautions are to keep it in the coolest possible place and protect it from dust, and particularly from flies during the summer months.

General Treatment of Milk.—It has already been seen that it is quite impossible to prevent the entrance of bacteria into milk. By proper precautions the entrance of disease-producing organisms can be very largely prevented, but not that of the ordinary organisms present in the air. By immediately cooling the milk, however, the multiplication of the germs which have found entrance can be very much reduced. The milk should be removed from the

byre at once and passed over a cooler in a room as free from dust as possible and immediately bottled, or, when that is impossible, transferred to a churn and kept free from dust. During the whole period of transit the importance of keeping the milk at the lowest possible temperature cannot be too strongly insisted upon.

Methods for the Preservation of Milk.—Under the conditions of modern city life a considerable time must elapse between the time the milk is obtained at the farm and its delivery to the consumer. Since milk is in all cases contaminated with bacteria it will not keep fresh for any length of time. Various artificial methods for the preservation of milk have, therefore, been introduced, not only with the object of improving its keeping qualities, but also to destroy, as far as possible, the bacteria present, and so to lessen the risk of disease being conveyed by the milk.

Cooling.—The method of cooling or refrigeration has already been referred to. It should be noted, however, that cooling or even freezing does not destroy the bacteria present, but merely reduces the rate at which they multiply. Cooling to 10° C. (50° F.) is what is generally aimed at in practice, and this prevents any notable increase in the number of bacteria present in 24 hours. This is the most satisfactory method of preservation, and the extent to which it is used is only a question of cost.

Pasteurisation.—"Pasteurisation," or "sterilisation" as it is often popularly called, consists in heating the milk up to such a temperature (usually 62·8° C. = 145° F) as will kill the greater number of the bacteria present without sensibly affecting the taste or other properties of the milk. No such thing as really sterile milk in the bacteriological sense is ever produced commercially. To sterilise milk thoroughly requires heating to such a temperature that the colour, taste and other properties of the milk are altered.

The ordinary processes of Pasteurisation, if efficiently carried out, kill all the disease-producing organisms, including the tubercle bacillus, so that its use in the present state of the milk supply is not to be condemned. It is very essential that the milk should be cooled as rapidly as possible after Pasteurisation, the cooling and bottling being carried out under such conditions as will reduce the risk of re-infection to a minimum. It must be clearly understood that if bacteria gain access to Pasteurised milk, they will develop even more rapidly than in ordinary raw milk.

A considerable objection to Pasteurisation is that owing to the destruction of the greater number of the lactic acid bacilli, which cause souring of milk, Pasteurised milk will keep for a number of days without turning sour, and may be sold as fresh milk. All this time other bacteria may have been developing, and the milk, although not sour, and more or less normal in taste, may be highly dangerous.

There is the further objection that if Pasteurisation became the common practice and the dairyman could keep his milk fresh, no matter how dirty it was, a great incentive to cleanliness would be removed. Unless carefully carried out in a proper form of apparatus and by persons possessing the requisite skill, the method may be quite ineffective.

The old fashioned domestic method of heating the milk slowly up till it just boils and then cooling as rapidly as possible is quite effective in destroying disease-producing organisms.

The Effect of Heating on the Food Value of Milk—There has been a considerable amount of controversy as to whether heating milk as in Pasteurising or in the common domestic method of "scalding" alters it sufficiently in composition to affect its value as a food for infants and young children. It is known that heating reduces the activity or completely destroys certain enzymes or ferments naturally present in milk. These were formerly supposed to take a considerable part in the digestion of the milk, and it was considered, therefore, that their destruction made the milk more indigestible. More recent investigations have shown that the part taken by these enzymes in digestion is relatively unimportant, and that their destruction by heating has no appreciable effect on the food value of the milk. A second argument against the use of Pasteurised or boiled milk was the statement that in various children's hospitals boiled or Pasteurised milk had been found to be unsuitable. The fallacy in this argument is that the milk was being fed to children who were all in an abnormal condition owing to disease, and who were unusually sensitive to any slight alteration in their food.

Without more discussion it may be stated that numerous investigations carried out in recent years have failed to show that there is any appreciable difference between the nutritive values of raw and of boiled milk. These experiments have been extensive, and have been carried out in different countries and by different workers, and the result may be taken as well established. In the present state of the milk supply the feeding of raw milk to young children should be avoided if possible (Lane-Claypon, p. 171).

Sterilisation by Electricity.—Methods for the destruction of bacteria in milk by electricity have been investigated by Beattie and Lewis in Liverpool (*Journal Board of Agriculture and Fisheries*, xxii. (1916) 1229). The milk is passed through a tube provided with copper electrodes between which a high tension current of from 2000-3000 volts is passed. The destruction of the bacteria appears to be satisfactory. B. coli. and allied organisms were completely destroyed; when the treatment is adequate the tubercle bacilli are also destroyed. The cost (1916) varied from 0·85d. to 1·25d. per gallon according to the source of power employed.

Condensing and Drying.—Amongst other methods for the treatment of milk, brief mention must be made of condensing and drying. The effect of these methods on the bacterial content of milk has been investigated by Delépine (*Reports to Local Government Board on Public Health and Medical Subjects.* Food Reports, No. 21). Three processes were specially studied—(1) manufacture of sweetened condensed milk; (2) drying milk over heated revolving cylinders; (3) drying milk by spraying it into a current of hot air.

By these methods the number of bacteria present in the milk was considerably reduced, the reduction being greatest with the first and least with the last method, where a considerable amount of contamination appeared to take place after the drying.

At none of the stages of drying was the milk ever found to be completely sterile, some bacteria, the tubercle bacillus amongst others, surviving all these methods of treatment. The vitality of the organisms, however, appears to have been considerably reduced, and young rabbits fed with milk containing these modified bacteria did not contract tuberculosis.

There can be no doubt that if milk could be dried without seriously affecting its food value, many of the present difficulties regarding contamination and distribution would be overcome. There would also be much greater economy in use, as a supply for several days could be purchased at once, and what was not required one day need not be wasted as at present.

A large number of dried milks are now on the market, some simply dried, and others which are specially advertised as infants' foods, modified so as to approximate in composition to human milk.

While a certain amount of work has been done on the food value of dried milk, especially as regards its suitability as food for infants, the amount of information available at present is hardly sufficient to enable very definite conclusions to be drawn. Dried milk has been extensively used in this country for a considerable time by certain municipalities and also by various child welfare agencies. While no detailed results have been published, the general reports on its use submitted to the Conference on Infant Mortality held in London in 1913 were quite favourable.

Standards of Cleanliness.—It has been suggested that definite standards of cleanliness for milk should be set up. That is, clean milk should not contain more than a certain specified number of bacteria, the standard proposed varying from 10,000 to 50,000 per cubic centimetre. In ordinary commercial milk 800,000 to 900,000 organisms per cubic centimetre are common and frequently even larger numbers are found. The objection to a bacterial standard is that it takes no account of the nature of the bacteria present. The fitness of the milk for human consumption depends obviously not merely on the number of bacteria present, but on whether the milk contains disease-producing organisms or not.

In certain towns in America, milk of a high quality of purity is now on sale under the name of "Certified Milk." The milk is produced by agreement between certain societies of medical men and dairy farmers. The conditions as to production are very stringent, and the cows, dairies and workers are regularly inspected. The milk is submitted to regular bacteriological examination, and must not contain more than 10,000 germs per cubic centimetre of milk. For details of these regulations see Savage's *Milk and the Public Health*, page 347.

Such milk necessarily costs more to produce than ordinary milk, but readily finds a market. The introduction of a system of grading, both as regards quality and purity, is a reform much needed in this country, and the higher price which would be obtainable for the better quality of milk would stimulate dairy farmers to improve the quality of their product. The present method of selling milk at more or less the same price irrespective of its quality or purity cannot be justified.

General.—As to the future, there is much need for the further education of those who produce and handle milk as well as of those who consume it. The production and distribution of pure milk is an industry requiring a highly intelligent and skilled set of workers, and most careful and thorough management. The education given at present in the dairy schools in different parts of the country, while no doubt admirable for those who are going to become expert cheese or butter makers or instructors, does not reach a large proportion of the class who are actually engaged in the handling of milk. For these a more elementary type of training should be devised. The Agricultural Colleges should have, at suitable centres in their areas, dairy farms equipped with up-to-date apparatus, where the most improved methods of handling milk should be taught. These courses, which might extend over six months, should be attended by sons and daughters of dairy farmers and others who intend entering the milk trade.

Much may be expected from the new Milk and Dairies (Scotland) Act already referred to. Greatly increased powers are given to Local Authorities as regards the inspection of cows and dairies. Provision is made for the bacteriological examination of milk, and regulations will be made to prevent contaminated milk being sent out for consumption. The Local Government Board has power to compel local authorities to enforce the Act. These provisions are all admirable and in the right direction, but to make the Act fully effective the intelligent and willing co-operation of the dairy trade is absolutely essential. Unless the Act is carried out in the spirit as well as in the letter, its usefulness will be greatly reduced. It is difficult to see how many of the reforms indicated above can be effectively carried out so long as the retail distribution of milk is in so many hands as it is at present. The present methods are wasteful, and render anything like adequate supervision or control of the distribution quite impossible. Without any exaggerated belief in the virtues of municipalisation, it does appear that much greater organisation and centralisation of the distribution of milk is absolutely necessary.

VARIATIONS IN THE COMPOSITION OF MILK.

J. F. TOCHER, D.Sc., F.I.C.

MILK is a universal article of food, and differs from all other foods in being the liquid secretion of the mammary glands of the cow. It is possible for milk to be diluted to a certain extent without the dilution being readily detected by the purchaser. It differs in this respect from butcher meat and from fish. From the legal standpoint it differs from artificially prepared foods in having a standard, or rather a minimum percentage, fixed with respect to two of its constituents, namely, butter fat and solids-not-fat. No standards at present exist, for instance, for such articles as sugar,

jams, cheese, bread, tea, coffee and the like. A limit is fixed as to the amount of water to be permitted in butter and to the amount of butter fat in margarine, but no standard of butter fat in butter or of the chief constituents of margarine are prescribed by law.

When we enquire into the cause of minimum limits being fixed by law with regard to cow's milk we find that, as a result of a Report by a Departmental Committee on milk standards issued in February 1901, the Board of Agriculture and Fisheries at that time fixed artificial limits with respect to the proportion of butter fat and to the proportion of solids-not-fat expected to be present in genuine milk. The effect of the Board's Regulation is that a presumption is raised, until the contrary is proved, that milk sold to the public and containing less than 3 per cent. of butter fat or containing less than 8·5 per cent. of solids-not-fat is not genuine milk, but adulterated in some way. The Society of Public Analysts had previously adopted these limits, and it is not very clear from the data available why such particular limits should have been recommended by them and officially adopted by the Board. While it was recognised that genuine milk could contain less than 3 per cent. of butter fat, no proper investigation was conducted into the nature of the natural variations in either butter fat or solids-not-fat, and, even after a lapse of many years, when data have undoubtedly accumulated, these data have not received the detailed examination necessary to establish the facts. Meantime many cases of actual adulteration and of suspected adulteration have been brought side by side into court. Many of the suspected cases frequently received unscientific treatment, simply because of averments as to the minima likely to be found being based on scant, insufficient and very often faulty data. As a consequence honest, although perhaps indifferent, dairy farmers suffer and continue to suffer with the guilty, who endeavour to profit by the laxity and the confusion abounding all over the country with respect to the quality of milk as measured by the constituents usually determined by analysts.

It can be shown that the *average* percentage of fat given by a normal cow during her entire lactation period (between two successive calvings) depends upon the age of the cow and upon the quantity obtained for the lactation period. It can also be shown that during the first portion of the lactation period the percentage of fat for each individual gradually falls, and that there is a gradual rise in the percentage during the latter portion of the lactation period. It is well known that the butter fat percentage varies during the lactation period. The variations in all these cases are regular and can be demonstrated for each age, for various yields and with respect to time. The writer is about to publish a memoir dealing fully with these variations and the factors affecting them. The normal conditions affecting the quality of milk are therefore very complex, quite apart from the nature of the rations given. As no reference is made in the Regulations to the nature of the feeding of cows, or to the likely effects of different feeding stuffs, it is to be presumed that the limits prescribed for butter fat and for solids-not-fat, are limits for cows normally fed and not underfed. But, as will be shown in this paper, no adequate study of the natural

variations of the constituents of milk was made. The authorities had not had placed before them a mental picture of these variations, and had to take the judgment of experts who dealt in averages, and who never ascertained exactly what number of cases could naturally occur giving various percentages of butter fat and various percentages of solids-not-fat.

In all the cases described in this paper the cows were properly fed, properly housed and were well nourished, and, therefore, the milk obtained from them was genuine milk from cows in a normal state of health and living in a normal environment.

The first series studied was a series of 384 samples. The ages of the cows were not ascertained, but they were dairy cows, the milk from which was being supplied to the public at various centres. A complete analysis of milk should cover determinations of butter fat, milk-sugar, casein, albumen, ash and other constituents. In the present series only fat, solids-not-fat and ash were determined. The writer desired to ascertain from samples of genuine milks in various areas in the north of Scotland what were the lowest and highest percentages of these constituents in the 384 samples, how the variations in butter fat occurred and how they were related to the other constituents, and, generally, how the variations in all constituents were related to each other. The samples were not samples from individual cows, but were samples of the mixed milk of herds of various sizes (most of them were small herds) and of different ages, and were collected irrespective of hour of milking, in order to cover the general conditions of dairy practice and to show what might be expected to occur in practice when the Regulations of the Board of Agriculture should apply. It should be kept in mind that milk from even one cow is genuine milk to which the Board's Regulations should apply. Genuine milk from one cow was, however, avoided and only milk from a herd examined, so as to avoid very exceptional conditions, although this was really unnecessary from the point of view of the writer. An endeavour was made to get as many samples as possible from areas which, from experience, were found to yield a more than average number of "deficient" samples.

We shall first consider the variations in butter fat in the 384 samples. The following table shows (column 3) the numbers of samples found to have the percentages of butter fat indicated in column 1. The lowest percentage found was slightly over 2 per cent. All percentages between 2·00 and 2·15 were placed together in one group; percentages between 2·15 and 2·30 were placed in the next group; the successive groups were formed in a similar manner, those falling within the range of 0·15 per cent. being constituted a group.

[TABLE I.

TABLE I.

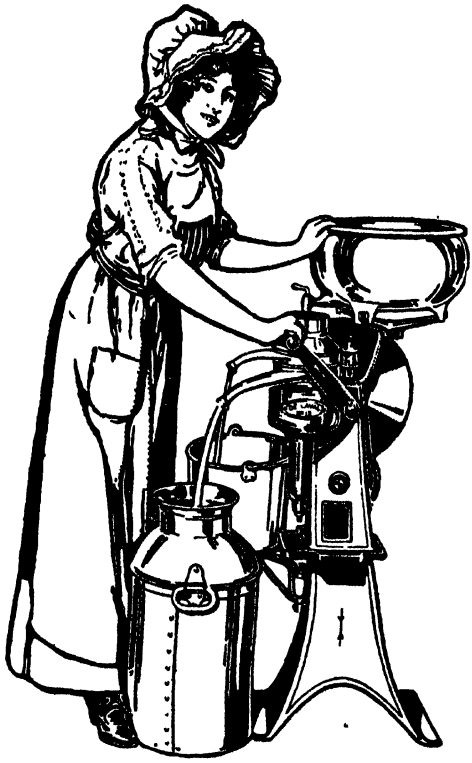
1. Butter Fat Percentage.	2. Central Percentage of Group.	3. Number of Samples.	4. Number of Samples per 1000 in each Group.
From 2·00 to 2·15	2·075	1	2·6
2·15 2·30	2·225	5	13·0
2·30 2·45	2·375	6	15·6
2·45 2·60	2·525	6	15·6
2·60 2·75	2·675	15	39·1
2·75 2·90	2·825	11	28·6
2·90 3·05	2·975	39	101·7
3·05 3·20	3·125	31	80·7
3·20 3·35	3·275	45	117·2
3·35 3·50	3·425	41	106·8
3·50 3·65	3·575	43	112·0
3·65 3·80	3·725	34	88·5
3·80 3·95	3·875	33	85·9
3·95 4·10	4·025	18	46·9
4·10 4·25	4·175	17	44·3
4·25 4·40	4·325	18	46·9
4·40 4·55	4·475	5	13·0
4·55 4·70	4·625	6	15·6
4·70 upwards	—	10	26·0
		384	1000·0

From this table it is seen that as many as 83 samples (or 21·62 per cent.) contained less than 3·05 per cent. butter fat. Of these 83 samples, 71 were found to contain less than 3 per cent. In other words, 71 samples out of the 384 (or 18·5 per cent. of the whole samples) were below the minimum prescribed by the Board. These 71 cases would have been reported as deficient if they had been official samples drawn under the Food and Drugs Acts. In the great majority of cases, therefore, legal proceedings would have been instituted against the seller for supplying milk so deficient in butter fat as to raise a presumption for the purpose of the Sale of Food and Drugs Acts, 1875-1899, until the contrary is proved, that the milk was not genuine. It is quite true that a large number of samples were obtained from "low class" cows.[1] These cows, perhaps, should not be described as "dairy cows," despite the fact that the milk from these cows was sold to the public. Quite probably also another series of samples would give a lower percentage of cases below the minimum prescribed. The important point, however, to note is that the samples were samples of genuine milk from healthy cows, and if samples from these cows had been taken under the Food and Drugs Acts, 71 out of the 384 sellers would have been put to the necessity of proving that the milk was genuine and not adulterated (on account of the proportion of butter fat present), which is the attitude the local authority would have to

[1] It is frequently the case that in the hurry to get milk sent forward for consumption, many cows are left unstripped. This has the effect of lowering the proportion of butter fat. No conditions were laid down in getting the 384 samples of genuine milk. The writer saw that he got genuine milk under the normal conditions prevailing in the dairy.

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adopt under the regulations. Richmond[1] quotes Vieth's results of analysis of milk for butter fat, the number of cows whose milk was tested being over 6000, belonging to the chief breeds. Less than 6 per cent. of these cows gave under 3 per cent. of butter fat, but Vieth's figures were for breeds and not for any particular localities. It must not, however, be inferred that the writer holds that feeding or any other local condition produces poor milk. Poor milk in certain localities occurs mainly if not entirely because of the high proportion of "low class" inferior cows in these localities. The numbers of cows giving less than 3 per cent. in various localities have never been properly ascertained, and this information is essential before the minimum of 3 per cent. butter fat for *genuineness* can really be justified. The average percentage of fat for the 384 samples was 3·495, while the *standard deviation*, which measures the variation of the samples round the mean, was found to be 0·549 per cent, which, as will be seen later, is a large value That is to say, there was a greater range of values than one would expect to get from 384 samples taken quite at random, and there were greater proportions of small and large percentages of butter fat than one finds from even large series belonging to one breed only.

It may be useful briefly to summarise these results. We have up to the present discussed a probably somewhat exceptional series of samples of genuine milk, a series made up regardless of breed or age of cow, nature of feeding or hour of milking, but selected partly with regard to quality, the partial selection as far as could be secured in practice being in the direction of poorness of quality, as measured by low percentages of butter fat, and effected from a knowledge of the various areas concerned. This partial selection resulted in producing 18·5 per cent. of cases of genuine milk where the proportion of butter fat was below the prescribed minimum, while the whole 384 samples gave an average of 3·495 per cent. butter fat. In other words, if all the samples had been mixed thoroughly and the proportion of butter fat tested, the mixture would have been found to contain 3·495 per cent butter fat.

We shall now consider a larger series taken from the Records of the Scottish Milk Records Association. This body has, for many years, through the medium of its local societies, conducted periodical tests on a public and reliable basis on the quality and quantity of milk obtained from the best Ayrshire cows. The writer will here consider only the *quality* of milk as found by the tests conducted by the Association The herds tested were mainly on dairy farms in the south-west and south of Scotland. In order to exclude abnormal and unusual cases, we have confined our analysis to the percentages of butter fat recorded from cows between two successive calvings. Thus the figures considered in each case were those of a cow during her entire lactation period. Each cow was known to have had another calf and to have entered into another lactation period. The cows were therefore normal healthy cows with no break due to illness, and no break due to commercial exigencies. Instead of taking the percentage of butter

[1] Richmond's Dairy Chemistry, p. 155.

fat from any one of the fortnightly tests on the milk of each cow, the average of the whole of the tests during the entire lactation period of each cow was the figure taken. Milk from the herd as a whole was excluded. The data differ in this respect from the 384 samples just considered. The average percentage of butter fat from each normal cow during a lactation period alone was considered. The records of over 11,000 of these cows were examined in two different series. The results of analyses of these two series are given in the following table.

TABLE II.

Butter Fat Percentage.	Central Percentage of Group.	Number of Samples per 1000 in each Group.	
		Series I.	Series II.
From 2·00 to 2·25	2·125	·150	...
2·25 2·50	2·375	·301	·214
2·50 2·75	2·625	1·504	1·070
2·75 3·00	2·875	13·087	11·133
3·00 3·25	3·125	60·319	57·803
3·25 3·50	3·375	166·215	170·841
3·50 3·75	3·625	272·563	286·663
3·75 4·00	3·875	265·794	272·320
4·00 4·25	4·125	154·332	146·649
4·25 4·50	4·375	53·249	44·744
4·50 4·75	4·625	10·981	7·707
4·75 5 00	4·875	1·355	·642
5 00 upwards	...	·150	·214
		1000·000	1000·000

It is seen from Table II. that only 1·5 per cent. of the cows gave milk which on an average during the entire lactation period fell below 3 per cent. in butter fat (see results from Series I.). In the second series the corresponding figure was 1·24 per cent. of the cows. These figures, 1·24 and 1·50 per cent. respectively, are not comparable with the figure 18·5 per cent. found for the 384 samples already discussed. In the first case (384 samples) we have the percentage of samples of genuine milk, each sample being a mixture of the milk of a herd for a particular day; while, as just pointed out, in the second case (11,000 cows) we have the percentage of cows giving milk which, being tested fortnightly for butter fat, show an average percentage of butter fat below 3 per cent., the whole milk record of the cow for a lactation period being taken into account. This, however, is a condition which never occurs in practice when milk is examined officially under the Food and Drugs Acts. On the contrary, the conditions are parallel to those existing in the series of 384 samples. But we learn from the results obtained from 11,000 cows that from 12 to 15 cows out of every 1000 *consistently* yield milk below the prescribed minimum, and this occurs in a large group of cows specially selected for milk production. The mean percentage of butter fat for 11,000 cows was 3·727 (as against 3·495 for the 384 samples), while the standard

deviation was only 0·324 per cent. (as against 0·549 per cent. for the 384), showing there was considerably less variation round the mean in the 11,000 selected Ayrshire cows.

We shall now consider briefly the variation in solids-not-fat in the 384 samples. The average percentage of solids-not-fat was found to be 8·85, with a standard deviation of 0·375 per cent. There was therefore less variation than in butter fat. The number of cases where the samples fell below 8·5 per cent. (the prescribed minimum for solids-not-fat) was found to be 37, or 96 per 1000. Thus the minimum prescribed for solids-not-fat lies near the average instead of near the minimum which actually exists in the proportion of solids-not-fat from many samples of milk of dairy cows, the milk of which is sold to the public. The following table shows the number of samples for each solids-not-fat percentage named, the range for each group being 0·25 per cent.

TABLE III.

Solids-not-Fat Percentage.	Centre of Group.	Frequency.	Number per 1000.
to 7·00	...	1	2·6
From 7·00 to 7·25	7·125	...	...
7·25 7·50	7·375	2	5·2
7·50 7·75	7·625	6	15·6
7·75 8·00	7·875	2	5·2
8·00 8·25	8·125	13	33·9
8·25 8·50	8·375	13	33·9
8·50 8·75	8·625	96	250·0
8·75 9·00	8·875	123	320·3
9·00 9·25	9·125	91	237·0
9·25 9·50	9·375	27	70·3
9·50 9·75	9·625	5	13·0
9·75 10·00	9·875	4	10·4
10·00 upwards	10·125	1	2·6
		384	1000·0

In order to see the full effect of the Board's Regulations the following table should be examined.

[TABLE IV.

TABLE IV.

Percentage of Fat. Centres of Groups.	Percentages of Solids not-Fat. Centres of Groups.														
	6·875	7·125	7·375	7·625	7·875	8·125	8·375	8·625	8·875	9·125	9·375	9·625	9·875	10·125	Totals.
2·075	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1
2·225	...	...	...	1	...	1		1	1	...	...	...	1	...	5
2·375	...	...	...	...	...	...	1	1	2	1	...	1	...	...	6
2·525	...	...	...	1	...	...	1	2	1	1	...	...	...	...	6
2·675	1	...	...	...	1	1		1	7	2	2	...	..	...	15
2·825	...	...	...	...	...	...	2	3	5	1	...	...	...	...	11
2·975	...	...	1	1	...	4	1	11	8	11	2	...	...	...	39
3·125	...	...	...	...	...	1	1	9	13	5	2	..	...	...	31
3·275	...	...	...	...		1	...	14	15	13	2	...	...	...	45
3·425	...	...	...	...	...	...	2	8	19	7	5	...	...	.	41
3·575	...	..	...	...	...	1	2	11	10	12	6	1	...	...	43
3·725	...	...	...	1		...	1	6	17	7	1	1	...	...	34
3·875	...	...	...	1	...	1	1	7	10	11	1	...	1	...	33
4·025	...	...	...	...	1	...	...	6	3	6	1	...	1	...	18
4·175	...	..	1	...	...	1	...	5	3	4	2	..	...	1	17
4·325	...	..	...	1	...	1	1	3	5	5	1	...	1	...	18
4·475	...	...	..	...	.	...	...	2	1	1	1	...	...	...	5
4·625	...	...	...	...	...	...	...	1	2	2	...	1	...	...	6
4·775	...	...	...	...	...	1	...	4	1	2	1	1	...	...	10
Totals ...	1	...	2	6	2	13	13	96	123	91	27	5	4	1	384

This table shows the percentages of butter fat in all samples containing the percentage of solids-not-fat indicated on the top line of the table. For example, there were 123 samples containing from 8·75 to 9·00 per cent. of solids-not-fat, that range being indicated by 8·875 per cent., the central value of the range. These 123 samples, containing practically the same amount of solids-not-fat, had varying amounts of butter fat from 2·225 per cent to 4·775 per cent. As many as 22 samples had amounts of butter fat varying from 2·225 to 2·975 per cent., and these came within the scope of the Board's Regulations. The numbers within the dotted line on the lower right hand side of the table when the actual percentages are considered contain 3 per cent. and over of butter fat and 8·5 per cent. and over of solids-not-fat. These were 276 in number. All those outside the lower right hand side of the table (108 in number) were samples below the Board's prescribed minimum with respect to either butter fat or solids-not-fat, or both. The table shows that there is no constancy in the proportions of butter fat for any particular percentage of solids-not-fat, and there is no constancy in the percentages of solids-not-fat for any particular percentage of butter fat. It is thus seen that 108 samples out of 384 samples of genuine milk were samples which would be reported by public analysts in the ordinary course of their work as coming within the range of the "Sale of Milk Regulations" prescribed by the Board on 28th December 1901, which run as follows:—

"MILK.

"(1) Where a sample of milk (not being milk sold as skimmed, or separated, or condensed milk) contains less than 3 per cent. of milk fat, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk fat, or the addition thereto of water.

"(2) Where a sample of milk (not being milk sold as skimmed, or separated, or condensed milk) contains less than 8·5 per cent. of milk solids other than milk fat, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk solids other than milk fat, or the addition thereto of water."

Judging from the foregoing results it is seen that no amount of action, based on these Regulations, has up to the present deterred dairymen from keeping cows giving milk of poor quality, and it may safely be said that these Regulations as they stand will not deter dairy farmers in future from keeping such cows. It may be true (1) that a large number of dairy farmers may be put to the trouble, some of them without success, to prove that the milk supplied was genuine, and (2) that a number of cases of adulteration have been brought to light and the offenders duly punished under these Regulations. But no success has been attained in the direction of raising the quality of milk. The Regulations will have to be modified in some way to ensure success in raising the standard

of quality. The simplest way is to provide that all milk sold to the public must contain not less than 3 per cent. butter fat and not less than a specified percentage of solids-not-fat. I shall later on return to this point.

In order to see whether there is really any relationship between the percentage of solids-not-fat and butter fat, the following table has been drawn up showing the average percentage of butter fat associated with particular percentages of solids-not-fat.

TABLE V.

Percentage of Solids-not-Fat Type.	Average Percentage of Butter Fat.
7·625	3·275
7 875	3·350
8 125	3·379
8·375	3·275
8 625	3·505
8 875	3·443
9·125	3·575
9·375	3·564
9·625	3·815
9·875	...

On inspecting the table, it should be borne in mind that the numbers of samples with very low and very high percentages of butter fat are quite small, and therefore no special weight should be put on these averages. The general trend is, however, quite clear. There is a small but quite appreciable increase in the proportion of butter fat with increases in the proportions of solids-not-fat and *vice versa*. The coefficient of correlation, as it is called, amounts to 0·1. This fact should therefore be remembered in fixing minima. What, for instance, is the average percentage of butter fat associated with 8·5 per cent. of solids-not-fat? Also, what is the average percentage of solids-not-fat associated with 3 per cent. of butter fat? In the first case the value is 3·42 per cent. butter fat. In the second case the value is 8·81 per cent. solids-not-fat.

The results of this paper show that the prescribed minima for butter fat and for solids-not-fat are artificial in character, and are based neither on the real minima found to exist for these constituents, nor on an adequate study of the natural variations occurring in genuine milk. The prescribed minima are nearer the average values for the constituents, but for legal cases, in which individual samples of milk are considered, minima based on *averages* are unscientific and worthless, and are therefore unjust in their operation. It is easy to see why so many representative bodies objected, at the time, to the Departmental Committee's recommendations. It would have been logical and even fair to insist on all milk sold to the public having not less than 3 per cent. of butter fat, irrespective of whether the milk was genuine or not. Such a regulation would have caused dairy farmers to select cows yielding

milk containing 3 per cent. of butter fat or over. The present Regulation does not operate in this way, or if it does, it operates only in a slight degree. Dairy farmers, despite the fact that they are brought into court for selling milk containing less than 3 per cent. butter fat, generally continue to sell milk from the same cows, and they are often quite justified in doing so, provided always that genuine milk is sold. The writer has witnessed many hard cases of struggling honest men being brought into court to prove that they were innocent. The principle underlying the Regulation is unsound. The figures in this paper abundantly prove what is conceded but not acted upon, namely, that many cows give milk containing less than 3 per cent. butter fat. To adopt a minimum of 3 per cent. for butter fat which from the nature and the wording of the Regulation is really subject to revision in a court of law (and when the minimum is really nearer 2 per cent.), is wholly unfair to the sellers, and should never, in the writer's opinion, have been made the basis of a Government Regulation. If, however, it is made illegal to sell genuine milk containing less than 3 per cent. butter fat, that is quite another matter. Dairy farmers would then understand that, in purchasing a dairy cow, they must know whether she is a good milker or not; but chiefly, if not solely, whether she gives rich milk or milk containing at least 3 per cent. butter fat. The result would be that all "low class" cows would disappear as dairy cows. Breeding for quality as well as for yield would be encouraged. In any case, no injustice could occur when a dairyman was brought into court for selling milk containing under 3 per cent. butter fat, since he would know that to do so is an offence. Dairymen should not be brought into court unless there is clear evidence of adulteration, or of a contravention of an Act of Parliament. As milk is one of the most important and universal of human foods, and as butter fat is its most important constituent from the nutritive point of view, it is essential that, for the health of the public, a reasonable and fair standard of quality should be maintained. This can be secured only by constant supervision and selection of cows by dairy farmers. An absolute and unqualified minimum of 3 per cent. for butter fat would operate in this direction and would cause no injustice to the honest and progressive dairy farmer, while at the same time a good milk supply would be assured to the general public.

Instead of fixing an absolute minimum, milk might be sold under a guarantee, but this method presents many practical difficulties, unless as an alternative at the option of the dairyman. There is no sound reason why dairymen should not ask a higher price for higher grade milk, that is to say, for milk containing a higher proportion of butter fat. The grading of milk as regards quality would, however, involve continuous analysis. It therefore seems simpler and fairer to adopt absolute and unqualified minima with respect to both butter fat and solids-not-fat, leaving enterprising dairy farmers with the option of choosing to sell graded milk, guaranteed to contain certain specified percentages of butter-fat, even if one of these grades is below the prescribed minimum. It would follow that the price of milk would vary with the grade guaranteed.

BOT-FLIES OF THE HORSE.

JAMES RITCHIE, M.A., D.Sc., F.R.S.E.

THE increase in the numbers of Bot-flies which has been noticed in Europe and America as the result of the unusual bunching of horses in fields and paddocks due to the conditions of the war, the unusual prevalence of the troubles to which the bots give rise, and the possibility of an increase of bot diseases in this country through the dispersal of infected Army horses, suggest that the time is ripe for summarising the results of the many recent experiments which have had in view the prevention or cure of bot diseases.

Species in Britain.—Three species of horse Bot-flies occur in Britain: the Common Horse-Bot (*Gastrophilus intestinalis* or *equi*), the Red-tailed Bot (*G. hæmorrhoidalis*), and the Nose Bot (*G nasalis*). All are moderately large, hairy, two-winged flies (from ½ to ⅝ of an inch in length), seldom found except in the neighbourhood of horses. All have a tendency to tawny yellow in their colouring, but bright orange or golden yellow hairs clothe the thorax of the Nose Bot, a band of orange yellow on the hinder end of the body marks the Red-tailed Bot, while the most familiar species, the Common Horse-Bot, is of a more sober brownish-yellow tint, and is easily recognisable by clouded areas on its wings (see Fig. 1).

Habits.—Adult Bot-flies are to be found on the wing most numerously in the warmest summer months—July and August—and on bright days, when the females may be observed hovering near a horse awaiting opportunity to lay their eggs. The eggs of the Common Bot-fly (Fig. 2) are attached to hairs, generally on the inside of the fore-legs, but also on the shoulders, mane, or even on the hind legs, in positions liable to be licked by the horse's tongue. The eggs of the Nose Bot-fly are most often found attached to hairs on the under surface of the lower jaw, while those of the Red-tailed Bot-fly, dark in colour, are fastened to the bases of the fine hairs on nostrils and lips By one means or another the embryo which develops within the egg-case reaches the mouth of the horse, in the Nose Bot the larva may possibly penetrate the skin, but in the vast majority of cases moisture and friction, supplied by the licking of the horse, are necessary for the escape of the embryo, the hooks of which at once give it firm anchorage in the horse's mouth Within the food-tract of the horse the larva or 'bot" continues its development, remaining there, if undisturbed, throughout the autumn and the succeeding winter and spring. During this period it migrates from the mouth and takes up a fixed position in the food canal, where, feeding upon the serous fluids and the juices contained in the lymphatics, lacteals and blood-vessels, it reaches full larval growth (Fig. 3, and Fig. 4 showing larvæ attached to stomach of horse).

Bots of different species show preference, as a general rule, for particular parts of the food canal. Thus the Common Bot is most often found in the stomach, the Red-tailed Bot in stomach,

duodenum or rectum, while the Nose Bot occurs in duodenum or stomach and even in the throat. During the later stages of their growth the bots forsake their definite points of attachment, and

The Common Horse Bot-fly and its stages.



FIG. 1.—Common Horse Bot-fly (*Gastrophilus intestinalis*), female, twice nat size (linear)



FIG. 2.—Egg of Common Horse Bot-fly attached to horse's hair, 25 times nat. size (linear)



FIG. 3.—Full grown larva ("bot") of Common Horse Bot-fly, showing narrow head end with hooks for attachment, and double rows of hooks upon the segments, 2½ times nat. size (linear).

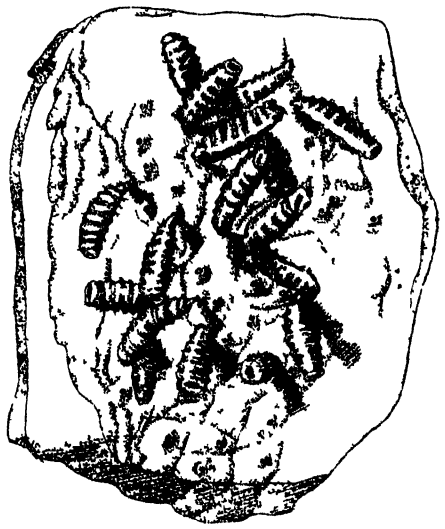


FIG. 4.—Portion of stomach-wall of horse, showing bots attached, and raised perforated swellings caused by the attachment of bots from which the larvæ have fallen ⅔ nat. size

passing down the food tract finally drop on the ground, where they enter the quiescent pupal stage. In the course of little over a month the winged adults emerge from the pupa cases, and the vicious cycle begins again.

It is obvious from the long period during which the bot larvæ are parasitic within the horse that the transference of infected horses from one area or one country to another is an almost certain method of causing the spread of Bot-flies and the troubles to which they give rise. To the traffic in horses is no doubt due the world-wide distribution of common European species of Bot-flies, which are now recognised as pests in countries so far-spread as Australia, Africa, Europe, the United States of America and Canada.

Harmful Effects of Bot-flies and their Larvæ.—The ill effects of the flies themselves are due to the annoyance caused to the horse by their continued presence and buzzing, and their persistent efforts to deposit eggs. This nervous irritation is especially marked in the presence of the flies least often met with in Britain—the Nose and the Red-tailed Bot-flies—and with a highly strung horse may lead from constant tossing of the head and rubbing of the muzzle against barbed wire or other convenient projection to complete loss of control and stampede.

The bot larvæ give rise to more persistent symptoms. Where few are present no ill effects may be noticeable, but the presence of numbers, each individual causing an inflammatory thickening of the intestinal wall, leads to serious loss of condition in the animal infected. The blocking of the throat and windpipe by bunches of the Nose Bot, or of the intestine by this and other species, may lead to suffocation or to obstruction and death, and the development of inflammatory lesions or the perforation of the intestinal wall may also end fatally. These possibilities are not surprising when one learns that nearly every horse examined after death in Morocco in 1913 contained over 1000 larvæ. More recent observations made during the war on German and Russian army horses revealed the presence, as a rule, of from 500 to 750 bots in the stomach; while of 80 horses dissected between mid-February and mid-May 1916, 55 died from the effects of the bot larvæ.

It has been found that the symptoms are most severe and the disease is most deadly when the Nose Bot (*G. nasalis*) is implicated; fortunately, this is the rarest of the three species in Britain.

Apart from such mechanical disturbances as the above, recent experiments have shown that extracts of bot larvæ have themselves a toxic effect upon horses into which they have been injected, and produce the symptoms of pernicious anæmia; so that it is tolerably safe to assume that the very presence of bots has a harmful effect, leading directly to serious results.

Warnings of Bot Trouble.—Apart from the general indications to be gathered from an otherwise unaccountable emaciation and loss of weight on the part of a horse, watch should be kept from July to September for the presence of Bot-flies endeavouring to deposit their eggs, or for the presence of the eggs themselves. Warning of the presence of the flies is often given by the horse itself, through the repeated irritable jerking backwards of its head accompanied by loud snorting. Throughout autumn, winter and spring watch should be kept for bot larvæ passed in droppings.

Measures against Bots. — (*a*) *Preventive.* — Where Bot-flies show themselves a nuisance it is well to endeavour to check their activities, which are mainly confined to sunny days during the months of July and August. Three methods are available.

(i.) The deposition of eggs may be discouraged by the use of a repellent mixture smeared over the parts likely to be visited by the flies. Where the Common Bot-fly is present the chin and fore-legs especially should be attended to; in the presence of the Red-tailed and Nose Bot-flies, the lips and under part of the lower jaw should be smeared. A dressing compounded of oil of tar 1 oz. and olive oil 6 ozs. has been found to be effective against the Common Bot-fly, but it has to be applied daily—a serious disadvantage. More practicable is the American mixture of equal parts of pine-tar and lard, a smearing with which proved effective for four days. The U.S. Department of Agriculture records very good results with a mixture of pine-tar 3¾ ozs. thinned with kerosene 1¼ ozs., to which is added laundry soap 1 oz. and powdered resin 1 oz., dissolved in 14 ozs. of hot water. This mixture has not only great repellent action, but it so clags the hairs in bunches that the flies cannot attach their eggs.

(ii.) A second method, used where the Red-tailed and Nose Bot-flies are common, endeavours to prevent deposition of eggs by

Apparatus devised to prevent egg-laying of Bot-flies on horse's lips and jaws (after Hadwen and Cameron).

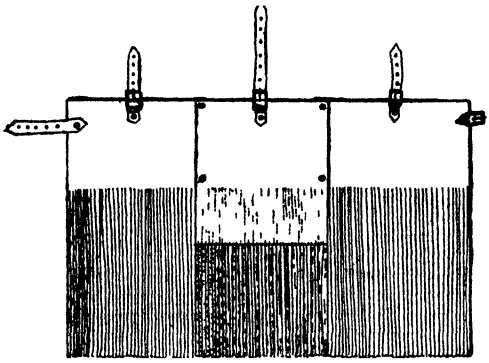


FIG. 5.—Leather band with fringed margin and attachments.

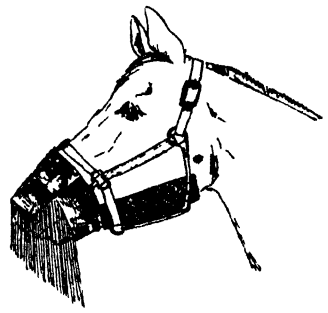


FIG. 6.—Band in position round horse's muzzle, and additional canvas protection for under side of lower jaw.

apparatus devised to disturb the attacks of the fly. Of many types of such apparatus an effective form, modified and recommended by S. Hadwen and A. E. Cameron, is here illustrated. It consists of a leather band, the lower part of which is cut into strips three-sixteenths of an inch wide, and which in use surrounds the muzzle of the horse and is attached to the head stall. To avoid the possibility of the nose becoming uncovered an additional leather flap, the lower edge of which is also cut into strips, projects over the bridge of the nose (see figures 5 and 6). Such a device is effec-

tive against the Red-tailed Bot-fly; the attacks of the Nose Bot-fly are countered by a piece of strong canvas placed along the underside of the lower jaw (see figure 6), and attached to the noseband and to the side rings of the head-stall on each side.

(iii.) The third preventive method is aimed specially against the Common Horse Bot-fly, and is therefore of more significance in this country It endeavours to prevent infection on the part of the horse even after the eggs have been successfully laid, and depends upon the fact that the eggs do not hatch, even if the embryo be fully developed, unless friction and moisture (usually supplied by the tongue of the horse) be applied to them It consists in rubbing down the horse's coat, especially such parts as the inside of the fore-legs, with a slightly moistened cloth or brush, at the close of every day during the egg-laying season, from about July to September. By this means the embryos approaching maturity are released from the egg-cases and destroyed, and the danger of a serious infection is greatly reduced.

(*b*) *Curative.*—Where internal infection has taken place and the presence of the bots is distinctly indicated, active measures for their destruction must be taken. In the first place infected horses must be well fed Not only does this help them to combat the drain upon their systems caused by the presence and feeding of the bots, but, according to the authors of the experiments on German and Russian army horses already referred to, insufficient and unsuitable fodder seems actually to favour the presence of the larvæ.

The ordinary remedies effective in the case of "worms" have been found to be almost useless when used against bots, and recourse is now almost invariably had to an internal fumigant. Of these the most satisfactory is carbon bisulphide administered in gelatine capsules. Many different doses have been tested with good results, but the larger quantities used in earlier experiments tend to be harmful to the horse, causing colic and other unfavourable symptoms. The following method is recommended by the Bureau of Animal Industry of the United States Deparment of Agriculture —

> "The day preceding the treatment a small amount of hay and a moderate amount of oats is given in the morning; in the evening food is withheld and a purgative given—Barbadoes aloes 1 ounce, or raw linseed oil 1 pint The day of the treatment, at 6 o'clock in the morning, give 3 drams of carbon bisulphide in a gelatine capsule, at 7 o'clock repeat the dose in the same manner, and at 8 o'clock give the third and last dose, making in all 9 drams of carbon bisulphide in three gelatine capsules.
>
> "The above treatment is for the adult horse. For a yearling colt half the quantity of carbon bisulphide used for a mature horse will give the desired results. If properly administered, the gelatine capsule reaches the stomach intact, but soon dissolves, and the carbon bisulphide rapidly evaporates, suffocating all bot larvæ and other parasites with which it comes in contact, but not injuring the horse Worms are quite often expelled as well." (*W E. Dove*)

The larvæ are killed by the fumes, and dropping from their places of attachment are expelled in the droppings. With specially effective treatment dead larvæ are ejected after 24 hours, but generally the first bots appear after 36 to 48 hours Thereafter they have been observed to be ejected for a period of 5 days.

RURAL INDUSTRIES.

Professor W. R. SCOTT,
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Localisation of Industry.—The whole question of rural industry can scarcely be adequately discussed without some reference to the wider problem of localisation of industry. It is difficult to realise how recent is the development of the present concentration of productive processes in towns. It is largely a consequence of the development of invention and the coming of what is called the "coal and steam age." Thus iron smelting was carried on in the seventeenth and eighteenth centuries by means of charcoal, and hence the works were situated in the vicinity of forests where the wood could readily be obtained—a method of working which accounts for the deforestation of the country. Again, in the early history of the textile industry, power was procured from the rivers of the country, and in many districts woollen and cotton mills were placed at intervals along the banks of a suitable stream; hence the industrial population was much more scattered that it is at present. Accessory trades were generally established, making the villages centres of numerous small industries producing for a market which was largely local, though by means of stage coaches and carriers many of their products were distributed over comparatively wide areas. The coming of the steam engine completed the work of the industrial revolution, and the building of railways inevitably catered for the towns and at the same time contributed to further concentration and even to congestion.

If one tries to discern the direction of coming tendencies, it becomes apparent that it would be a mistake to consider this tendency as one which will continue with ever increasing force. It is one of the mysteries of human affairs that, just when a movement has become so well established that everyone considers it fixed as a law of nature, there are already the beginnings of counter-tendencies which limit its increase and in the end may possibly destroy it. To one who looks below the surface, the beginnings of such counteractive forces operating to diminish industrial concentration may, even now, be discerned. These come mainly from two directions—the economic and the social. The congestion in towns has forced land for factory sites to a very high price, and for the last twenty years small factories have tended to move to the smaller towns or even to semi-rural areas. At the same time the method of electrical power distribution has extended the radius for the location of new works by enabling the necessary power to be delivered at any point within an extensive area of supply. When the rise in the price of coal, due partly to the greater difficulty of working, partly to changed labour conditions, forces the development of the hydro-electric possibilities of the country, the radius will not only be lengthened, but it will start from a new centre. In power distribution from coal or the heat of blast furnaces, the centre from which the power is distributed is in a coal field, and hence in an area already partially industrialised. In generation from water power the source must be in a purely

rural area, where hitherto any industry depending on power was under a special disadvantage owing to the high cost of bringing coal. This development will be of peculiar interest to Scotland, since a great part of the larger water powers of Britain are situated in this country, and that too in the mountainous parts, where difficulties of transport had made the use of power very difficult, if not impossible. Industries will go, inevitably, to places where power is cheap; and, if our resources in water power can be developed so as to compete advantageously with power generated from coal, there will be a striking change in the centre of gravity of industrial localisation. The social causes are no less important in the coming renaissance of rural industry. The success of closer settlement on the land will depend for its ultimate success on the reconstituting of the villages as centres of social life, and it is difficult to see how this can be accomplished without a revival of rural industry. Also the country is pledged to the establishment in life of the disabled and partially disabled soldiers, and for them life in a village, where they are able to find their main occupation in a workshop and have a garden to cultivate as a subsidiary occupation, seems to offer the best hope of a solution.

Development of Rural Industries.—In view of these general considerations it becomes possible to outline some of the conditions which must be fulfilled in order to recreate village life through adding to it the due balance of rural industry which it has lost for too long. The development of industry in rural areas may take place in any or all of the following ways:—

(1) Hydro-electric development may bring large industries to remote rural districts. Necessarily such industries, carried on in these areas, will not be "rural industries" in the sense in which this term is often understood. They will be manufactures working on a comparatively large scale which will have established themselves in the country. But the mere fact of the coming of the population of workers and their families will create a new demand in that area for many goods, and some of these can be produced best on the spot. Hence there will be room for the small industries which will supply these needs. Then if the development of power takes place by a method which will provide for generation in bulk with retail distribution, workers will be able to obtain it just as the city dweller gets his gas or electricity. It is remarkable that in Switzerland (where development of this kind has taken place) there are a very great number of small electrical motors in use—many of them in the homes of the people. Further, it usually happens that industries occur in clusters—that is to say a main industry draws with it those industries which depend on it for their raw material or in other ways. Some of these are quite small, and they may be capable of development as rural industries.

(2) Agricultural development in the form of closer settlement will in itself cause a demand for the rural industries accessory to it, as for instance the making and the repair of the simpler agricultural tools and implements, *e.g.* carts, harness, spades, tool-handles, hurdles, fencing, beehives, egg boxes, etc. Some forms of artificial

manures might form the basis of a rural industry. Thus in the event of hydro-electric power being used for some of the chemical industries, several of the by-products of these might be worked up for manurial purposes; or again, if sea-weed were treated scientifically in the districts where it is found, there would again be by-products suitable for the purpose.

(3) The working up of agricultural products as the basis of a rural industry is capable of considerable development. Meal mills could be established with considerable advantage in a number of districts. In the Hebrides, for instance, there seems to be an unnecessary payment of freight in bringing oatmeal from the mainland, if local oats of a sufficiently good quality can be produced. Again there seems to be ample room for small woollen factories working up the wool of the district, if a comparatively high quality of cloth is secured. The hand-spun tweed, such as Harris, is a speciality, and depends upon a highly specialised and exclusive demand. That demand is of such a nature that a considerable increase in the supply would be likely to reduce it. In fact, in the cloth trade, the demand for hand-spun tweed somewhat resembles that in the book trade for large paper copies issued in limited numbers. Therefore, valued as this industry is in its own class, it seems likely that extension should be sought in other directions. It seems possible that there is scope for research and study in the dyeing of tweed, which might be either hand woven or power loom woven. The Shetland hosiery industry is capable of considerable development, since it depends upon the natural properties of the wool. It has been subject to somewhat disgraceful imitations, and if it is to maintain itself the producers require to be safeguarded against these disreputable attacks. Osier growing for basket making should prove profitable. The experiment at Kilmuir in Skye proved both that osiers could be cultivated successfully, and that excellent crans and baskets could be produced. The large demand for the former from the fishing industry should secure a good market. If pig breeding were extended, bacon curing ought to follow, and it can be carried on best in the vicinity of the place where the pigs are reared. Cheese making has already developed in the dairying districts.

(4) Afforestation gives opportunities for saw milling, and it seems possible that use should be made of the waste from saw mills.

(5) Building and allied operations will necessitate quarrying, or, in some districts, brick making. It would be worth enquiring whether it would not be possible to make pipes and tiles for the drainage of land where there is suitable clay, in order to save the heavy cost of transport and breakages.

(6) There are many organised handicrafts which can be carried on with success in rural districts. These need training, and some of them a certain amount of the artistic faculty. For these both the organising of the industry and the training of the workers are required. As regards the first, either some one person or a small local committee must first select an industry which is suitable to the local circumstances and the available labour. Then, since the market for these crafts is to be found in the centres of population,

the necessary trade connections must be established, the supervision of the workers and the work must be arranged, and in fine all the normal business arrangements need to be made. There was much public-spirited work of this kind done before the war, but it must be remembered that no amount of enthusiasm or good intentions is a substitute for ordinary business habits. For the work of partially disabled soldiers much more of this kind of organisation will be required, partly to arrange the necessary preliminary training, partly to carry on the work as a business concern. It would be advantageous, and in some cases necessary, that at least one of the members of a Committee of this kind should have had a business training, since any enterprise of this type will not obtain a considerable turn-over unless it enters into ordinary trade competition, and one element in success will be the diagnosing of demand and the ordinary routine of business.

Home Industries.—As to the type of industry which could be started with fair prospects of success, the existing difficulties and the expense of rural transport limit the choice. Hence village industries of this type are confined at present to those goods which can be packed in small bulk, or the value of which when completed is large enough to stand high cost of transport. Where, in addition, there is a basis of artistic perception certain industries result. Thus the lace industry at Tarbert, Loch Fyne, has been successful in obtaining many prizes at exhibitions, and the lace made by the workers finds a market. Naturally when a reputation has been built up orders are secured with less difficulty. Wood carving seems to offer possibilities, especially in the form of objects to be worked up elsewhere, as for instance parts of carved furniture. Inlay and marquetry work falls in the same class. Fairly successful local industries have been established elsewhere in hammered and beaten metal work and in bent iron work. In these cases design is exceedingly important, and must be supplied by those who organise the industry. Enamelling has been tried in several places, and also book binding, but the market for both would appear to be limited, since the latter would apply only to the intermediate class of whole or half bound books in leather, excluding these with very difficult tooling which fetch the highest prices, as much as £100 a volume being paid in London at present for specially elaborate work.

Scotland has particular advantages for the work just described. It has been proved in the dyeing of tweed that the workers have a keen appreciation of harmony of colour, and the lace workers have shown great delicacy of manipulation. With this foundation on which to build much could be accomplished, and it might be expected that more could be achieved by the Home Arts and Industries Association, which has reached an established position. Certainly, particularly as regards disabled soldiers, much can be effected where there is determination and natural ability even in spite of physical drawbacks. A case quoted in the *Report on Home Industries in the Highlands and Islands* should be encouraging to all those planning industries for disabled soldiers. It was that of Mr. James Omand of Kirbuster, near Stromness. "He was formerly a school



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teacher, but became bed-ridden when a comparatively young man. He took up the making of good violins copied from the celebrated models of the past, and worked at this occupation as his strength permitted him. The venture met with marked success, and diplomas were obtained at the Melbourne Exhibition in 1898, at the Edinburgh Exhibition in 1890, at the Glasgow National Trades and Industrial Exhibitions in 1895-6 (and also a bronze medal), at the Glasgow East-End Industrial Exhibition in 1908. Altogether Mr. Omand estimates that he has made nearly two hundred violins. These formerly sold at £6 to £7 each, but of late (*i.e.* 1912) the price has had to be reduced. A case of this kind should afford a most encouraging example to those who have to contend with great physical disabilities. It would seem that the difficulties to be faced were almost insuperable. With strength for only a few hours' work, which had to be done in an almost recumbent position, a person whose occupation had previously been teaching set himself to learn a handicraft which demands not merely great dexterity but a high degree of artistic perception—and all this in a cottage on a lonely hill side, three miles distant from the nearest town."

Under the limitations of present transport arrangements there is a number of industries which require dexterity, but not an artistic faculty. Watch and clock making has been suggested. It is carried on as a rural industry in Switzerland with very great success. The Swiss watchmakers are so highly skilled that a determined and sustained effort would be needed to recover the home trade, and much would depend on whether the import duty of 33⅓ per cent. *ad valorem* were retained. Other industries in this class are the preservation of fruit and vegetables (an industry which has developed during the war, and which may, as a result of improvements, extend in colonial and foreign markets), hand-made carpets and rugs, leather dressing, pottery, printing, perhaps paper-making, the making of golf clubs, cricket bats, fishing flies and other requisites for games and sports, toy making and others.

If, as a condition of closer settlement, rural transport is improved, and especially is cheapened, the range of rural industry is capable of extension. Larger and heavier goods are capable of being produced and sold. Furniture making has been suggested in this connection, and the working up of Scottish oak for this purpose might possibly be revived. The making of Orkney chairs and Prince Charlie chairs for some years before the war was to some extent a tendency in this direction, though both of these depended for their popularity on a special design, and they should perhaps be classed rather with basket work or straw work than with furniture making in the strict sense of the term. There seems a possibility that the working and carving of Skye and other native marbles might be developed. Further, under the conditions now under consideration, a heavier type of metal work than that already discussed might be undertaken, In fact there is considerable scope for any industry which is mainly hand work or which, alternatively, requires only small power, and that can be carried on by a single worker or a small body of workers, always provided that the work can be organised, and that transport is efficient and reasonably cheap.

WOODLANDS AND WOODLAND INDUSTRIES IN RELATION TO SMALL HOLDINGS.

JOHN SUTHERLAND.

PART I.

A self-supporting holding—*i.e.*, a holding of a size sufficient to occupy a family fully—is a desirable subject. It affords scope for energy and initiative, but even such a holding has its limits as the family grows in number and age. By a self-supporting holding is meant a small farm requiring, for the cultivation of it, two horses—"a two horse place"; it may consist of 50 acres of arable or of 1500 acres of pasture, or of a combination of arable and pasture within these limits of extent. A holding of less than 50 acres of arable, if there is a ready sale for market garden or other produce in the vicinity, can be self-supporting. Such holdings in Scotland have hitherto been occupied only by a relatively small body of agriculturists. They are expensive to equip with buildings, whether established by landowners or by the State They have not infrequently been the stepping-stone of the industrious to the larger farms, but when vacated they have unfortunately sometimes been merged in adjoining holdings. In Scotland recent official figures convey the information that the whole extent of arable land is 3,360,562 acres. Even if it were possible to sub-divide all of it into 50 acre holdings, the net result would be only about 67,000 holdings, whereas at present we have 50,612 agricultural holdings of from 1 acre to 50 acres, 5571 from 50 to 75 acres, 17,640 from 75 to 300 acres, and only 2563 of 300 acres and over, or 77,440 holdings in all. These figures include pastoral and arable subjects, and of course it is possible to increase the number of holdings over the whole country by the sub-division of permanent grass land and hill ground; but the fact remains that the extension of settlement depends largely on the creation of holdings which require the support of other industries. There are economic and other reasons for not sub-dividing all the hills and low pastures into small farms, and it is not possible to make any estimate of the number of self-supporting small pastoral farms which could be formed in a general scheme of sub-division. For farms of large and of medium size there are reasonable arguments, and it is not believed that it is desired to obliterate them altogether. The large farm, fully and scientifically cultivated, probably yields, acre for acre, a larger crop than any other type of place. The multiplication of several large farms in one tenancy is, however, undesirable, since it establishes a monopoly of land among a limited class.

This prelude seems necessary for the consideration of the subject of this paper, if only for the purpose of showing that Scotland can provide only a limited number of self-supporting holdings. Moreover thousands of men do not want self-supporting places. They require a home with one or two cows or other stock and a small area of arable land. Limited capital, moderate ambition and

other social and personal reasons combine to this effect; but places of the lesser kind cannot occupy a man's full time, neither can they maintain his family in comfort, and he must therefore find a further outlet for his earning energy.

The gradual drift of the younger rural life to the towns for many years prior to the war was a source of grave anxiety, and it became so prevalent in certain districts that little, if any, extra labour for harvest or cropping could be secured. Apart from the "call" to the towns—a call engendered by better wages and the attractions afforded by the cities—the young people went away because they saw no outlook for them at home. In the highlands, except for fishing, there is little in the way of industry other than agriculture. There is nothing to give the rising generation hope that they can form homes for themselves—the shops of the country blacksmith, the local joiner or shoemaker were all they were privileged to see of home industry. The want of rural industrial development has been one of the most direct causes of discontent, for how can anyone in a holding valued at £2 or £5 or £10 per annum expect to live and bring up a family. Could it matter seriously whether the land was exempt from rent altogether? When the interest in life is so circumscribed it cannot be wondered that grievances were rife and that depopulation was on the increase. To stem this tide of youth to the cities and to make country life more stable, we have to look for industries which can flourish in the country. This is peculiarly necessary in those districts where facilities of transport are indifferent, and where the capacity of the land both for crop and for stock is limited. While there are good water powers in the highlands, they have not been developed, and in such outstanding instances of the harnessing of water energy as have been accomplished by the British Aluminium Company at Foyers and Leven, there have been many difficulties to surmount. Many years ago an effort was made to induce the manufacturers of tweed to open factories in the north of Scotland; but the response was that they could not risk going so far away from the recognised and established producing centres. Other industries have been discussed and some have been encouraged, but they have not so far been of vital and general utility. To serve the purpose properly, employment must be reliable and regular. Some of the population should be engaged all the year round, and others must know that at certain seasons they will be required. To a small holder and his family such a certainty would make all the difference. To meet this need forestry and wood industries would make an important contribution—partly immediate and partly in the future, and it is certain that the effect of capital expenditure by the State upon afforestation would be immediately apparent in the life condition of the people. The highlands of Scotland, both northern and southern, contain most desirable areas for afforestation, and the suitability of the soil and of all other essential conditions cannot be confuted; in fact it can now be maintained from actual investigation that certain species of trees such as Larch and Scots Pine will grow with greater vigour and give better results financially than in any other country in Europe. It so happens that the land which can be afforested has not increased in value in consequence

of the war, and that it can be acquired at moderate and economic rates either by purchase or by lease.

It is not the object of this paper to advocate the raising of forests, or to support the many and valuable contributions which have been made in this connection by others, but it may be permissible to lay emphasis on the fact that all the work is in the open and in the country. It may therefore be claimed that the capital devoted by the State to afforestation, apart from being, as is confidently believed, a sound investment, will yield a far higher return in the vitality and health of the nation.

Labour for Afforestation.—The initial stage in which employment will be made available for the rural population will be in the actual creation of forests. For the purpose of this paper a unit of 10,000 acres is first taken as an example. An area of this extent should preferably be in two blocks of say 5000 acres each, but it could also be composed of several separate blocks of smaller extent. Instead of elaborating the case in detail the following figures are worked out so that the amount of local labour required annually may be clearly understood. The estimate does not include either plants or material of any kind, and is based upon rates of wages now ruling. Of course all estimates are liable to criticism and individual schemes will vary materially, but an effort has been made by comparison of different schemes to arrive at a fair average.

Labour Costs.

1. Fencing,	...	£6,000
2. Draining,	...	3,000
3. Road-making,	...	1,500
4. Planting,	...	19,000

£29,500, or say £30,000.

The labour required as detailed above covers a period of years. It relates only to the creation of the crop, but the adage "once forest always forest" must be applied, and the permanence of forestry work in the area is implied. If therefore the State afforest 10,000 acres a year, almost 600 people can earn £2 per week on an average of 26 weeks every year, but this is by no means the limit of employment, for foresters and foremen will also be required all the year round, and there will be horse haulage of material which will bring in money to the coffers of holders. The ramifications of all sources of employment cannot be adequately described, but the advantages which will accrue through the creation of the industry over separate localities may, it is hoped, be partially visualised. These figures will be multiplied with the expansion of afforestation. The important aspect, that of providing certain and unchanging employment, has already been mentioned, but it is a further element of satisfaction that in the development of afforestation labour forms about 50 per cent. of the whole capital expenditure. In addition the labour is just of a type which can be performed by persons engaged in agriculture—the spade, the pick and the axe all are readily wielded by the small holder.

Departing from the initial process of forming forests, we come to trace the extent to which the growing of wood can otherwise foster industrial employment in the country. The first stage will be in the nursery.

Seed Collection.—For rearing plants, seeds must be collected. For the growth of willow and of poplar, cuttings have to be prepared, but as the propagation of them must be a gradual development, it is proposed to leave them out of consideration for the present, and point only to their cultivation as an important asset in future. In the past, unfortunately, we have been content to invest in large quantities of foreign tree seed, and for certain species this will have to continue, but as it is recognised from experience that British coniferous trees yield excellent results, the use of them should be universally encouraged. For planting coniferous forests extending to 10,000 acres, 15,000 bushels of cones will be required. The collection of these cones will employ 120 persons for 4 months every year. Very small skill is required, and a short period of instruction will suffice to make the collectors understand the difference between a bad and a good cone.

The cones have subsequently to be kiln dried and the seed extracted, all of which will be done at established centres. To suggest any definite number of centres would be premature, but it will not fail to be substantial, as continuous careful treatment in the kiln, the granaries and in packing is required. The forest seed industry in Denmark, France and Germany has been a large and remunerative one, and our dependence upon supplies from these sources should gradually cease if the industry is sensibly treated at home.

Nurseries.—The nurserymen in Scotland estimated that they could produce 120,000,000 to 150,000,000 forest plants a year. This was on a pre-war basis, and for the supply only of private owners. But under recognised State afforestation the expansion of this trade should easily be trebled in a few years, and the employment available under it may be indicated with some certainty. In this case the unit of annual planting of 10,000 acres is again taken as the foundation of calculation. For this area, making due allowance for losses and contingencies, 40,000,000 plants should be produced each year. To raise them a seed bed area of close upon 30 acres will be used, and for transplanting operations from 160 to 200 acres will be occupied. When both are in full crop the yearly expenditure in labour will not fall far short of £30,000. In this work women can be employed extensively. If wages are taken at an average of 40s. per week, 1250 people will get at least 12 weeks' work. In actual experience the employment will be partly whole time, as for example in superintendence, but the limit of occupation is not by any means exhausted in actual trade development, because tools and packing material would be utilised and road and other transport required for the enterprise. Nurseries would not infrequently be formed on or near the actual site of the plantations, so the labour would be well distributed throughout the country. It is expected that the example of the State in afforestation will give encouragement to both nurserymen and planters, and that this expansion

of this branch of forestry will be pronounced at an early date. Indications of activity are in fact already observed.

Forest Products.—Beyond the establishment of woodlands, forestry has, however, a wider commercial importance, since the industries which are allied to the forests will bear fruit of a valuable kind. These industries may be divided into two classes, the larger being the provision of timber and of timber products in quantity, and the lesser,—equally important in relation to holdings,—the manufacture of those articles which can be made in or near the home, and which, with helpful organisation, can be placed on the market.

Pitwood.—In the afforestation of this country it will be desirable to give thought to the production of timber for mining purposes. Apart from the advantageous effect upon the industrial side of the subject, to which reference is made later, it is especially necessary to obtain as quickly as possible some financial return for the capital to be invested. Hitherto the universal view of those who had given a modicum of attention to the subject was that no real return for any timber crop was possible for about 70 years. On the other hand it is quite probable that good returns can be secured in less than one-half of this period if the proper species of trees are planted in suitable soil. Clear felling of plantations at 25 or 30 years should yield to the private owner or to the State a fair interest for the investment, and the turnover from the same ground will be at least twice as much as under the longer rotation. It will also double the employment, for crops will have to be felled and marketed and the cleared land will have to be replanted.

To reach some reliable estimate of the labour requirements in relation to pitwood is not altogether an easy process. The want of standardisation in weights and measures in wood leads to many mistakes, but the following figures are approximately accurate In 1913, 580,314 tons of pitwood were consumed in Scotland, and of this quantity only 104,818 tons, or 18·3 per cent., were produced at home. Last year (1918), 697,291 tons were consumed, and the whole of it was cut and manufactured here. This exemplifies the possibilities of home production. Some inroads into our woodlands have been made during the war, and we cannot, without imported wood, maintain the requirements of the mines during the next 20 years, but if systematic forestry operates at once we could possibly meet the demand after that period. The felling, peeling, handling and delivery on rail of say 600,000 tons of pitwood annually would employ roughly 7700 people full time, or if, as would be the case, the work were mainly done over half a year, 15,400 people would have occupation for this period. This branch of woodland industry does not require great skill—it has been undertaken successfully during the war by men and women without any previous experience, and it will be a regular asset to the rural population. Of course it does not follow that 600,000 tons will be the limit of production in Scotland, because much larger supplies are required in the mining regions of England, which market would also be open.

(*To be continued.*)

RURAL HOUSING.

JOHN A. W. GRANT.

IT will be readily acknowledged that the difficulties that lie in the way of anything like an immediate general improvement in rural housing conditions are very great. Some of those difficulties are applicable to all parts of the country; others arise only in particular districts. As a rule, however, it is just those obstacles of a general nature that will be least easily surmounted. For instance, let us take the financial implications of a policy which aims at providing suitable and sufficient house accommodation for the whole rural population. In the first place it must be noted that the cost of building a house now will be at least double what it was before the war. Who is to find the necessary capital for a comprehensive scheme? In the past, landlords have been accustomed to bearing the cost of putting farm-houses on their estates, but now they are faced with the same problems as have driven private housebuilders in town and city to invest their capital elsewhere than in house property. The consequence of this cessation of private enterprise is the entrusting of housing schemes to urban local authorities. In the case of rural housing, the position of the local authority is somewhat different. The charges falling on the rates levied by a rural local authority through an extensive scheme for re-housing farm-workers would not bear the same proportion to the total rates as similar charges would to the rates of a town or a city. Consequently the burden of taxation would be relatively more onerous to the rural ratepayer, who would not himself benefit by the special improvement. If the local authorities are to take in hand schemes of rural housing, it would appear that the State must offer them considerably more financial assistance than has been given to urban local authorities.

The financial aspect of the problem is even more difficult if we go on the assumption that landlords will take the responsibility of improving housing conditions. The rate of interest is so high, and is likely to remain so, that it would mean continual loss for any landlord to borrow as extensively as he would require for re-housing his estate. Landlords themselves clearly recognise this.

There is another important difficulty—that of the relation of rents and wages Notwithstanding the recent general increase in the wages of agricultural workers, it is probable that in the great majority of cases they would not be able to pay an economic rent for houses built at more than twice the pre-war cost. Obviously there are only two solutions of this difficulty: one is for the State to make good the loss involved in charging a "losing" rent; the other is a further advance in wages.

The other difficulties referred to are perhaps not so vital, but they are not negligible. They are concerned mainly with the locality in which houses are to be built, and turn eventually on the question of transport facilities. In mainland districts situated at some distance from a railway or from the sea there is an appreciable addition to the cost of material through carting and similar expensive charges; while, in the islands, freight costs bear a wholly disproportionate relation to the cost of material. Generally

speaking the lack of means of communication and the inaccessibility to sources of material result in forced restriction of house-room and of desirable conveniences.

It is the object of this article, however, to deal rather with the rural housing problem from a technical point of view; to outline the considerations to be borne in mind in the choice of sites and the selection of types of houses; and to show how most of the errors that have contributed to the present state of matters may be avoided.

Site.—It cannot be said that much care has been shown in the past in the selection of building sites in rural districts. The evidence points on the contrary to an arbitrariness which it would be very difficult to excuse on any ground. To place a house in the immediate shelter of a rock may serve to counter the cold blast; but dampness and the absence of sunlight are usual accompaniments which far outweigh any advantage. Were it not for the testimony of the eyes, it would seem almost superfluous to advise that, in the choice of a site for a house or a block of houses in the country, the essential considerations are those which provide for a dry soil, for openness to the sun, for protection from wind and rain and for proximity to a supply of water which may be utilised in the house. In country districts there is ordinarily a large amount of freedom of choice in determining sites; but even where freedom is limited, as in the case of single houses for a special purpose such as accommodating shepherds or cattle-men, there is still sufficient latitude to avoid the evil consequences mentioned above, if not actually to secure the best conditions.

Single houses for special purposes such as are referred to in the preceding paragraph are to a large extent unavoidable. But it is desirable that, wherever possible, some attempt at erecting houses in groups should be made. In addition to a saving on the initial expenditure, it will be found that to group houses together will mean that a more effective use can be made of such conveniences as drainage and water supply. Much attention can in general be profitably directed to investigating in particular localities the combination of natural conditions which makes for the best site for houses.

Villages.—It is, however, in the planning of villages that the future holds out the greatest possibilities. Among the many advantages to be gained by the grouping of cottages in villages may be mentioned the benefits of public services such as drainage, water and lighting, and in the near future with the development of the water power resources of the highlands, it may be possible to supply electricity in villages which will considerably reduce the amount of labour in the house. There are also the benefits of social amenities such as the village hall and club, school, church and shop, and playgrounds for children. The dullness of the rural labourers' life is in part responsible for the depopulation of rural districts, and it is of first importance that something should be done to make the life of the workers attractive.

If we take for example a village in which it is proposed to build about two dozen houses, it will be advisable to acquire

several acres of land and group the houses round quadrangles or round a village green. If the village does not possess a hall and club, a space should be reserved for this purpose at some focal point of the group. The question of arterial roads through villages is a matter that requires consideration. It is unfortunate that in many of our existing villages this point has been neglected in the past. The houses on either side of a main traffic road should be placed well back, and a distance of at least 150 feet should be kept between the houses to allow the road to be widened should necessity arise. At the present time there are opportunities of remedying many of the errors of the past and taking steps to ensure that these will not be repeated in future; and in this connection it is important that the plan of the whole village should be considered wherever it is proposed to go on with a housing scheme, keeping in view the future development and the possibilities of improvement that might arise. The need for care in development is just as essential in the case of rural villages as it is in the towns.

It is probable that the encouragement of rural industries will form part of the programme of reconstruction, and as this will necessitate the provision of numerous new houses in existing villages and possibly the creation of new villages, it is of importance that the planning of the sites should have the most careful attention. The expense of having this done is so infinitesimal compared with the advantages gained that it would be inexcusable to neglect it.

House Plans.

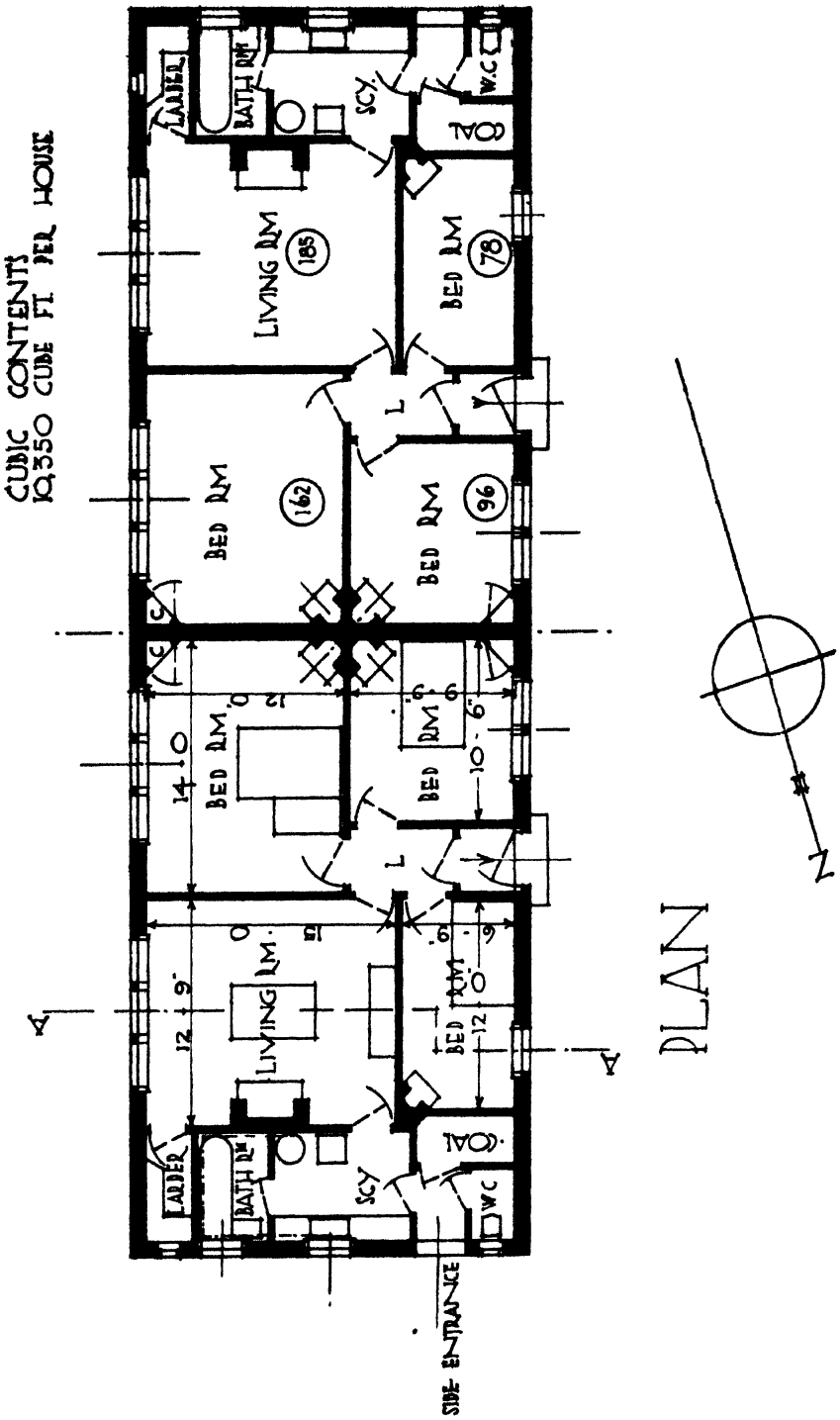
The essentials in the planning of a good house are health, convenience and appearance, and at the same time the importance of economy should be kept in view.

Health.—Dealing with the first of these essentials, that of health, the Scottish Housing Bill proposes to fix, with certain exceptions, a minimum of three rooms and scullery for any new houses. This is certainly a step in the right direction, but, in the opinion of the writer, it would have been desirable to have fixed the minimum at four rooms. It is obvious that it will be impossible to separate the sexes where a family of boys and girls are living in a three apartments house, unless the living room is used as a bedroom as well. The use of the living room for sleeping in is objectionable under all circumstances, but more especially so in rural cottages. In a house in a town a large part of the work usually performed in the living room can be relegated to the scullery, owing to the facilities available for cooking by gas; but in a rural district under present conditions the cooking has to be done in the living room owing to the expense of having two fires going in the winter time. The chief objection, however, is the lack of privacy, and the unwholesome atmosphere which is prejudicial to health. In many of the cottages in rural districts, especially in the highlands, windows are not made to open, except the lower sash, when they have two sashes. In many cases the window is a fixed sash, so that there is no means of ventilation. The writer has come across numerous instances where the windows

are of the sash and case type, but the top half is permanently fixed, and the lower part can be kept open only when propped up with a stick, owing to the absence of weights and cords. It is important that the windows should be double hung as a help towards ventilation. Casement windows, while they may be more pleasing in appearance, are very unsuitable in exposed districts, and cannot be regulated for ventilation as conveniently as hung sashes. Most cottages will have to depend on doors, windows and fireplaces for ventilation. Careful planning is therefore necessary if draughts are to be avoided. At the same time experiments should be made with some simple form of ventilation to ensure a supply of fresh air when the windows are closed. It is almost unnecessary to mention the importance of adequate damp courses and laths and straps in the case of stone walls to prevent damp. It is, however, important that care should be taken to prevent damp walls if built of stone, brick or concrete. It is a notable fact that the number of existing rural cottages with dry walls is comparatively small. Very little attention has been given to the necessary matter of providing against ground damp. In most town areas the bye-laws insist on the area occupied by the building being covered with asphalt or concrete, and this is quite as necessary in the case of rural cottages.

Another essential point is the provision of sanitary conveniences and a supply of good water. The importance of a larder should also come under this head, as it seems to have been neglected in the past. The larder should have an area of at least 150 square feet and be provided with a window, the top part of which should open inwards, with a piece of wire gauze fixed on the outside to prevent the access of flies, etc.

Conveniences.—It is becoming more generally recognised that by careful planning of workers' cottages the labour in the house can be considerably reduced. The plan shows a cottage for rural workers arranged on one floor. This house has three bedrooms, living room, scullery, bathroom, larder, W.C. and coal store, which is the minimum accommodation desirable. The advantages of having the house arranged on one floor are many; *e.g.*, in the case of illness, there will be less work in attending the invalid, and also less work in keeping the house clean. In this case the cooking will be done in the living room unless gas is available, in which case a gas cooker could be provided in the scullery This convenience is seldom to be found in rural districts at present. The arrangements of the living room fireplace and scullery fittings allow a hot water installation to be provided at a very moderate cost. In the case of two houses in course of erection the cost of the hot water system supplying bath, sink and tub is only £9 per house at present day prices, and when consideration is given to the amount of labour saved by this convenience, it will be admitted that the expense is fully justified. This type should be suitable for many districts, as it is economical and conveniently arranged. In addition to the accommodation shown, a small barn should be provided for the storage of garden produce, cycles, etc. It will be found more convenient and less costly as a rule to provide this in a separate building.


CUBIC CONTENTS
10,350 CUBE FT. PER HOUSE
LIVING RM
BED RM
BED RM
BED RM
BED RM
BED RM
LIVING RM
LADDER
BATH RM
SCY.
W.C
GAL.
SIDE ENTRANCE
PLAN
N

The objection to cooking in the living room could be overcome in some cases by having the living room and scullery fireplaces back to back, with the oven and hotplate on the scullery side and a sitting room grate on the living room side. In this way the objection to having two fires would be overcome. The plan shown, however, could not be adapted in this way. It would be necessary to have the scullery larger, and the window would be in the wall at right angles to the range, as the most of the work would then be done in the scullery. The fitting arrangements would require to be improved. In addition to the sink, tub and boiler, a dresser should be provided with enclosed upper part for crockery, etc., and sufficient space for a table for baking and ironing. Space for storing pots and pans convenient to the sink and range and a sufficient quantity of shelving at a convenient height should also be provided.

Appearance.—An attractive exterior does not depend on cost. A cottage with elaborate ornamentation is usually unpleasant, and it will be found that the best means of gaining an attractive appearance is by simplicity of design, careful proportion of doors and windows, and care in selecting the right materials.

Crofters' Houses.—In connection with the provision of crofters' houses, the practice in the past has been for the Board of Agriculture to advance loans for the purchase of material. The crofter did the building himself. The result, although it has effected a considerable improvement, cannot be said to be entirely satisfactory. The houses do not meet all the essentials of health, convenience, comfort or appearance that one would desire. This is due to a certain extent to the smallness of the sum advanced, and the difficulty of insisting on the type of house to be built. The crofter is not as a rule educated on these matters, and believes himself that he has erected a perfect house.

The Royal Commission on Housing recommend that the Board of Agriculture should be placed in possession of £30,000 a year for ten years for rebuilding crofters' houses. If this sum is to be spent, a definite policy should be outlined regarding the type of house to be built. The most satisfactory scheme would be to design a type simple in construction and on economical lines to suit each district, in order that the crofters should have no difficulty with the buildings. A specification of each type should be prepared, and careful supervision by one of the Board's Inspectors should be essential. In the design of the houses, care should be taken to ensure that the materials available in each district are used to the best advantage. At the same time the effects of climatic conditions should be considered.

MÉTAYAGE.

H. M. CONACHER.

MÉTAYAGE is an arrangement common in the west, south-west and centre of France for securing the cultivation of land by the association with the owner of a tenant, who does not provide as

much of the working capital as does the normal British farmer. Nor does the landowner draw his share of the revenue of the land in the form of a fixed rent, but as a part of the gross profits.

Historically the professional capitalist farmer common in Great Britain, if not peculiar to this country, has never played a great part in France. It may be said that there is less room for him because the small farm is common in France, but this might be suggesting a mistaken explanation of his presence in Great Britain —for it is possible that he caused the consolidation of small farms quite as much as the consolidation brought him in. Certainly to-day in Scotland it is he who is largely responsible for such consolidation as is still going on. In France before the Revolution there was a large class of peasant proprietors and a yet larger class of métayers, who indeed were the normal kind of tenant farmers, except that, of course, "farming" in the original sense of the word is just what their "tenancy" or "occupation" of the land was not. They were diminished in number by the confiscation and sale of the estates of emigrés and church lands. They still hold on, however, in the parts of France specified, which happen to be those in which the Revolution caused least disturbance.

The purpose of this article is not to describe métayage simply as a biologist might, as some half rudimentary type of structure, obviously inferior to the higher kinds of organisms which have superseded it. For métayage in recent France has shown great vitality, and, by the testimony of reliable witnesses, has gone far to enable French agriculturists to get through the severe test which the past generation seems to have imposed on the agriculture of Western Europe. Thus the monographs on small property which the French Department of Agriculture published ten years ago noted three Departments, the Indre, Lot-et-Garonne and Morbihan, in which métayage had been gaining at the expense of ordinary agricultural tenancies as against one, Corrèze, in which the converse had happened.

British farming depends upon the existence of a class of professional capitalist farmers and another class of wage-earning labourers. If the former became less numerous independently of anything that happened to the latter, or if the labour of the latter became scarce and dear, the British system might have to be revised. As things are, in certain districts and for certain forms of agriculture, one finds smallish farms capable of being taken by men of moderate capital and worked by the farmer and his family, relying but little on hired labour, the more common unit of production. If this arrangement became more common in this country the extended class of small farmers would be recruited presumably largely from the sons of existing small farmers or from wage-earning labourers. In either case the new candidates would at first probably be handicapped by lack of working capital, and some agency—the landowner, whether private individual or public authority—would have to find part of the working capital, just as at present the landowner finds the fixed capital. He might still do this and yet not enter into a contract of métayage with the tenant, preferring instead either to get a fixed annual payment for the use of the working capital, just as happens on certain "fell" sheep

farms in Cumberland and Westmoreland, where the stock is bound to the farm and logically belongs to the landowner.

If, however, the new class of tenant had neither the capital nor the professional skill of the large farmer—and manifestly these things tend to go together, and the large farmer is what he is by his skill in buying and selling as well as in actual cultivation and rearing of stock—the landowner, finding a considerable share of the working capital, would have to intervene directly in order to assure himself that the working capital was being wisely and fully used. Out of this set of relations a profit-sharing arrangement would naturally arise. The whole scheme works in France largely because the landowner himself is usually a man having a moderate estate and residing regularly on it. It could not be worked by an absentee landlord or on an estate too much ruled by lawyer factors. The owner must be an absolute owner—in France all attempts to work métayage through a middleman or tacksman seem to have failed. Strictly speaking the profits are shared equally between the two partners, who also hold equal shares of the stock, the landowner finding the land and permanent improvements, and the métayer the labour and implements. In many cases the métayer pays a rent for his house and garden—thus reducing the subjects forming part of the métairie more narrowly to the actual agents of production.

It is curious that statistics of land under cultivation in France in 1882, as quoted by Mr. H. Higgs in an article on métayage in Western France in the *Economic Journal* for March 1894, show the average size of holding in the case of métairie as rather larger than the average size of leased holdings, and much larger than those of peasant properties. The figures are 13·04, 11·94 and 4·48 hectares respectively. The smaller average size of peasant properties is doubtless due partly to division on inheritance. It is said that in districts where in recent years landowners have created métayer tenancies on their estates, the sizes of these new holdings have varied from 30 to 80 acres, which means that they are not "small holdings" as the expression is used in France. It is said that the system on the whole promotes and does not hinder improvements. This statement should be considered with reference to the effect of the law of fixtures, which so long as it is maintained without modification in any country tends to make it difficult for ordinary tenants to execute permanent improvements. In Great Britain the Agricultural Holdings Acts have tended to a certain extent to correct the prejudicial effect of the law on the improvement of land.

At the best, however, it would hardly be contended in favour of métayage that it is superior to the normal British system under which the tenant farmer finds the working capital, pays a rent for the use of the fixed capital and hires labour, having a general discretion in the manner of working the farm. In France the métayer tenant seems in many cases to look forward to being in a position some day to be in the normal position of the French agriculturist, viz., the owner of his own farm. One does not look forward to private owners of land in this country creating métayer tenancies on their land.

The conditions under which métayage has been resorted to on an increasing scale in France in recent years have, however, their parallel in those under which the land settlement of ex-soldiers is likely to be carried out in this country. Many of the new settlers will not have enough working capital to enter into an economic holding—and there are obvious reasons why the creation of non-economic holdings should not be encouraged at the present time. Many of them too will not have the same experience in farming as the normal occupier of an agricultural holding. Under these circumstances there seems an opening for the State, acting through a Public Department, to enter into arrangements for creating métayer tenancies upon land acquired for settlement. Through its officials it can undertake the share of the management for which in France the landowner makes himself responsible. Similarly it can supplement the working capital of the settler. Further, a co-partnership of this kind could be made useful for ensuring provision against the depreciation of capital, from which those are likely to suffer who are entering upon agricultural holdings for the first time at the present day. The high profits of the first few years may be directed partly towards providing against the depreciation. In Scotland, where stock raising must be the main part of the business of new settlers on the land, this consideration is of importance, since it is through a decline in the value of stock that the depreciation of capital will mostly be felt; nor need the contract of métayage be looked upon as a permanent arrangement. It could be contemplated from the outset that the métayer in time would save enough money to buy out the Government's share in the working capital, and thus become an ordinary agricultural tenant.

IMPROVEMENT OF RURAL TRANSPORT IN SCOTLAND.

A NUMBER of interesting suggestions and recommendations for the improvement of means of transport in rural districts is made in the Report of the Rural Transport (Scotland) Committee which was recently presented to Parliament. The question of improving means of communication in country districts has an important bearing on all schemes of agricultural development in Scotland, and in particular on those in the more remote districts of the country.

The Report of the Committee examines in detail the areas where agriculture, forestry, fishing and other rural industries could be developed by the provision of light railways, motor transport services, or improved steamer services. It also contains interesting and illuminating sections dealing with the principles which determined existing communications in Scotland, and showing how the existing scheme has gradually developed, and wherein it is incomplete. The development of a system of roads in Scotland is of comparatively recent date, so much so that "a few years after the Revolution it was found less inconvenient to send goods of bulk from the Baltic to the East of Scotland than to convey them

from Glasgow by road. In the middle of the 18th century goods were carried from the Clyde to Edinburgh in baskets on horseback, and even about 1760 the rudest type of wheeled cart was only beginning to come into use in the Lowlands." These facts indicate the immense amount of work which had to be done in the latter part of the 18th and during the 19th century in providing the country with an efficient system of highways, which is in great measure the work of those great road and bridge-makers Macadam and Telford.

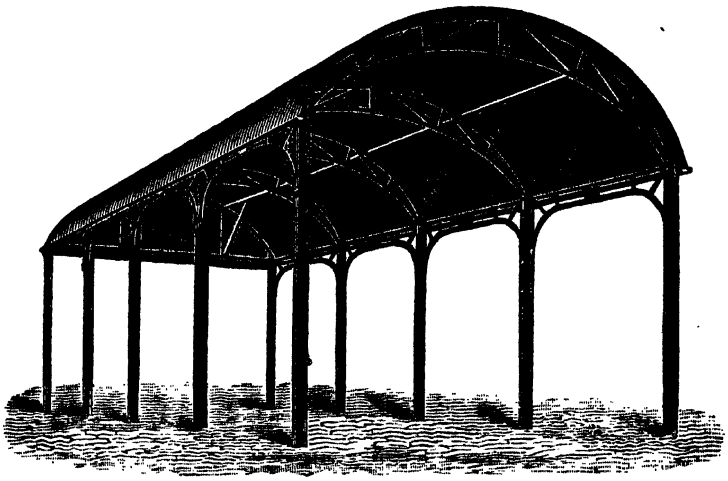
The Report deals at length with the problem of transport improvement as it presents itself in different districts. In the lowlands, northern and southern, a system of transport exists both by rail and road which, while it compares favourably with that of any similar areas in the Kingdom, is still capable of improvement. Here the recommendations of the Committee are "by way of making good minor deficiencies in what is otherwise a tolerably complete system of communications." In the western highlands and islands and in many of the straths and glens a different state of affairs prevails, and the Committee feel that the remedy proposed resembles "the raising of a new structure on an existing foundation." In dealing with these latter districts, the inhabitants of which are severely handicapped by the lack of reasonable transport facilities, the Committee appear to have been impressed with the necessity for exceptional treatment, and express their views as follows:—

"We take the broad view that there is a national duty to provide every community with reasonably convenient means of communication. The fact that people have settled in isolated districts implies no fault on their part; with limited facilities, they are endeavouring to utilise the resources of land and sea, and in this they are giving effect to national policy, and are entitled to claim the utmost assistance the State can afford. In considering what assistance is possible, it would be too narrow a view to look merely for a direct pecuniary return on the capital expended. The indirect return is important—the increased production and better diffusion of wealth, and more than these, the growth of intelligence, efficiency and contentment in the population. We press this view the more strongly as it accords with the national aspiration that, wherever capacity exists, there also should be given opportunity for its fullest development."

In the section of the Report dealing with transport by rail an interesting comparison is made between Scotland and other small maritime countries as regards their mileage of railway in proportion to population. It will probably surprise many to learn that Scotland comes after Sweden and Denmark in the comparison, and is only very slightly ahead of Norway, the mileage of railway per 10,000 of the population of the countries specified being, Sweden 16·2, Denmark 8·5, Scotland 8·2, and Norway 7·9. Belgium and Holland are excluded from the comparison owing to the prominence of canals in their system of transport.

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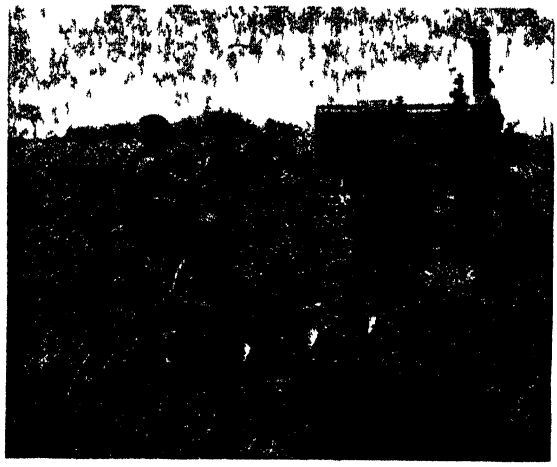
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of conveyance are to be found in every district of the country. On behalf of the former are urged its greater carrying capacity, regularity of running, and suitability for conveyance of perishable produce. The advocates of motor transport point to the high degree of flexibility of that system, and to the smaller capital outlay involved in its establishment in a district, as compared with the cost of constructing a light railway. The Committee consider that both systems can play an important part in the development of rural industries, and indicate the considerations which have led them to recommend the adoption of one or other system in the districts which they have visited. Motor traction has its limitations where the traffic is heavy or has to be carried over a long distance, and where the road system is defective. In this connection the conclusions are quoted of the Great North of Scotland Railway Company, which for some years has been using motor transport as a feeder to its railway system, namely, that "while these motor-omnibus and steam-lorry services have improved the means of transport they do not allow of the traffic being fully developed, and have probably only postponed the demand for railways." From this point of view motor transport might be described as a rudimentary form of branch line. It develops traffic, and when a time arrives at which the increased volume of the traffic has become greater than can be dealt with effectively by this method, the railway extension follows naturally and necessarily.

In some districts the motor traffic, without reaching such volume as would justify the construction of a railway, may impose an excessive burden on the district for maintenance of roads. The remedy suggested by the Committee in such cases is the construction of concrete wheel tracks for motor traffic laid on or by the side of the existing roads. As the suggestion has not been tested by actual experiment, the Committee recommend that a stretch of road at some suitable centre, easily accessible and connecting with a main railway line, should be laid with an experimental track on which tests could be carried out.

In rural districts served by a motor transport system the higher rates charged for conveyance of passengers and goods, as compared with the cost of conveyance over equal distances in other areas by rail, have proved inimical to rural development. On this point the Committee make important recommendations which we quote in full:—

"If motor traction be regarded as supplementary to the railway system of the country the rates charged for that service should be uniform with railway rates. Just as a branch line is not considered independently as regards rates, so motor services (being rudimentary branch lines) should charge such rates as would be charged on an equivalent extension of the railway. By this method all the small communities which must depend on motors for the carriage of goods would have the same advantages in regard to rates as other places which are supplied by railway, and a district that was being developed would not suffer in the initial stages through the high rates it would be necessary otherwise to charge during the time traffic was being built up if it had to rely on an independent motor service. Further, the institution of through rates

and fares for combined services by motor and rail, or even by motor, steamer and rail, would be advantageous to all forms of rural industry. The adjustment of rates for motor services would go far to satisfy local demands for railways which would in all probability involve considerable losses in working. At the root of the demand for such railway construction there is often the comparison between fixed railway rates and higher motor rates in the particular district. The element of hardship in such cases would be met by a system of standard motor rates, which should not be higher than railway rates for comparatively short distances when the cost of cartage to and from the railway is taken into account.

"While this adjustment would to some extent meet the needs of the case, it is not overlooked that motor services would impose an increased strain on the roads, the efficiency of which varies greatly in different districts. In many cases in the Lowlands the roads generally are good, and, apart from minor improvements, such as easing relatively sharp turns and strengthening bridges, are capable of carrying the new traffic. No doubt this would involve increased charges for maintenance, and this point has been taken into account by the Convener's Committee of the county of Roxburgh in deciding in favour of this form of traction as against an extensive system of light railways in that county. We quote the following extract from the Committee's memorandum, 'With the exception of the new railway above indicated, the Committee are of opinion that rural transport would be possibly better developed in the county by means of an increased number of motor and steam lorries and tractors, which have the great advantage over railways that they minimise the hauling of goods from the farm to the station and *vice versa*. . . . The Committee are aware that much additional wear and tear of the roads would take place, but they regard this as inevitable, and probably not more expensive to the rates than would be the burden of an extensive light railway system.'"

Narrow-Gauge versus Standard-Gauge Light Railways.—An interesting section of the Report is devoted to a discussion of the relative merits of narrow-gauge and standard-gauge light railways in rural districts.

The conclusions of the Committee are as follows:—

"Where the proposed railway connects with an existing standard-gauge railway in a poor country it has been found that the greatest economy is secured by constructing the lightest line possible capable of carrying the main-line rolling-stock but with lighter locomotives, and by maintaining the standard-gauge where the branch line is a short one. It is only where the railway is isolated and likely to remain isolated from the main lines, or is of sufficient length in itself to be worked independently of the main line and to create a paying local traffic along its own route, that it has been found desirable to have a break of gauge. Similarity of gauge avoids the expense, divided responsibility, delay, breakage and loss in transhipment from one wagon to another. A break of gauge would be particularly unsuitable for live-stock traffic, and

would result in much of this traffic being driven to the nearest main-line station when being sent to market. Uniformity of gauge has a further advantage in that it permits of the locomotive and rolling-stock used on the line being taken to a main-line workshop for repairs, whereas in the case of a narrow-gauge line it would be necessary to put up local workshops for the repair of the locomotives, carriages and wagons.

"The absolute cost of construction of a narrow-gauge line would be from £500 to £1000 a mile less at pre-war prices than that of a light standard-gauge line, but, having regard to the fact that most of the branches recommended by us are short lines connecting with an existing line of standard-gauge, even this saving in construction would not justify a break of gauge.

"There are no narrow-gauge lines in Scotland connecting with a standard-gauge line. The only lines of narrow-gauge are the Glasgow District Subway, which is a circular underground city line with no connection (gauge, 4 feet), and the isolated Campbeltown and Machrihanish Light Railway (gauge, 2 feet 3 inches).

"In Ireland numerous experiments have been made in the construction of narrow-gauge railways, with, on the whole, rather unfavourable results; but it must be remembered that in that country the standard-gauge is 5 feet 3 inches. Even there the consensus of opinion now is that any extension should be constructed on the standard-gauge.

"We recommend therefore that where a proposed railway has physical connection with an existing line it should be of standard-gauge, while in cases where such connection is impossible or highly improbable, as, for instance, in that of a railway on an island where there is no question of a train ferry, a narrow-gauge line is recommended. A narrow-gauge line is appropriate in the islands, and in the special case of the Loch Eck scheme, where physical connection with a standard-gauge system is impossible. For such lines we would prefer that the gauge should be 2 feet 6 inches, but, since permanent-way material and rolling-stock of 60 cm. (1 foot $11\frac{3}{4}$ inches) may be available from France, this material could be used in these districts. The other lines we recommend should be light railways of standard-gauge, being too short to form efficient narrow-gauge units. Several are intended to deal with the fish traffic, others with the milk traffic, and in these circumstances it is necessary to avoid the delay in transhipments through a break of gauge. In the case of our recommendations of new lines from Turriff Station to Maud Junction in Aberdeenshire and in the Glenkens district of Kirkcudbrightshire, such lines would connect two standard-gauge railways, and in the latter instance would afford an advantageous through route. Therefore to attain the objects in view the standard-gauge would be required.

"Railways of both gauges should be constructed as cheaply as is consistent with efficiency. Where possible the tracks should be laid alongside an existing highway. The train should be run at a low speed, and in most cases the line would be unfenced. The rolling-stock should be adapted to passengers entering the carriages from the ends and at the level of the rails, so that raised

platforms would not be required. Fares would be collected *en route*, thereby dispensing with booking-clerks and booking-offices. Instead of stations there would be 'halts' or stopping-places without buildings, save where sheds were needed for the reception of goods awaiting delivery or despatch. It is recommended that in all cases, with the exception of the proposed line to Lochinver, these rural railways should be worked by one locomotive in steam and thus avoid the cost of signalling. Rails would be spiked to the sleepers, thereby saving the expense of chairs. A rural railway of this type would serve the needs of the district for purposes of development, and its cost would be reduced to the minimum."

Finance.—In considering the financial aspect of their proposals the Committee address themselves to the consideration of three main questions, viz.:—

"(*A*) How far should or must the various sets of services recommended be considered—with respect to their possible remunerativeness—together with the existing transport system of the country?

"(*B*) How far should financial considerations determine the choice of methods of providing communication?

"(*C*) How far should deficits on the working of schemes be made good from (*a*) central, (*b*) local funds?"

As regards (*A*) the conclusions arrived at by the Committee are briefly:—

"That additions to existing systems once made must be treated from the point of view of earning revenue as parts of these systems. Their capital cost cannot well be put on the proprietors of the existing systems, but should all fall on one authority. Again a separate and remodelled system, such as is proposed for the west highlands and islands, must be provided from public funds, but, once provided, should be worked with the general railway system of the country if running expenses are to be covered, and the chief users of it are not to be charged abnormally high rates."

In reply to (*B*) the Committee state that—

"Taking the railways as a whole we are satisfied that the capital cost will have to be met from public funds, and that in most cases not more than a return sufficient to cover working expenses can be looked for. The position, however, is put in a different light if we look on the whole system of transport in the country as unified and managed on the same principles as those on which the Postal Service is conducted. Then the provision of railways for agricultural districts will take its place as making good a defect in the whole system as it has been handed on to us from an earlier generation."

The summation of the views of the Committee on (*C*) is as follows:—

"(1) That so far as the services which we recommend, whether

branch lines or motor services, are extensions of existing railway systems, the attachment of these services to the existing systems will probably enable working expenses, exclusive of interest on capital, to be met more or less successfully without charging the users of the extensions high rates.

"(2) That so far as the services involve a reconstruction of the existing means of communication in the less populous districts, the capital cost and possible deficit in working expenses may have to be met mainly from public funds, but that the appropriation for this service of the existing mail subsidies will help to minimise the further charge on the Exchequer.

"(3) That railways have been recommended in some cases as making up a deficiency in the railway planning of previous generations which might have provided rural districts with more railways as part of a general scheme for dealing with the whole country without a net addition to the total cost of providing lines of real utility.

"(4) That generally the capital cost of services should be provided for from the public funds, and that, in the case of railways, interest on such expenditure is not likely to be recoverable.

"(5) That so far as such services relieve the roads of heavy traffic, Local Authorities may be called upon to contribute according to ability towards making good deficits in working expenses."

Increased Value of Land.—The Committee also discuss the subject of securing to the State or other promoters of improved means of transport a proportion of the increase in value of land caused by the provision of such transport facilities. On this point they state:—

"We are of opinion that there should be applied in the case of all rural transport improvements the principle of betterment as affirmed in the conclusions of the Committee appointed by the Minister of Reconstruction to report on the subject of the acquisition and valuation of land for public purposes, namely, 'as a general principle where the State or a Local Authority by a particular improvement has increased the value of the neighbouring land, the State or Local Authority should be entitled to participate in such increased value.' In practice this principle would, however, be subject to modification in respect of proprietors who make a free gift of the land required in any scheme of improvement or construction.

"We also recognise that in most rural districts, and especially in the Highlands, the owner of the land would probably reap no immediate and direct benefit from the construction of a line of railway, owing to the fact that most of the land through which the line would pass would be held on lease by the occupiers of farms, or would be in the occupation of crofters with fixed rents. In such cases it would be necessary either to forego any attempt

to assess betterment, or if it was so assessed on the owner of the land he would require to be authorised to recover the assessment in an annual sum from the occupier. In several of the schemes also the betterment will, for the most part, be enjoyed by the population resident at or near the terminus of the line, or even by the population of islands within reach of the terminus by steamer. We do not see how in such cases any betterment can be recoverable.

"Under this heading, perhaps, we may briefly refer to another element in a policy of railway construction. A situation might conceivably arise in which a railway having been built with the assistance of public funds with a view to developing a district, the expected result might fail to follow through the unwillingness of the owners and occupiers of the land of the district to make the land available for more productive uses. We think, therefore, that the Government before making a railway through undeveloped territory should satisfy itself in advance through the appropriate Department that its plans will not be stultified. We do not suggest that in the absence of satisfactory guarantees the line should be abandoned, but that, if the public interest justified it, the Government should be empowered to take the necessary steps to enable them to carry through in its entirety the scheme of development, whether agricultural, silvicultural or otherwise."

Administration.—As regards the administration of the proposed new transport services the recommendations of the Committee are as follows :—

"Having outlined the improvements in communication which we recommend, it is advisable to add some observations on the question of administration. The Second Report of the Select Committee on Transport and the Bill for the establishment of a Ministry of Ways and Communications aim at a unification of the transport agencies of the Kingdom. Under such a system it is necessary, in our opinion, that there should be a separate body charged with the control of ways and communications in Scotland. The geographical conditions under which transport is conducted in this country, the remarkable diversity in the density of population (manifesting itself in the existence of two thinly-populated upland areas north and south of the populous midland valley), the comparatively large number of places which must depend on communication by sea, the striking differences in agricultural conditions as between England and Scotland—all indicate that there would be a gain in efficiency if a distinct body were appointed for the control of Scottish communications. In the special case of railways the need for decentralisation has been impressed upon us from two very different points of view. On the one side, it is evident that the extension of railways for the purposes of development is a matter of great importance to the districts concerned, but that the local circumstances in remote parts of Scotland are often distinctive, and are liable to an imperfect appreciation if judged according to the essentially different standards which prevail in England. On the other side, in the north of Scotland railway connections are already dominated by the London service to an

extent which makes it difficult to effect important improvements, and which, in our opinion, is sometimes disadvantageous.

"The functions of the Scottish Department of Ways and Communications which are suggested by our study of the conditions would include such a control of railways as would ensure that the extensions which we have recommended should be constructed, worked and maintained efficiently. It must be recognised, however, that this would still leave great tracts of country and a considerable population dependent on other means of communication. In some cases these must be by sea, in others a considerable increase in motor traction will be required. Each of these, in our opinion, will require somewhat different treatment. For reasons stated in detail, we are of opinion that the steamer service of Messrs David MacBrayne, Limited, should be taken over by the State upon equitable terms, and that this undertaking, as well as the new mail steamer services recommended, should be administered by the authority which we suggest. This method would ensure public control of fares and rates for heavy goods carried by the larger steamers, and also for the lighter traffic of the mail steamers. Similarly fares and rates on the small coasting steamers would also be controlled by the same body, but it would not be necessary that the actual working of these services should be undertaken in all cases by the proposed Department. Subject to its approval of the rates to be charged and the character of the service, the actual operation of minor steamer services might be undertaken by private enterprise, and only failing such enterprise under the conditions specified should the Department maintain these services in addition to those of the mail boats and the larger cargo steamers running to the Hebrides and the West Coast. The case of the steamer service to Orkney and Shetland will be dealt with in our Supplementary Report.

"The Department we propose would also be charged with the duty of organising and, where necessary, maintaining motor transport services. It is only by such control that, in our judgment, the full development of rural industry can be achieved. We consider that an essential element in the use of transport for purposes of such development in the case of Scotland will be unification of control, so that those persons who must depend upon motor services or motor services and steamer services combined, should have the same advantage in respect of rates and fares as will be enjoyed by others who are able to use a railway. In the case of motor services the proposed Department should be authorised either to undertake such services or to authorise private persons to undertake them, always subject to the control of the Department as to rates, fares and other conditions."

The appended table shows the extent of the new services recommended by the Committee. Each proposal is dealt with in detail in their Report, which can be obtained through any bookseller or directly from any of the various branches of H.M. Stationery Office.

SUMMARY OF THE COMMITTEE'S RECOMMENDATIONS FOR THE IMPROVEMENT OF MEANS OF COMMUNICATION IN RURAL AREAS IN SCOTLAND.

NEW LINES OF RAILWAY.

County.	Terminal Points.	Distance.	Gauge.
		Miles.	
Aberdeen	Alford and Bellabeg (Strathdon)	19¼	Standard.
,, ...	Ballater and Braemar	17	,,
,, ...	Turriff and Maud	21½	,,
,, ...	Fraserburgh and Aberdour ...	9	,,
Wigtown	Stranraer and Drummore ...	14½	,,
Kirkcudbright ...	Parton and Dalmellington . .	28	,,
Ayr	Pinwherry and Ballantrae . .	8	,,
Bute (Arran) ...	Whiting Bay and Blackwaterfoot	20	Narrow.
Argyll	Dunoon and Strachur	21	,,
Stirling	Balfron and Fintry	8	Standard.
Ross and Cromarty	Garve and Ullapool	33	,,
,, ,,	Conon and Cromarty	18	,,
Ross (Lewis) ...	Stornoway and Barvas (with branches to Carloway and Ness)	40	Narrow.
Inverness (Skye)	Ardvasar and Dunvegan, and Branches	75	,,
Sutherland ...	Culrain and Lochinver ...	40	Standard.
Caithness	Lybster and Dunbeath	8	,,
,, ...	Thurso and Scrabster	2	,,
	Total ...	382	

Total mileage of standard gauge recommended, 226.
,, ,, ,, narrow ,, ,, 156.

NEW ROADS AND ROAD IMPROVEMENTS.

County.	Location of Roads.	Distance.	Nature of Improvement.
		Miles.	
Aberdeen ...	Aberdeen and Echt and Skene.	15	Concrete motor track.
,, ...	Aberdeen and Newburgh.	14¾	,, ,,
,, ...	Cock Bridge and Inchrory.	4	New road.
Aberdeen and Inverness.	Linn of Dee and Feshie Lodge.	17	,,
Banff	Inchrory and Tomintoul.	7	Strengthening and improvement of surface.
Kirkcudbright	Southwick to Dalbeattie.	12	Widening, bottoming, and improvement of surface.
,,	Dalbeattie to Kirkcudbright.	15	,, ,, ,,

NEW ROADS AND ROAD IMPROVEMENTS.—*continued.*

County.	Location of Roads.	Distance.	Nature of Improvement.
		Miles.	
Ayr	Maybole and Straiton	8	Widening, strengthening of surface, and improvement of bad corners.
Argyll	Tayinloan and Carradale.	12	New road.
„ (Kintyre)	Kinnecraig and Ranachan.	11	New section of road to avoid a very difficult section of the existing road.
„ (Mull) ...	Salen and Bunessan.	32	Improvement of sections of road.
Sutherland ...	Lairg and Tongue.	37	Reconstruction of stretches to enable them to carry heavy motor services.
„ ...	Thurso and Tongue.	45	
„ ...	Forsinard and Melvich.	16	
„ ...	Durness and Rhiconich.	14	
Ross	Achnasheen and Kinlochewe.	9½	„ „ „
Sutherland ...	Loch Laoghal and Strathnaver.	5	New road.
Ross	Torridon and Shieldaig.	4	„
„	Loch Maree and Poolewe, *via* Tollie.	5	„
Inverness ...	Glen Affric and Kintail.	16	„
„ (Skye)	Druim-nan-cleochd Brae.	...	Diversion of road to secure better gradient.
Ross (Lewis) ...	Morsgail and Loch Miavaig.	11	New road.

ROAD MOTOR SERVICES RECOMMENDED.

County.	Terminal Points.	Distance.
		Miles.
Banff	Banff and Aberchirder	9
„	Macduff and Gardenstown	8
Kincardine ...	Stonehaven and Bervie	10
Kirkcudbright	Dumfries and Dalbeattie (*via* Colvend) ...	26
„ ...	Dalbeattie and Kirkcudbright (*via* Auchencairn)	19
Dumfries ...	Lockerbie and Eskdalemuir	16
Selkirk ...	Selkirk, Ettrick, and Yarrow	20
Ayr	Maybole and Straiton	15
Argyll ...	Ardrishaig and Oban	39
„	„ „ Loch Sween	18
„ (Islay)	Port Ellen and Port Askaig	19
Sutherland ...	Forsinard and Melvich	16
„ ...	Durness and Rhiconich	14½
Caithness ...	Dunbeath and Helmsdale	15

NEW STEAMER AND MOTOR BOAT SERVICES.

County.	Terminal Points.	Type of Vessel Recommended.
Ross and Cromarty	Kyle and Ullapool ...	Drifter, carrying 30 to 50 tons cargo.
Sutherland ...	Lochinver and Kinlochbervie	Do. do.
,, ...	On Loch Shin	Small motor boat.
,, ...	Thurso and Durness ...	Same as for Kyle-Ullapool service.
Ross and Cromarty and Inverness.	Kyle and Mallaig (Sound of Sleat service).	Do. do.
Inverness ...	Mallaig, Kyle, and the Outer Hebrides.	Two vessels of 12 knots speed and cargo capacity of 100 tons each.
,, ...	Mallaig and the Small Isles	Motor boat or small steamer.
,, ...	Barra and Berneray ...	Same as for Kyle-Ullapool service.
Ross (Lewis) ...	Stornoway and Tarbet and Carloway.	Do. do.

Guaranteed Prices for Grain Crops of 1919.

THE minimum prices fixed by the provisions of the Corn Production Act, 1917, Part I., for wheat and oats grown in the year 1919 are 55s. and 32s. per quarter respectively. In November 1918, however, it was announced that the War Cabinet had decided that the maximum prices then in force for controlled cereals should be the guaranteed prices for the crops of 1919. These cereals include barley and rye as well as wheat and oats. The prices are as follows:—

Wheat and Rye.—71s. 11d. per qr. of 480 lb.; 75s. 6d. per qr. of 504 lb.

Barley.—61s. 6d. per qr. of 400 lb.; 68s. 10½d. per qr. of 448 lb.

Oats.—44s. 1d. per qr. of 312 lb.; 47s. 6d. per qr. of 336 lb.

It was subsequently announced that the guarantee applied to the proportion of the entire produce of each cereal usually sold, and that effect would be given to it by means of the machinery of the Corn Production Act. This involves payment to growers of the amount (if any) by which the average market price of each cereal for the period from 1st September 1919 to 31st March 1920 falls short of the guaranteed price, on the basis of a yield per acre of 4 qrs. of wheat, 4 qrs. of barley, and 5 qrs. of oats. It has been decided to take four-fifths in the case of barley and two-thirds in the case of oats, as the proportion usually sold. The grower of wheat will therefore be paid for each acre four times the difference between 71s. 11d. (or 75s. 6d.) and the average market price; the

grower of barley 3⅛ times the difference between 61s. 6d. (or 68s. 10½d.) and the average market price; and the grower of oats 3⅛ times the difference between 44s. 1d. (or 47s. 6d.) and the average market price. As regards rye, payment will be made only in respect of that which is harvested as grain. As this cereal is not included in the scope of the Corn Returns Act, 1882, a special arrangement will fall to be made in order to determine the average market price.

It should be noted that these guarantees are subject to Section 1 (*b*) of the Corn Production Act, which is as follows:—

> "If it appears to the Board that any such land (*i.e.* land in respect of which a claim is made) has been negligently cultivated, the Board may either withhold altogether the payments to which the occupier would otherwise have been entitled, or may diminish the amount of those payments to such extent as the Board think proper to meet the circumstances of the case."

A full account of the provisions of the Corn Production Act appeared in this JOURNAL, Vol. I., Part 1 (January 1918).

The following notice was issued to the Press on 28th May last:—

"The Board of Agriculture for Scotland draw the attention of farmers to the arrangements made for the payment of any sums found to be due under the decision of the War Cabinet, intimated in November 1918, to growers in respect of the grain crops of 1919. The Government guarantee covers wheat, barley, oats and rye, and the amount (if any) payable in each case will be ascertained by the method laid down in the Corn Production Act, 1917, Part I.

"The schedules for the Annual Agricultural Returns to be filled up on 4th June, which are now in farmers' hands, will in the first instance be taken as evidence of the acreage involved. The utmost care should therefore be taken to ensure accuracy in the statements of acreage of wheat, barley, oats, mixed grain and rye. A considerable proportion of the returns will be checked by inspection of the farms.

"Further intimation will be made at a later date regarding the actual making of claims for payment."

The Size of Seed.

IN a bulletin[1] of this title issued by the North of Scotland College of Agriculture, the writer deals with the question of the relation of the size of seed to its productive value. To begin with he points out that this problem has two aspects, namely, the respective values of large and small seeds of the same strain (or in the same sample), and

[1] North of Scotland College of Agric., Bull. No. 23, "The Size of Seed," Wm. M. Findlay, N.D.A., Superintendent of Experiments at Craibstone.

secondly, the case of different samples of seed in which the average size is different.

Under the first heading the results of experiments with oats, barley, turnips and red clover are given.

Oats.—Large and small seeds were sifted out of samples of Propsteier and Yielder oats and sown in plots on two farms, Kirkton and Overton. In all cases the seeds were well formed and healthy looking, the only difference being in size. Tests which had been made showed that there was practically no difference in the germination of the large and small seeds, both being very high. Each plot was seeded with the same number of germinating seeds, the following amounts being required per acre :—

	Large Seeds.	*Small Seeds.*
Propsteier ..	333 lbs. ...	172 lbs.
Yielder	330 lbs. ...	132 lbs.

When the braird appeared the difference in the size of the plants was very marked, but as the season advanced the difference in the appearance grew less. The crop was threshed and weighed, and the results, calculated as per acre, were as follows :—

	KIRKTON.		OVERTON.	
	Grain.	*Straw.*	*Grain.*	*Straw.*
	Bush.	Cwts.	Bush.	Cwts.
Propsteier, Large	73·6	43 3	56·2	52 5
Do. Small ...	53·3	30 5	46·7	50·0
Yielder, Large	52·0	33 0	46·2	42·5
Do. Small .	43·0	28 2	35·7	38·5

Here, at both farms, and with both varieties, the large seed produced the heavier crop of both grain and straw. It was noted that the straw of the small seeds at Overton, especially of the Propsteier, contained a considerable amount of weeds. Owing to the plants growing so slowly at first the weeds got the upper hand, on account of their more vigorous growth, and undoubtedly checked the growth of the oats to some extent. If the land is at all dirty, plants produced from large seeds are better able to check the growth of weeds.

Barley—In the case of an experiment with barley—the varieties Standwell and Archer being used—an interesting result was obtained In both cases the large seeds showed a greater tillering power than the small seeds, and incidentally it is interesting to note that the early sown seed tillered better than that sown later.

Turnips.—In another experiment large and small seeds of a sample of turnips were sown on several farms.

When the seeds brairded the difference in the size of the seedlings was again very marked. As the season advanced, however, the difference grew less, although, all along, the drills sown with the large seed generally looked rather better, and when weighed in early winter the larger seeds in every case produced the heavier crop.

In another trial of the same kind with turnips, 100 of the large and 100 of the small seeds were weighed, and later 100 plants of each, 3 weeks, 7 weeks and 5 months after sowing. It is interesting to note that although at each weighing the plants from the large seeds were heavier than those from the small seeds, the difference between them was gradually becoming less.

Red Clover.—A sample of Red Clover was separated into four sizes—large, medium, small and very small. These were sown alone on small plots, the same number of germinating seeds being sown in each.

When they brairded, the young plants showed the same relative size as the seeds, and when weighed in autumn the largest seeds produced the largest crop. In the next two seasons, however, it was found that the smallest seeds produced the largest crop, and on the aggregate for the three years the largest seeds produced the lighest crop and the smallest seeds the heaviest crop. The probable explanation is that in this sample there was more than one strain, and that the smallest seeds were on the whole of a better and more lasting strain than the large seeds.

It would appear from these trials, with grain, turnips and Red Clover, that the large seeds in a sample will, the first year, on the average, produce a heavier crop than the small seeds, the reason, no doubt, being that the larger food store which the large seeds possess gives the plants a better start, and this start they are in most cases able to keep.

Where the plants last longer than one year, and after they have become fully established, the influence of the size of the seed no longer obtains, except in so far as a larger crop the first year may to some extent have weakened the plant. It is well known among florists that the slowest growing plants often ultimately become the best specimens.

The following is a short account of the trials made with samples of different sized seeds of the same kind.

Oats.—In the year 1905 Siberian Oats from two different sources were experimented with by the College at thirteen farms. One was a good plump sample of home-grown oats, weighing 44 lbs. per bushel; the other sample was English grown, and weighed only about 37 lbs. per bushel, and looked little better than "Shellocks." In one lb. of the Scotch sample there were 12,160 grains, and of the English 15,920.

In all cases the same number of seeds was sown per acre, 265 lbs. being necessary for the Scots sample, while 192 lbs. were sufficient for the English. On the average of the thirteen centres the English grown seed produced 65 bushels of grain and 28 cwt. of straw, compared with 62 bushels of grain and 27 cwt. of straw for the Scots grown. At five of the centres, however, the Scots seed proved better than the English, producing 69 bushels as compared with 65.

In trials at Westfield and Longmorn, Elgin, samples of good home-grown Banner Oats were compared with a sample of small badly filled Canadian Banner weighing only about 35 lb. per bushel.

In both cases the smaller Canadian seed produced heavier crops of both grain and straw than the larger home-grown seed.

It is well known that in the north-east of Scotland a change of Oat Seed from an earlier district is often beneficial, and in the case of the Banner Oats, and the 8 or 9 centres where the smaller English Siberian was superior, the change evidently more than counterbalanced any advantage that the larger size of the home-grown seed might have possessed.

Turnips.—It is well known that home-grown turnip seeds are usually very much smaller than English grown seeds. Many farmers know, however, that their own home-grown small seed often gives a better result than seed brought from the South. A number of years ago variety trials were carried out on several farms, and in those cases where small home-grown seed was used a heavier crop was got than from large South seed.

A few years ago a number of bulbs was selected from Yellows and Swedes. These were planted and the seed of each bulb kept separate. There was a great difference in the size of the seed produced from the different bulbs. The following year the seeds from each bulb were sown in a separate drill. The difference in the size of the seedlings in the drills was again very marked, the largest seed producing the largest seedlings. The weights of the crops, however, bore no direct relationship to the size of the seed.

G 8, the largest of the swede seed, produced 20 tons, whereas H 9, the smallest, produced 24 tons 12 cwt., and G 13, a medium sized seed, produced 25 tons 5 cwt., while B 10, the largest of the yellow seed, produced 16 tons 10 cwt., compared with 21 tons 12 cwt. produced by B 13, the smallest. Undoubtedly in many, if not most, of our farm seeds, there is a mixture of strains, and this was evidently the case with the original turnips. In this trial, the strain was of much more importance than the size of the seed, a small seed of a good strain being better than the larger seed of a strain which is inferior. If the good strains were selected and grown, an all round improvement in the cropping power would undoubtedly be effected.

Red Clover.—Red Clover seeds are imported into this country from many other countries, and it is well known that these seeds vary considerably in size. It is evident from the trials made that the origin or source of the seed and the variety are of much more importance than the size of the seed, and in buying Red Clover we should not select "bold" samples without inquiring first of all as to those two factors. Undoubtedly many failures with Red Clover are due to the use of foreign seed.

Summing up these results then, we arrive at the conclusion that, from the first point of view, the large seeds in a genuine sample are generally superior to the small seeds, but when we compare different samples of the same kind of seed we find that there is no connection between the size of the seeds and the resulting crop, the strain and origin of the seed being of far more importance. Small seeds from a good source and of a good strain are more valuable than large seeds of a poor strain and from an unsuitable source,

but, of seeds of the same variety and from the same source, the largest seed should be preferred.

Effect of Sifting out Small Seeds.—Very few samples of grain used for seed are properly graded, but contain 15 to 30 per cent. of small seeds. The question naturally arises, are the plants produced from these small seeds capable of competing successfully against the plants produced from the larger seeds?

Several experiments with oats were carried out for the purpose of determining how far the larger seedlings from big seeds would adversely affect the smaller seedlings from the smaller seeds.

In order to get over the difficulty of knowing which plants were produced from large seeds and which from small seeds, samples of White and Black Oats were taken and the small seeds sifted out from each. The Small Black was then mixed in known proportions with the Large White, and the Small White with the Large Black. The results of the experiments show that the adverse influence of the competition of the larger on the smaller seeds is very great. At Craibstone, where 15 per cent. of small seed was used, the loss was fully half. When it is remembered that this is the second reduction that the use of ungraded seed involves, as when sown alone, the smaller seeds give a smaller yield than the large seeds, the importance of grading will be realised.

Undoubtedly the influence that the larger plants produced from the larger seeds exerts will depend, to a considerable extent, on the thickness of sowing. The thicker the sowing the greater the influence.

It would be well to keep in mind, however, that practically all samples of grain are mixtures of different strains, and that the small grains may be of a better strain than many of the large ones. These small grains are all the produce of plants capable of producing either two or three grains in the spikelet, whereas many of the large grains may be the produce of plants capable of producing only single grains in the spikelet. Therefore, although the large seeds, owing to their size, are able to produce a heavier crop in any particular year than the small seeds in the same sample, by continually discarding the small grains we would gradually increase the proportion of plants capable of producing only singles. In other words, by continually using the large seeds we might in time get a sample of grain most of which was the progeny of single grained spikelets, and therefore not hereditarily fitted to produce the most prolific plants. The only way to effect a lasting improvement is to select the best yielding strains. From these the largest crop will be got if the small seeds are sifted out.

Red Clover.

IN view of the value of Red Clover in the hay crop and its frequent and often unaccountable failure, a study of the conditions necessary for its growth has been made by Mr. Findlay of the North of Scotland College of Agriculture.[1] The factors contributing to success or failure are grouped under three heads, viz.:—

(1) The kind and quality of the seed.

[1] N. of Scotland Coll. of Agric., Bull. No. 24, "Red Clover," by Wm. M. Findlay, N.D.A.

(2) The soil and its condition.
(3) The plants competing with it in the soil—(*a*) the "nurse" crop, and (*b*) the grasses.

Dealing with the seed of Red Clover, Mr. Findlay ascribes the frequent confusion of ideas as to varieties and their respective values to the fact that most of the information on the subject has been obtained from English sources and does not hold good under climatic conditions in Scotland, especially in the north. He points out that plants tend to lose their characteristics if grown under different conditions of soil and climate, thus Late-Flowering Clover may become earlier if grown for a number of years in an early district. This is probably the reason why, when some samples of the Late-Flowering type are sown, the plants are not so distinctive in character as they should be

The results of several experiments are given, all conducted in the north-east of Scotland, with a view to finding out the varieties of seed best adapted to the climatic conditions In one experiment carried out at the Cruikshank Botanic Gardens, Old Aberdeen, with seventeen samples of clover, the total weights of clover cut from the different plots over three seasons shows markedly the advantages of seed of the Late-Flowering type and from colder climates. Norwegian seed gave the highest total, followed by English Cowgrass, Late-Flowering, Swedish and Garton's, while the lowest yields were those of seed from Hungary and Wisconsin In another experiment, where seed of Broad-leaved English, Canadian, Chilian, French, German and Late-Flowering English clovers were sown with a grass mixture, the superiority of the English seed was very marked—Late-Flowering English giving a total weight of hay per acre of 52·1 cwts, Broad-leaved 45 1 cwts, and Chilian being next with 34·3 cwts.

Another point of interest came out in this experiment, namely, the effect of the different clovers on the grasses It is well known that grasses, and especially quick-growing ones, like ryegrasses, have a considerable adverse influence on clover, but the clovers, when the conditions specially favour them, may have a very adverse influence on the grasses From this point of view, then, a too luxuriant growth of Red Clover is not to be recommended, because many of the plants die out before the following year, and as it has in the meantime retarded the growth of the grasses, the pasture is considerably poorer.

Other points noted are that Late-Flowering Red Clover will often grow where Broad-leaved fails, and as a rule more plants of the former will be found in the second and third year's pasture As it has a very adverse influence, however, on the grasses and other clovers, only a small proportion should be sown. It was noted also that where Red Clover was present in largest quantity the amount of Alsike Clover was small. This shows the utility of sowing Alsike in a mixture, especially on soils where Red Clover cannot be depended on to do well.

The chief factors in the condition of the soil to which attention should be paid in connection with the growth of Red Clover are tilth and soil moisture. These may be influenced to a considerable extent by the previous crop and its cultivation.

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TO LET.

It has frequently been observed that there is more Red Clover after potatoes than after turnips. Several factors may contribute towards this result.

First of all, after the potato crop, the soil is usually in a more friable condition. This may be due partly to the extra cultivation that potatoes usually get, and partly to the root action of the plants. A fine condition as regards tilth is very favourable to the germination of the clover seeds. Then there is very often a poorer grain crop after potatoes than after turnips, and the reduced competition may benefit the clover. Again, a good supply of potash is essential for the growth of Red Clover, and as more of this fertiliser is generally used for potatoes than for turnips, the larger residue after the former may account for the better result. After potatoes, the land is not only cleaned of the crop earlier, but it is also usually ploughed earlier, and on light soils, especially in a dry spring, this may affect the germination of Red Clover considerably.

The bad effect on the Red Clover of allowing the turnip crop to remain on the land for too long a period was extremely well seen a year or two ago on a field of light soil on a gravelly subsoil in the Deeside district. Certain parts of drills of turnips were pulled much earlier than the remaining parts of the same drills. The whole was ploughed at the same time, and seeded with the same grain crop and grass seed mixture. It should be noted that the weather at this time was dry. The following year, when the field was in hay, the result was remarkable. On the parts where the turnips had been pulled early there was an abundance of Red Clover in the hay, whereas, on the parts where the turnips were late in being pulled, there was hardly any clover at all—just a plant here and there.

Early ploughing and the application of dung to the preceding crop, by increasing the capacity of the soil for retaining moisture near the surface, have a beneficial effect on Red Clover especially on light soils.

Several trials have been made with a view to obtaining information as to the best time and method of sowing the seed. The following are the conclusions drawn.

The seeds should be as near the surface as possible, consistent with their getting sufficient moisture to germinate. The closer the seeds are surrounded by the soil particles the better is their chance of getting sufficient moisture. It has been found that on the average the largest number of Red Clover seeds grow where there is a covering of about ½ inch of soil, while about half the seeds will grow with a covering of about 1½ inches of soil. If the surface is dry, however, it will be well to have them deeper than on a damp soil.

The time of sowing depends largely on the kind of soil. On a clay soil it may be well to wait until the grain is well rooted. If this method is adopted the soil should be well harrowed with a good heavy harrow before the seeds are sown, then harrowed again after sowing and rolled lightly.

On light sandy soils the time of sowing must be regulated by the amount of moisture. The ground is likelier to be in condition

for sowing after early ploughing, and in this case it would be best to sow the seeds on the harrowed surface and roll them in. If ploughing cannot be done until a short time before the grain is sown it should be shallow. The ground should then be rolled and harrowed lightly and the grass seeds sown, with another light harrowing and further rolling after sowing.

Clovers, like all other plants, require for their complete development a sufficient amount of phosphate, potash and lime in an available form, and if a soil is deficient in any one of these the clover plants will either be absent or weakly. Lime is also essential, and no doubt the lack of it is, in many cases, the reason why Red Clover does not grow.

As nurse crops, wheat is said to be the least injurious to clover, barley next and then oats. The older varieties of oats, owing to their greater tillering, have a more injurious effect than the newer grain varieties

To give the clover as good a chance as possible the grain should not be sown too thickly, and it should be cut as soon as possible. Nothing is gained by allowing a heavy grain crop to become fully ripe, and it is distinctly advantageous both to the quality of the grain and of the straw and to the future well-being of the grass to cut early On haugh land and peaty soils which may be depended on to grow a heavy crop of straw, and where it is usually difficult to get a stand of Red Clover, it would be an advantage to sow one of the dwarf early varieties of grain

Undoubtedly one of the chief reasons in many cases why Red Clover is deficient in the hay crop is the adverse influence of grasses. While all grasses have some influence, the quick growing ryegrasses have the most, Italian Ryegrass in particular having a very marked adverse influence.

The excessive use of nitrogenous manures, by stimulating both the grasses and the straw of the grain crop, materially reduces the yield of clover, large quantities of liquid manure frequently having this effect.

Whether or not sheep should be put on grass during the first winter must be decided in each case according to the kind of soil and the weather conditions In early seasons, when there is considerable growth in the new grass after harvest, it is better to have it eaten down before winter sets in, while on light, dry, loose soils grazing by sheep in winter may be beneficial in consolidating the soil. In any case care should be taken not to graze new grass when wet or on a clay soil.

In conclusion the following deductions and recommendations are made :—

A.—Applicable to all Soils.

1. All seeds should, if possible, have a high germination. If the seeds are of low germination a proportionate increase in the quantity used must be made.
2. English or Welsh seeds, or seeds from a high-lying, cool district, should always be used in the N.E. of Scotland.
3 It will be better to use such seeds, even although the germina

tion is low, rather than seeds of higher germination from warm climates.

4. About 1-1½ lb. per acre of the Late-flowering type should always be used along with about 2 lb. of Broad-leaved.
5. An excessive amount of quick-growing grasses (especially Italian Ryegrass) should not be used in the seed mixture.
6. An excessive amount of nitrogenous manure should not be used either for the preceding grain crop or for the hay.
7. All soils deficient in lime or potash should get dressings of these ingredients.

B.—Peaty Soils.

1. As peaty soils are deficient in lime they should get a dressing (20-25 cwt. per acre) one year, and if possible two years, before the time for sowing the clover.
2. Potash should always be included along with phosphatic manures, and the combined total amount should be at least 2 cwts. of muriate of potash, or an equivalent of other potassic manures, applied in part to the turnip and in part to the grain crop.
3. As peaty soils are always loose they should be well rolled before sowing the grass seeds.
4. Short strawed, grain producing varieties of oats, like Yielder, should be sown on peaty soils in order that the clover may not be choked out.
5. The grain crop should always be cut as soon as possible, and especially if there is much straw.
6. If it is found that clover plants have no nodules on the roots, the soil may be inoculated with a pure culture, or with soil from a field where clover grows well.

C.—Sandy Soils.

1. Care must always be taken not to reduce the soil moisture needlessly.
2. The turnips should be cleared off the ground early, and the land ploughed early.
3. If the turnip land is, however, ploughed late in the season, the ploughing should be comparatively shallow, and the land should be rolled before the "seeds" are sown.
4. If there is sufficient moisture in the soil, the seeds should be sown immediately the grain is sown. If the top soil is dry, wait until there is rain.
5. Dung should be applied to the turnip crop.
6. As sandy soils are usually deficient in potash, 3-4 cwt. of Kainit should be applied to the turnip crop and also to the nurse crop.

D.—Clay Soils.

1. If there is excessive moisture, the soil will be cold, and the seeds may rot. The soil should therefore be drained.
2. Lime should always be used on clay soils, particularly to get the soil into a more friable condition. From 25 to 30 cwts. per acre should be applied, at least one, and if possible two years, before the time for sowing the seeds.
3. If the soil is cloddy, it should be rolled before sowing the seeds.
4. Sheep should never be grazed during the first winter on clay soils.

Composition of Potatoes.

A SUB-COMMITTEE of the Food (War) Committee has recently issued a report on the composition of potatoes grown in the United Kingdom (Harrison & Sons, St. Martin's Lane, London, W.C. 2, price 2s.). In the course of their investigations the sub-committee directed their attention mainly to the content of total dry matter and of total nitrogen, with a view to simplifying analytical procedure and thereby enabling a large number of samples to be dealt with. Ten widely grown varieties were selected for test, six being main crop and four second early, and of these, 227 samples were obtained. In addition 20 samples of 17 "miscellaneous" varieties were analysed. The samples were obtained from about 65 growers in 18 English, 7 Welsh, 6 Scottish and 23 Irish counties.

The general average of the 247 samples dealt with was 22·09 per cent dry matter, and ·327 per cent. nitrogen (equal to 1·48 per cent. nitrogen in the dry matter). Sub-dividing the varieties into "late" and "early," the averages show for the former 22·08 per cent. dry matter and ·324 per cent. nitrogen (equal to 1 47 per cent. nitrogen in the dry matter), and for the latter 22·15 per cent. dry matter and ·334 per cent. nitrogen (equal to 1·50 per cent. nitrogen in the dry matter). The figures show no significant difference in composition between the two groups, but it is not unreasonable to assume that "early" varieties tend to be somewhat more nitrogenous than the late varieties, as the averages suggest.

The investigations made included an attempt to determine the effect of general climatic influences. The results obtained are set out in tabular form, and show the variations between the eastern and the western half of the country and also between the northern and southern areas. In the eastern half the averages worked out at 22·73 per cent. dry matter and ·331 per cent. nitrogen, and in the western half 21·79 per cent. dry matter and ·337 per cent nitrogen. It is reasonably safe to assume that the regional variation represents in the main the effects of difference of rainfall.

The sub-committee are of opinion that the data are too heterogeneous to permit of any clear correlation between soil characteristics and the composition of the tuber. There are indications of a tendency towards increased dry matter and nitrogen-content in the potatoes grown on the heavy soils as compared with light soils, but the variations within each group are too great to warrant any definite conclusion. There is also no clear relation between manuring and percentage of nitrogen, nor perhaps should such relationship be expected, since the direct connection is usually between manuring and total quantity of nitrogen in the crop.

There is more distinct evidence of correlation between the size and the composition of the tuber, the percentages of dry matter and nitrogen rising roughly in the same proportion with increasing size of tuber, and the percentage of nitrogen in the dry matter remaining approximately constant.

The enquiries have been carried out under conditions in which many variables were involved; the sub-committee suggest that in any extension of the investigation it would be advantageous if experiments on identical lines could be carried out at different centres suitably distributed through the country, with a view to obtaining

more precise information as to the specific influence of variety, soil, manuring and climatic conditions respectively.

Minimum Wages for Agricultural Workers.

AT their meeting on the 12th of June the Central Agricultural Wages Committee fixed minimum rates of wages for those classes of agricultural workers regarding which the duty of fixing rates had been transferred to them by the Board of Agriculture under Clause 7 of the Second Schedule to the Act. They took the opportunity of utilising the experience which they had gained to lay down as clearly as possible the general conditions on which the rates fixed by them are to be reckoned and applied. Those conditions may be summarised as follows:—(1) the minimum rates fixed are inclusive of the value of any benefits or advantages received by the workman in part payment of wages; (2) they apply to all workmen who are wholly or partly employed in agriculture within the meaning of Section 17 (1) of the Corn Production Act during such time as they are so employed, unless where special exception is made in the Order; (3) the rates fixed per week apply to all workmen who are engaged for whole-time work for a week or any longer period, and the rates fixed per hour apply in other cases; (4) when a workman is engaged for whole-time work for a week or any longer period, the minimum rate applicable shall be payable in full, even although, through no fault, failure or disability of the workman, the hours agreed upon between him and his employer and actually worked are less than the number of hours on which the minimum rate is to be reckoned. The proposals of the Central Committee had in each case been notified in the public press, and communicated to the District Wages Committee concerned. All objections received were considered, and special consideration was paid to the recommendation of the District Committee, where that had been passed with practical unanimity, as the Central Committee felt that where the District Committee were unanimous in their wishes, they should accept the local view and give effect to it in their Order. The application of this principle has led to considerable differences in the Orders passed by the Central Committee for different districts.

For the Forfar and Perth District the Central Committee had to fix minimum rates of wages for all male workmen in agriculture over the age of 21 employed in ordinary farmwork. In accordance with the recommendation of the District Committee, they decided that in this district the minimum rates are to be reckoned as applying to an average for the year of 54 hours per week exclusive of meal times and time required for stable-work, allowance being made for 21 full days' or 42 half days' holidays in each year, besides (1) the usual New Year's day holiday, and (2) in the case of yearly engagements one Hiring Fair day, and in the case of half-yearly engagements two Hiring Fair days; and that all employment in excess of the working hours so calculated shall be treated as overtime employment for the purpose of the differential rates for overtime, provided that, when a workman is by the con-

ditions of his employment required to attend to animals, no stable-work, byre-work, shepherding, or other work necessary for the health and comfort of the animals shall be reckoned as overtime employment. It is to be noted that Wages Committees have no power to compel any employer or workman to adopt any definite number of working hours per week. All they can do is to fix the minimum rates of wages, and to decide how they shall be reckoned. An employer and his workmen are free to make any arrangement on which they may agree as to the actual number of hours to be worked, and all that the Act does in the matter is to render an employer liable to fine if he pays his workmen wages less than the minimum wage calculated on the hours actually worked according to the scheme adopted by the Wages Committee. The minimum rates are to be increased by 2s. 6d. a week for each dog which the workman is required, by the conditions of his employment, to keep and feed. They are to be reduced by 3s. 6d. per week, or 1d. per hour, during the first two years of a man's employment in agriculture. They are to be increased for a ploughman, cattleman or shepherd by 6s. per week, or 1½d. per hour, for the time during which he is under contract of employment or employed as such. Subject to the above conditions the minimum rate for a male workman over 21 years of age has been fixed at 36s. per week, or 9d per hour. The effect of these orders is that in the Forfar and Perth district a ploughman, cattleman or shepherd over 21, if he has had two years' experience of agriculture, must get at least 42s. per week, or 10½d. per hour. He will not be entitled to any addition to this minimum wage for any work done in attending to animals, but he will be entitled to overtime payment, on the same conditions as the other workers, for extra time spent on work in the field. Until a ploughman, cattleman or shepherd has had two years' experience of agriculture, his minimum wage will be 38s. 6d. per week, or 9½d. per hour If a man is engaged as a ploughman, cattleman or shepherd he will be entitled to one or other of these rates of minimum wage, even although he may be during part of his time employed on other work. A man over 21 engaged and employed as an ordinary labourer, not in charge of animals, will, if he has had two years' experience of agriculture, be entitled to a minimum wage of 36s. per week, or 9d. per hour; and until he has had two years' experience of agriculture, his minimum wage will be 32s. 6d. per week, or 8d. per hour. If he is temporarily employed as a ploughman, cattleman or shepherd he will be entitled to an increase of 6s. per week, or 1½d. per hour, for the time during which he is so employed.

In the Fife and Kinross District the recommendations of the District Committee were not unanimous, and the Central Committee decided by a majority vote that the minimum rates in this district are to be reckoned as applying to an average for the year of 52 hours per week, exclusive of meal times and time required for stable-work, and that any time worked in excess of this average shall be treated as overtime employment for the purpose of the differential rate for overtime, which they fixed at one-and-a-half times the rate fixed per hour for the class to which the workman belongs. They decided that for the purposes of reckoning working

hours, and the differential rate for overtime, when a workman is by the conditions of his employment required to attend to animals, no stable-work, byre-work, shepherding or other work necessary for the health and comfort of the animals shall be reckoned as overtime employment. No meal-time, rest-time or other interval of work provided for by the conditions of the employment shall be reckoned in calculating the working-hours. Subject to the above conditions, the working-hours shall, in the case of a ploughman, be reckoned as near as may be from the time when the horses leave the stable to the time when they return to the stable, and shall not include time spent on stable-work, or in coming from and returning to his house, but shall include time spent in going from the stable to the field or from the field to the stable; and shall, in the case of other farm-workers (except cattlemen and shepherds), be reckoned as near as may be in the same way as for ploughmen. The allowance for a dog was fixed at 2s. 6d. per week as in Forfar and Perth. The minimum rate is to be reduced by 4s. per week, or 1d. per hour, during the first three years of a man's employment in farm work, forestry, nursery work or market gardening, as the case may be. The minimum rate is to be increased for a ploughman, cattleman or shepherd by 6s. per week, or 1½d per hour, for the time during which he is under contract of employment or employed as such. Subject to the above conditions, the minimum rate for a male workman over 21 years of age has been fixed at 35s. per week, or 9d. per hour, and the minimum rate for a male workman between 18 and 21 is 32s per week, or 8d. per hour. Thus in Fife and Kinross a ploughman, cattleman or shepherd over 21, if he has had three years' experience of farm work, must get at least 41s. per week, or 10½d. per hour; and a man over 21 not in charge of animals, if he has had three years' experience of farm work, must get 35s. per week, or 9d. per hour. Until a man has had three years' experience of farm work, these minimum rates will be reduced by 4s. per week, or 1d. per hour. The minimum wage for a youth between 18 and 21 will in each case be 3s. per week, or 1d. per hour less than for a man over 21; so that an inexperienced youth under 21 may be employed at a minimum wage of 28s. per week.

For the Ayr Wages District the Central Committee had proposed the same scheme of minimum rates as for the Fife and Kinross district; but, as the Ayr District Committee unanimously recommended that there should be a flat rate of 37s. per week for all male workmen over 18 years of age, to be reckoned on the hours customarily worked in the district, the Central Committee resolved to accept this unanimous recommendation, and fixed the minimum rate accordingly. Thus in Ayrshire no male workman over 18 years of age can be employed in agriculture at less than 37s. per week, or 9d. per hour, however inexperienced he may be; and this rate is applicable to every male workman over 18 employed in agriculture, whatever be the character of his duties—unless the man can obtain a permit from the Committee allowing him to be employed at a lower rate on the ground of mental or physical infirmity.

The Dumfries and Galloway District Wages Committee have revised, extended and consolidated their Orders regarding minimum

rates for male workmen over 18 years of age; and, as the revised Order had been unanimously passed by the District Committee, the Central Committee resolved not to disallow it. The scheme adopts the general conditions for the reckoning of the minimum wage which had been proposed by the Central Committee for the Forfar and Perth district, and the plan proposed for that district by the Central Committee of increasing for a ploughman, cattleman or shepherd the ordinary minimum rate by so much per week (making it 5s. in Dumfries and Galloway) for the time during which he is under contract of employment or employed as such, provided that no stable-work, byre-work, shepherding or other work necessary for the health and comfort of animals shall be reckoned as overtime employment. It makes an allowance of 2s. 6d. per week for the first dog, and an additional 2s. per week for each additional dog, which the workman is required by the conditions of his employment to keep and feed. Subject to the above conditions, the minimum rate for a male workman over 18 years of age is 33s. per week, or 8d. per hour. The minimum rates are to be reckoned as applying to the following working hours per week: From February 1st to June 15th—9 hours per day; from June 16th to October 15th—10 hours per day; from October 16th to January 31st—8 hours per day, exclusive of meal times and time required for stable-work, and of 21 whole holidays or 42 half holidays in the year—none of which shall be demandable during ten weeks of hay and harvest. The minimum rates for overtime are to be the ordinary rates plus a quarter during haytime and harvest, and the ordinary rates for any other period. Thus in Dumfries and Galloway a male workman over 18 years of age must be paid at least 33s. per week, and, if he is a ploughman, cattleman or shepherd, must be paid at least 38s. per week.

The initial work of the Wages Committees may now be considered as completed, as there is now throughout Scotland practically no worker in agriculture—man, woman, boy or girl—to whom some minimum rate is not applicable. An account of the minimum rates in force in the districts other than those mentioned above was published in the issue of this JOURNAL for April. A list of the values placed by District Committees on benefits and advantages, which may be reckoned as payment of wages in lieu of payment in cash, will be found under Official Orders and Circulars in this issue.

Goat Keeping in Scotland.

THE fact that the word "Goat" is found not infrequently in place names in Scotland from Godscroft (*i.e.* Goat's croft) in the south to Eilean na Gothail in the north, is sufficient proof that from remote antiquity the goat was an animal of no mean importance in the domestic economy of Scotland. Throughout historical times we have frequent reference to goats, and from the Statistical Account of Scotland we find that here and there considerable numbers of goats were kept. Indeed, within living memory flocks of goats of some size were maintained in the

Highlands, and the writer has had the pleasure of speaking, only the other day, to a man who, some sixty years ago, was employed to herd the kids. The goats were then run on the hill, summer and winter, just as sheep are run. In the spring, when the kids were dropped, it was important to secure the kid to prevent it following its mother and getting the milk. It was the herd's duty to watch for the kids and see where they were hidden, as they often were. Apparently sometimes the kid was tethered to the spot for a few days, but as they grew stronger they were shut up for the night, and carefully herded during the day. Every morning and evening the mother goats came down from the hill to the kids, when the goats were milked or rather partially milked, and the kid allowed to take the rest. This went on all summer, but about August, when harvest work came on, the kids were let away to the hill with their mothers, and the goat milking came to an end.

There was a regular market for goats in those days, and goats' flesh was eaten generally. Most of the males were castrated and were gradually killed off, and it is said that a three-year-old wether yielded 50 to 60 lbs. of excellent meat.

Presumably such was the system of goat keeping in times past until almost the present day. But the system has passed, and in such a form will probably not be revived. The system in its day was perhaps not unprofitable, but its extinction was undoubtedly hurried on by the fact that goats are very destructive to trees, so that when trees began to be planted, goats necessarily had to go

At the present time there must be a considerable number of goats in Scotland, but there are no statistics available from which even a rough estimate of the number could be drawn. First there is the so-called wild goat. It is practically certain that this goat is not a relic of an aboriginal race, but is the descendant of the flocks of goats that were once kept for domestic use. These wild goats—for they may so be termed—are to be found in many parts, particularly of the Highlands; sometimes on islands, but generally on steep rocky places where there are dangerous cliffs. These goats have been deliberately maintained there, and have been in many cases purposely put on to such places even recently, occasionally for perhaps sentimental reasons and to add some variety to the sportsman's bag, but the chief reason has been the belief that if goats were kept on these dangerous rocky places, the sheep would not be tempted to go in to them, because the goats would keep them out and eat the grass and thus save the sheep from temptation.

It is, however, questionable if the presence of goats really achieves the desired object. Because, if there are many goats they make tracks into dangerous bits, and sheep are apt to follow on along these tracks until they find themselves in a tight corner. If the sheep happen then to meet a billy goat, the goat at once knocks the sheep over the cliff without ceremony and with great ease The presence of goats will not relieve the sheep farmer of the loss of sheep from tumbling over the rocks, still it is believed that the loss is mitigated, and might be greater if the goats were not there. It is not any particular animus against sheep that induces the goat to treat them so unceremoniously when they meet

them in dangerous places, for kids and younger goats are treated in the same way in similar circumstances. As a rule these wild goats do not increase much in numbers; they do not seem to be good mothers, and the death rate among them seems heavy, and I daresay where there are not many of them, they are somewhat interbred Another reason that has led to goats being maintained in this semi-wild condition is the belief that they kill adders. Within living memory goats were kept on the Eildon hills because they were supposed to kill adders. This belief was at one time fairly wide-spread, but whether it has any justification in fact is extremely doubtful. These wild goats have little sporting value. They are shot, of course, but not to any great extent. There is no great difficulty in shooting them. Some of them are remarkably handsome specimens, and their heads make good trophies; but as a sporting asset, wild goats are not of much account in a shooting.

With regard to the domestic goat, as it may be called in distinction to the semi-wild goat, in the last year or two interest has been greatly revived. The economic pressure brought on by the national crisis has turned people's thoughts into enquiring into many things they had not troubled about before, and the "self-supplier," as he has been termed, has multiplied in the land, so naturally the keeping of goats came in for attention

In Scotland there has been always a number of persons who kept goats for profit, but the number was not large If good goats could be got now, at a reasonable price, there would undoubtedly be many more Unfortunately the supply is quite unequal to the demand.

As far as can be judged, the number of goat-keepers in Scotland is much less relatively than the number in England or Ireland. It is perhaps unnecessary to say that a good goat is a profitable animal, provided the owner treats the goat with care and consideration and is able to supply a certain amount of cheap food. That there are many persons who could do this, particularly in the country, goes without saying, and consequently there is a considerable potential supply of milk which might be developed if more goats were kept.

Of the goats kept in Scotland the majority are of the type of the British goat. The supply of goats in Scotland used to be largely maintained by the purchase of Irish goats. It was customary for Irishmen to come over with a drove and march them through the country selling them as they went for very low prices. Apparently the majority of these goats were not of much worth. The Scottish goat-keeper frequently describes them as useless, and probably they have done more harm than good to the industry of goat-keeping.

Probably many of the goats of the British type in Scotland are descendants of the goats kept in times past, and some of the wild goats are occasionally brought in and domesticated. Besides the goats of the British type there are, of course, many of the foreign type or cross-bred to the foreign type. The foreign goat is a superior animal. They have long been bred with care, and have thus been graded up to a high standard of excellence. In many cases their milk yields are remarkable for so small an animal. Naturally, then, there is a great run on this foreign type of goat or

cross-breeds from it. At the present time a good goat of this type costs a great deal of money, and is quite out of the reach of the cottar. Moreover, they need to be kept with more care than many could give them. So it is probable that a good goat of the British type might prove the better animal for ordinary conditions, and such a goat might rough it better than the other.

Goats are so destructive to trees, and are such adepts at getting through or over fences, that they generally need to be tethered unless they are kept in a particularly well-fenced enclosure or have a wide run on rough ground. A tethered animal is exposed to the vagaries of wind and weather for it cannot get shelter, and this must be borne in mind. The housing provided must be dry, and the animals ought to be housed every night. As for food, their requirements are simple and easily provided. They are very catholic in their tastes, and yet are fastidious. A hedgerow will provide them with plenty of food, and garden rubbish and household scraps will also be relished, so that a person who is prepared to take the trouble should find a goat not difficult to keep, and if the goat is a good one it should yield a very profitable supply of milk. Exceptional goats will give as much as a gallon a day, and in some cases their lactation period is a long one. Such yields, however, are rare; a really good goat should give from 4 to 6 pints a day, and perhaps 80 to 90 gallons a year. But such goats are not easily to be got. From 3 to 4 pints daily would be a more usual yield, with a total yield of perhaps 70 gallons a year. If a goat does not give 2 pints a day at the least she is not worth keeping. These figures do not seem high, but when the low cost of production is taken into account and the present high price of milk, it will be seen that the claim that the goat is a profitable animal is justified.

Mechanical Drainage.

THE following notes are contributed by Professor Stanfield, consulting engineer to the Highland and Agricultural Society:—

For some considerable time the Directors of the Highland and Agricultural Society of Scotland have had under serious consideration the problem of excavating drains on farm lands by other than manual labour, which is somewhat costly, especially at the present time.

Excavating drains by mechanical power has not hitherto been carried out in Great Britain except to a very limited extent, but this method has been in vogue for some time in America, where much thought and ingenuity have been displayed in the design and construction of several very efficient machines, which appear to give satisfaction under the conditions there prevailing

The Directors of the Highland Society came to the conclusion that the best course to pursue was to obtain a machine which appeared to be most suitable for work in this country, and place it at the disposal of farmers who wish to carry out drainage operations on a fairly large scale.

After giving very careful consideration to various types of machines, the description of which was obtained through the courtesy

of the U.S. Department of Agriculture, the Directors recommended the purchase of the No. 1. "Buckeye" Tractor Ditcher, made by the Buckeye Traction Ditcher Co., Findley, Ohio, U.S.A.

The necessary funds were supplied by the Board of Agriculture for Scotland, and in due course the machine was delivered and eventually erected, under skilled supervision, by Messrs. John Wallace & Sons, Glasgow.

In this particular machine the soil is excavated by means of a series of upward-acting cutters and buckets fixed to the periphery of a large revolving wheel, which is carried on a hinged frame extending rearwards from the main body of the machine. The vertical position of this frame and of the excavating wheel can be adjusted—within limits—to correspond with the depth of the drain to be cut. The excavated soil is carried by the buckets to the highest point of the wheel, and delivered on to a conveyor band, which travels in a direction at right angles to the plane of the wheel; the soil being finally deposited at the side of the cutting, ready for filling in after the tiles are laid.

In commencing work on virgin land the wheel gradually excavates the soil until the depth corresponding to the adjustment of this frame is attained; at first, the frame is at an angle, but as the cutting proceeds and the machine advances, the frame obtains a more or less horizontal position.

The No. 1. "Buckeye" machine excavates a trench 11½ inches wide, with vertical sides, to a maximum depth of 4½ feet; in some trials recently carried out at Pollok, near Glasgow, trenches were cut 11½ inches wide and 30 inches deep at the rate of 4 yards per minute. Certainly the conditions were favourable to good work, the soil being loamy and fairly free from stones, though some pieces of bog oak were encountered, but this particular obstruction did not interfere with the working of the machine. Of course, should any large stone or other obstruction be met with, it is necessary to back the machine and remove the stone, etc. by hand labour before proceeding. The only damage likely to happen to the machine under these circumstances is either a bent cutter or the breaking of a link in one of the power transmission chains, and the necessary repairs are easily effected.

So far, the experience gained in the recent trials indicate that the machine is easy to manipulate, and the consumption of petrol —about one gallon per hour—is much less than expected.

The motive power is derived from a four-cylinder vertical petrol engine, developing about 20 horse-power, and placed at the front of the machine. The power is transmitted from the engine through the usual clutch, change speed gear—provided with a reverse—differential mechanism, chain and sprocket gearing, to the excavating wheel, and to the land drive, which is on the caterpillar principle; this type of drive gives a powerful grip, and at the same time the pressure on the land is reduced to a minimum.

Of course the weight of the machine is borne by the uncut land, so that there is no tendency for the sides of the trench to cave in, unless the machine was required to make more than one trip, and even then it is doubtful if the trench would be damaged. It has been proved during the recent trials that the machine can be

driven across a trench without causing serious damage. When the machine reaches the end of a cutting, instead of turning round, the motion is reversed through the gear box, and it travels back to the starting-point at a quicker speed than that used for excavating, so that very little time is lost.

Under favourable conditions this machine should be capable of cutting field drains—spaced at 18 feet centres—at the rate of about 2½ acres per day of 8 hours.

When not cutting, or for travelling on the road, the excavating wheel is put out of action and elevated clear of the ground.

A fixed shoe follows the excavating wheel and leaves the bottom of the drain clean and smooth, with a central groove, ready to receive the tiles.

The steering is of the usual type, through a hand wheel operating two leading wheels attached to a pivoted frame at the front of the machine.

The "Buckeye" machine appears to be well designed, being constructed on simple and substantial lines, and should be capable of withstanding a considerable amount of hard wear and tear.

The Pollination and Setting of Fruit.

IN fruit growing one of the first essentials for the securing of a full and satisfactory crop is the free production of blossom which is healthy and vigorous. If the trees for a number of years bear few or no flowers the cause may be over-luxuriant wood growth, which is antagonistic to blossom and fruit production, and for this condition root pruning in autumn would be the remedy, coupled with suitable manuring. On the other hand fruit trees may be well balanced in growth and flowering freely, but fail to set fruit through their having become debilitated by frequent attacks of insect pests or fungus diseases, by unfavourable soil conditions or imperfect cultivation.

Other causes that reduce or prevent the setting of fruit are: (1) A spell of cold, blasting wind while the trees are in blossom, or heavy continuous rain wetting the pollen. Besides damaging the blossom, these weather conditions hinder the hive and wild bees from visiting the flowers and distributing the pollen. (2) A few degrees of frost when the flowers are open and in a moist condition destroys the pistils, and makes the production of fruit impossible. (3) Certain insects injuring the flowers, particularly the apple blossom weevil. (4) The variety may be self-sterile and unable to set fruit with its own pollen. The phenomenon of self sterility is very marked in many varieties of apple, pear, plum and cherry, and may often account for a single fruit tree failing year after year to bear fruit; this is only to be expected when an isolated tree happens to be a self-sterile variety, and no other variety of the same kind of fruit is near, and flowering at the same time, to secure cross pollination. It has been found that even varieties that are fertile to their own pollen set better when cross pollinated by other varieties, so that in fruit planting two or more varieties that flower together should

always be put in, and when planting on an extensive scale large blocks of a single variety should be avoided.

Bees, both hive and wild bees, are the best and most efficient agents in distributing pollen, and it is therefore beneficial to keep hive bees in conjunction with fruit growing, especially in districts where wild bees are scarce. Appended are lists extracted from *The British Bee Journal* of self-fertile and self-sterile varieties of fruits. Varieties not included in these lists may, pending further investigation, be looked upon as more or less doubtful.

APPLES—*Self-fertile.*—Irish Peach, Golden Spire, Stirling Castle, White Transparent (occasionally), Lord Derby, Tower of Glamis, Duchess of Oldenburgh, Egremont Russet, Devonshire Quarrendon, Summer Golden Pippin, Christmas Pearmain, Domino, Washington, Ben's Red, Red Reinette, Lord Grosvenor, Early Victoria, Ecklinville, Allington, King of the Pippins, Peasgood's Nonsuch, Pott's Seedling, Gladstone, Newton Wonder.

Self-sterile.—Astrachan, Ribston Pippin, Lord Suffield, Hoary Morning, Warner's King, Nonpareil, Striped Beefing, Sturmer Pippin, Fearn's Pippin, Belle de Pontoise, Duchess's Favourite, Bismarck, Cox's Orange, Beauty of Bath, Hambling's Seedling, King of Tompkin's, Beauty of Kent, Cellini, Worcester Pearmain, Seaton House, The Queen, Rival, Alfriston, Lady Sudeley, Loddington, Blenheim Orange, Waltham Abbey, Prince Albert, Grenadier, Hollandbury, Lady Henneker, Cox's Pomona, Golden Noble, Annie Elizabeth, William's Favourite, Mère de Menage, Sandringham, Graham's Royal Jubilee.

PEARS—*Slightly self-fertile*—Conference, Durondeau, Duchesse d'Angoulême, Colmar d'Eté, Hacon's Incomparable, Marguerite Marillat, Beurré Bosc, Beurré Diel, Doyenné d'Alençon, Flemish Beauty, White Doyenné.

Self-sterile.—Beurré d'Amanlis, Beurré Superfin, Catillac, Emile d'Heyst, Jargonnelle, Josephine de Malines, Louise Bonne of Jersey, Beurré Alexandre Lucas; Clapp's Favourite, Williams' Bon Chrétien, Olivier de Serres, Bellissime d'Hiver, Pitmaston Duchess, General Todleben, Winter Crisanne, Marie Louise, Dr. Jules Guyot, Beurré Diel, Citron des Carmes, Uvedale's St. Germain, St. Luke, Souvenir du Congrès.

PLUMS.—*Self-fertile.*—Victoria and Czar fruit nearly as well self-pollinated as cross-pollinated; Denniston's Superb, Monarch (but should not be planted alone), Early Favourite, Reine Claude Violette, Myrobella, Giant Prune, Early Transparent, Reine Claude de Bavay, Prince Englebert, Early Favourite, Gisborne, Oullin's Golden Gage, Golden Transparent, Pershore, Magnum Bonum (Red and White), Kentish Bush, Warwickshire Droopers, Damsons.

Nearly self-sterile.—Rivers' Early Prolific, Mallard, Stint.

Self-sterile.—Histon Gage, Early Orleans, Sultan, Kirke's Blue, Coe's Golden Drop, Coe's Violet, Washington, Late Transparent, Ickworth Imperatrice, Early Greengage, Old Greengage, Reine Claude d'Altham, Wyedale, Grand Duke, Jefferson, Pond's Seedling, Curlew, Prune d'Agen, Bryanstone.

CHERRIES.—*Self-fertile.*—Morello, Kentish Wye and Late Duke.

Self-sterile.—Black Heart, Elton, White Heart, Kentish Early Rivers, Burg d'Aunay, Black Tartarian, Bigarreau Napoleon, Bigarreau Frogmore, Early Giugne, d'Annonay, May Duke.

GOOSEBERRIES, CURRANTS, RASPBERRIES, LOGANBERRIES AND STRAWBERRIES.—In England all these set and mature fruit perfectly with pollen of the same plant or variety, though some of the strawberries grown in Canada and the United States need to be interplanted with another variety for cross pollination. Insects are absolutely necessary to pollinate gooseberries and white, red and black currants. Raspberries and loganberries give only imperfect fruit if not pollinated by insects, and strawberries, though chiefly pollinated by the movement of the air, doubtless benefit by insect pollination.

THE assistance offered by the Board under these Schemes may be summarised as follows:—

Schemes for the Improvement of Live Stock.

Heavy Horse Breeding.—The Board pay half the service fee payable by an occupier of land with an area not exceeding 100 acres or with a rental of £100 or less, and who is a member of an approved Society and has had a mare or mares served by the Society's stallion. The maximum grant payable by the Board in respect of any one mare served is 25s

Light Horse Breeding.—By arrangement with owners, thoroughbred stallions are provided in selected districts for the service of mares. The Board pay the service fees of a certain number of mares nominated by Committees in each of these districts.

Highland and Shetland Pony Breeding—The Board supply a number of Highland pony stallions to selected districts in the crofting counties for service of mares at the reduced fees of 7s. 6d. and 5s. per mare. It is also arranged with private owners for the travelling of approved stallions in the Highland districts, the Board paying a premium to these owners in return for their giving the services of their ponies at a reduced fee of 7s. 6d. per mare.

Cattle Breeding.—The Board award premiums to Societies in respect of the services by approved bulls of the Aberdeen-Angus, Shorthorn, Galloway, Ayrshire, Highland and Shetland breeds. The grants payable are £15 in the case of Aberdeen-Angus and Shorthorn bulls, £10 for Galloway, Ayrshire and Highland bulls, and £7, 10s. for Shetland bulls, provided that a minimum of forty cows belonging to small farmers, as defined above, are served by each bull. In addition to the assistance given by this means a number of Highland, Shorthorn, Aberdeen-Angus and Galloway bulls, the property of the Board, are supplied to Grazings Committees in the crofting townships, where suitable bulls, eligible for premiums, are not obtainable.

Pig Breeding.—The Scheme for the encouragement of pig breeding is worked on similar lines to the premium bull Scheme, the Board giving grants of £5 each to Societies in respect of the services by approved boars, provided a minimum of ten services are given by any one boar during the year, at a reduced fee, to sows belonging to small farms.

Sheep Breeding.—The Scheme for the improvement of sheep breeding is confined to townships in the crofting counties, and consists in the hiring of rams of the Blackface and Cheviot breeds, either the property of the Board or of farmers in the districts concerned. The hiring fee payable by the townships was previously 10s. per ram, but for season 1919 this has been increased to 15s. A limited number of Border Leicester rams are also supplied to townships in Caithness and Orkney at half cost price, the rams becoming the property of the townships.

During the last five years these Schemes, especially the Heavy Horse Breeding, Cattle Breeding and Sheep Breeding Schemes, have increased to a considerable extent, and the assistance offered has been widely taken advantage of. The results have been particularly gratifying, especially in view of the fact that the effect of the war has rendered it increasingly important that the supply of the live stock of the country should be maintained and improved. Probably the chief result of the Schemes has been the introduction of a better class of sire into certain districts of Scotland, particularly the congested areas and Highland districts. Reports received from the Board's representatives show that this has led to a marked improvement in the animals reared from these sires, and exposed for sale in the local auction marts. For example, in one district a Society with the assistance of the Board's grants procured five high class Aberdeen-Angus bulls, and the development has been so satisfactory that the members of the Society now hold a special sale of suckled calves which are keenly sought after by breeders and feeders from a wide area. Therefore not only do those who benefit from the services of a better animal realise increased financial return, but the feeder also is being provided with a superior class of animal, which is easier fed and will give a greater return in a shorter period than those formerly bred. It is also within the knowledge of the Board that farmers who formerly kept an inferior bull for themselves and neighbouring small holders do not hesitate, with the assurance of the grant from the Board, to buy greatly superior animals, and are enabled to give the services of these latter to the small holders at a reduced fee.

The following table shows the number of sires provided and the number of services given under each of the above Schemes during season 1918.

	Heavy Horse Breeding.	Light Horse Breeding.	Highland and Shetland Pony Breeding.	Cattle Breeding.	Pig Breeding.	Sheep Breeding.
Number of Sires provided	161	13	44	722	70	1064
Number of Services given	6314	672	1326	36,269	2077	—

Scottish Women's Rural Institutes.

DURING the last three months there has been a steady development of Institutes' work in Scotland.

The north-western area has now the greatest number of Institutes as compared with other Scottish areas, owing to the formation of a considerable group in Argyllshire and to the addition of new Institutes in the Fort William district.

The development of co-operation between the Institutes which have been formed for some time is exemplified by a combined meeting at Tranent at which thirteen villages in the south-eastern area were represented. A series of very successful inter-Institute competitions was held, and included exhibits in all branches of women's work which are of interest to the country women.

In Fife the Women's Institutes undertook to be responsible for an industrial section at the Ladybank Show. The exhibition was carefully organised and resulted in a display of local talent of a high order.

It is probable that as the Institute movement develops the larger places will form a focus towards which smaller Institutes in the vicinity may tend to converge.

Fort William has already taken steps in this direction and the Institutes in the district are working together in regard to arrangements for their meetings. Such co-operation is especially valuable in remote localities, where speakers and demonstrators, apart from those provided by the Board, can be obtained only at considerable intervals.

The Conference of Delegates from all Scottish Institutes will be held in Edinburgh on July 8th. During the year the Institutes have doubled in number and almost trebled their membership. The Institutes are also undertaking to supply an exhibit for the Highland and Agricultural Society's Show, by which it is hoped members may give some idea of the variety of work and interests which exists in the rural districts of Scotland.

Agricultural Conditions.

DURING the first three weeks of April the weather was generally favourable for agricultural operations, especially in the south-eastern and south-western counties It turned very cold in the last week of the month, culminating in a snow-storm of exceptional severity. The weather during May was warm and sunny, and by the end of the month rain was needed in most parts, especially in the case of light land. Uninterrupted progress was made with farm work, and the arrears of spring work were to a large extent made up. The heat continued during the early days of June, and on the 12th there occurred a thunderstorm, which in Ayrshire and other western counties was extremely violent and was accompanied by torrential rain Since then, with fairly strong westerly winds, the weather has been cool and unsettled.

Wheat recovered to some extent during April from the March frosts and made good progress during May, but on the whole it is still under the average in condition, many fields being thin, while in Forfar and Perth insect pests have caused damage. Barley and oats were sown late, but brairded well; growth was retarded by the drought of May, but the recent rain has brought the crops on fairly well. Young grasses and clover are healthy, but the season has been against their growth, and the hay crop will be rather light.

Potato planting was carried out under the most favourable conditions, and the lifting of the earlies has now begun. Turnip

sowing was later than usual, and germination was slow; rain came however in time to give the crop a fair start, and little resowing appears to have been found necessary. Mangolds made a good start except in south Ayr, where the brairds failed owing to some cause not yet ascertained.

Fruit-trees were exceptionally prolific in blossom, and the general prospects of both tree and small fruit are fair. Gooseberry mildew is, however, prevalent in south-east Perth, and caterpillars have caused damage to small fruit in Lanark.

Grazing cattle, dairy cows and sheep on arable farms have made good progress, although grass was becoming less plentiful towards the end of May. Hill sheep suffered exceptionally from the severe storm at the end of April, following on cold weather during the preceding months; their condition improved materially during May, but in most districts they are still rather thin. The lambing season was a normal one among flocks on arable farms, but on the hills the snow-storm had disastrous results, large numbers of ewes and lambs being lost, while many of the survivors are in poor condition.

While the labour situation continues to improve through the gradual demobilisation of agricultural workers, there is still a shortage of skilled men in parts of Aberdeen, Forfar, Perth, Argyll, Ayr, and some of the northern counties, while casual labour is almost everywhere difficult to obtain.

The proposed withdrawal of the men belonging to Agricultural Companies was, in consequence of strong representations, modified by the concession that 10 per cent. of the men should remain on farms, and this was afterwards raised to 20 per cent. The Board are now, in conjunction with the Ministry of Labour, taking steps to ensure, if possible, an adequate supply of harvest labour.

RECENT PERIODICAL LITERATURE.

The majority of the following extracts and summaries are taken from recent bulletins of the International Institute of Agriculture. Full references to the bulletins, and to the original publications quoted therein, may be obtained on application to the Secretary, Board of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh

Food Chemistry in the Service of Human Nutrition. *H. C. Shermann Jour. of Industrial and Engineering Chemistry.*—The author discusses in detail the question as to how adequacy of nutrition can be combined with such a use of food as to produce both financial and national economy.

An adequate diet should provide sufficient amounts of digestible organic nutrients to yield the necessary number of calories of energy. The average hourly expenditure of energy by an average man (70 kg.) under different conditions of activity is (calories):—

Sleeping, 60-70; awake, lying still, 70-85; sitting at rest, 100; standing at rest, 115; tailoring, 135; typewriting rapidly, 140; bookbinding, 170; light exercise (bicycle ergometer), 170; shoemaking, 180; walking slowly (about 2¾ miles per hr.), 200; carpentry, 240; metal working, 240; industrial painting, 240; active exercise (bicycle ergometer), 290; walking actively (about 3¾ miles per hr.), 300; stoneworking, 400; severe exercise (bicycle ergometer), 450; sawing wood, 480; running (about 5¼ miles per hr.), 500; very severe exercise (bicycle ergometer), 600.

The daily food allowances for healthy boys should provide a quantity of energy equivalent to 900-1200 calories for boys under 2 years, 1200-1500 for those from 4 to 5 years, 1700-2000 for those from 9 to 10 years, 2600-3100 for those from 14 to 15 years, 2700-3400 for those from 16 to 17 years. The requirements of girls are somewhat lower, especially after 8 or 9 years. The maintenance of an optimum degree of fatness (which, as Symonds has shown, is very near the average of healthy Americans) is usually the best evidence that the energy value of the diet is well adjusted to the needs of the individual. The estimation of the calories in the food is not necessary as a means of establishing the adequacy of the customary food intake if this is already established by the obvious condition of nutrition of the individual concerned; but if it is a question of rationing either an individual or a community, then adequate energy value of the ration is the first thing that must be considered, for only when the energy supply is adequate can the tissue-building constituents of the body and of the food be conserved to the best advantage.

The author estimates the daily protein requirement of a man to be about 75 gm. The requirements of children for protein as well as other tissue-building material will be considered as proportional to their energy requirements, and therefore much higher per unit of weight than in the case of adults. An adequate diet should provide a suitable quantity of ash constituents and furnish them in suitable proportions. A series of researches show that the average American dietary contains a much more liberal margin of protein than of either phosphorus or calcium, and that while the danger of a protein deficiency is rarely serious the danger of a deficiency of phosphorus or calcium is more important. Phosphorus deficiencies are plainly more frequent than are deficiencies of protein, and calcium deficiencies are more frequent still. The old assumption that adequate protein may be taken as meaning adequate supplies of all tissue-building material is found to be wholly misleading.

The iron requirement may average about 0·010 gm., and the corresponding standard be placed at 0·015 gm. per man per day. On this basis it would appear that the danger of a deficient intake of iron on freely chosen diet is less than in the case of calcium, but much greater than is the danger of a deficiency of protein.

For growing children the standard allowances of these substances in grams per 100 calories may be reckoned as 2·5 gm. of protein (which should be mainly in the form of milk protein in the dietaries of growing children), 0·048 gm. of phosphorus, 0·023 gm. of calcium, and 0·0005 gm. of iron. In addition an adequate diet supplies the organism with sufficient quantities of those substances so far unidentified, *i.e.* food hormones or vitamines.

The vitamine requirement cannot be stated in term of actual weights of Fat-Soluble A and of Water-Soluble B, but the percentages of certain foods rich in the one or the other of these essentials which suffice to make an otherwise satisfactory diet adequate for normal growth and reproduction have been determined experimentally by Osborne and Mendel and by M'Collum and his associates, so that the relative richness of several of the chief types of food in these dietary essentials is known in a general way: this factor of food value can thus be taken into account in considering the prominence which should be given to each type of food in planning an adequate and economical diet. It is very interesting to find how generally the types of food rich in calcium (milk, eggs, vegetables) are rich in vitamines as well, so that in safeguarding against deficiency of the element most likely to be deficient, an ample intake of vitamines is assured.

An adequate diet should include a sufficient amount of material of such physical character as to insure the proper handling of the food mass and its residue in the digestive tract.

Dealing with the application of these principles to the choice of food, the author says that "it seems a good general rule for families of any level of income or standard of living to spend at least as much for milk as for meat, to spend at least as much for vegetables and fruit as for meats and fish."

As regards substitutes for wheat the author adds: "To the extent that the saving of white wheat flour means an increased use of the coarser flours and of oatmeal and potatoes in breadmaking (or potatoes in place of white bread) this also will result in an improvement in the mineral and vitamine content of the diet. To the extent that wheat flour is replaced by maize-meal we may anticipate no appreciable gain or loss in nutritive value."

The "Integral" Method for the Growth of Cereal Crops. *J. Pequito Rebello.*—The author describes the method devised and applied by him, which consists in uniting a number of improved methods of cultivation advised (some a long time ago) by eminent experts and successful farmers. He describes these methods, discussing them separately:—early and thin sowing made with well-chosen seed (Hallet method); repeated shallow cultivation between the rows to keep the soil fresher, and moister at a depth (Algerian or Bourdiol method); an improved, worked summer fallow (Jean method); sowing in small furrows that are filled up and rolled to encourage tillering (Demtchinsky method). The author's method, which for this reason is called "integral," consists in the following operations:—(1) early sowing, after September; (2) choice of a variety with high tillering powers and very resistant to rust; (3) sowing in lines about 32 in. apart, with only ½ the quantity of seed usually sown in the locality where the integral method is being applied; (4) sowing on furrows in the bottoms of which is put the manure or fertiliser and then the seed, which is covered with a shallow layer of soil so that the furrow in which the plant will appear remains open; (5) during the first stage of growth, hill up slightly once or twice, topping once or twice, and roll one or more times, which will result in greatly stimulating tillering and the developing of adventitious roots; (6) during winter, profiting from the wide spaces between the lines, a few small furrows are opened alongside each row of cereal to help surface drainage; this operation can be combined with hilling up; the field is so arranged that the plants grow on the crest of a small ridge, leaving a larger and higher ridge in the midst of the space between the rows; (7) repeated harrowings should be given in spring, so that the field will be covered with a fine layer of soil that will prevent drying up and the growth of weeds; (8) in the following year, the same cereal, or that following in rotation, will be sown in the space between the lines, where the soil has been rested and is yet perfectly prepared just as if it had been a cultivated fallow.

The author tested his method on his estate at Alemtejo with poor, tertiary soil, where ordinary methods hardly produce 8·9 bush. of wheat per acre; he obtained 11·1 bush. without needing a fallow and with a saving of 43 pints of seed and 178 lb. of superphosphate per acre. He states that he obtained an income of 70 milreis per hectare (£6, 6s. per acre) in a district where the sale price of land is rarely more than 10 milreis per hectare (about £1 per acre).

The integral method was also tried in the North of Portugal. In the "Posto Agrario" of Minho Litoral 45 bush. per acre were obtained with a quantity of seed equal to 56 per cent. of that usually sown, whilst the crop grown by ordinary methods had never been more than 11·1 bush per acre; fine ears were obtained.

In the district of Caldas das Taipas, a well-known agriculturist, Dr. S. Garcia, tried the method, and obtained a yield of 575 fold with rye and 126 fold with wheat. The latter formed tufts having as many as 130 stems and very fine ears; there was a saving of both seed and fertiliser.

Destruction of Wheat by Weevils in Australia. *Jour. Dept. Agr., Victoria*, vol. xvi., 1918.—The hasty storing of wheat in Australia during the war led to an abnormal increase in the numbers of wheat weevils (*Calandra granaria*), and the recognition of the seriousness of the damage caused by them was followed by the appointment of a South Australian Weevil Committee with instructions to deal with the question of losses and their prevention. Many experiments have been carried out under the supervision of this body with a view to destroying the pests, but the greatest difficulty has been to discover a practical method of dealing with the enormous quantities of infested wheat. Limited tests, however, tend to show that poisoning by means of gases passed through the stored wheat offer the best chances of success. Carbon dioxide was very effective. In an experiment carried out with 8500 bags of heavily infested wheat, a mixture of carbon dioxide, 20 per cent., and nitrogen 80 per cent., with no free oxygen, was passed into the stack of bags, which had been made as airtight as possible with a covering of malthoid. Later examination showed that millions of weevils had been killed, that not one could be found alive, and that larvæ and pupæ also had perished in the process, which was accomplished in bulk without any handling of the wheat itself.

Investigations into Soil Acidity in the United States. (I.) *F. E. Allison;* (II.) *E. Truog;* (III.) *J. W. White.*—I. EFFECT OF AMMONIUM SUL-

PHATE ON SOIL ACIDITY.—It is well known that this manure increases the acidity of the soil to such an extent that, in extreme cases, it prevents crop growth. The author undertook to determine:—(1) this increase in acidity; (2) the effect of removing part of the added nitrogen by means of crops. The soils used were:—1 nearly pure quartz sand, 1 sand, 1 sandy loam, 2 loams, and 1 clay. All were acid except the third. The experiments were carried out in greenhouses in series of 4 pots, each holding 2·5 lb. of soil + 1 gm. of superphosphate + 1 gm. of potassium sulphate. Half of the pots also received 0·5 gm. of ammonium sulphate. One of each of the treated and untreated pots was planted with buckwheat. At the end of every three months a further 0·5 gm. of ammonium sulphate was added till 2 gm. in all had been given. Throughout the whole experiment four crops were grown.

Results.—At the end of a year there was little difference in the increase of acidity in the different soils without ammonium sulphate whether cropped or fallow. The smallest increase occurred in the quartz sand and the greatest in the loam, but there was no relation between this increase and the texture of the soil.

In the soils with ammonium sulphate the increase in acidity was much greater than in the former (control) pots. The partial removal of nitrogen in the crops decreased appreciably the acidity of the quartz sand and clay soils, increased it in the loam soils, and left it practically the same in the other three. The average increase in acidity in the soils used (excluding the quartz sand) was 4140 lb. of calcium oxide per 3,000,000 lb. of uncultivated soil, and 4240 lb. in soil which had yielded four crops of buckwheat.

The increase in acidity produced by 100 lb. of ammonium sulphate corresponded, on an average, to 80 lb. of calcium oxide.

II. SOIL ACIDITY IN ITS RELATION TO PLANT GROWTH.—The question is first discussed generally and 49 publications on soil acidity reviewed. From the data obtained from various sources the author has compiled a table showing the relation between the lime requirement of various plants and their response to the liming of acid soils, or their capacity to grow in acid soil.

Conclusions.—The amount of lime to be applied in practical agriculture depends on: (1) the lime requirement of the crop grown; (2) the acidity of the soil; (3) the fertility of the soil. The lime requirement of a plant is subjected to the following factors: (1) lime content of the plant, (2) rate of growth of the plant, (3) feeding power of the plant for lime, dependent on (*a*) extent and character of root system, (*b*) internal acidity of roots, (*c*) excretion of carbonic acid by the roots.

By comparing the figures given in the table, especially those expressing the lime requirement of the different plants, with those representing their capacity to grow in acid soils, a confirmation will be found of the theory that the chief disadvantage of the acidity of the soil is that it prevents the plants (especially those requiring much lime, but absorbing it with a certain amount of difficulty) from drawing this base from the soil quickly enough to satisfy their requirements. These considerations are important in devising a practical and rational liming system.

III. SOIL ACIDITY AS INFLUENCED BY GREEN MANURES.—The investigations deal with the effect on the acidity of the soil of applications of organic matter (green and poultry and barnyard manures) to an acid soil from plots fertilised with ammonium sulphate for several consecutive years. With lots of soil of 500 gm. each were mixed either finely cut plants for green manure (soybean, Canada field pea, sweet clover, alfalfa, red clover, hairy vetch, wheat, rape, oats, maize, rye, timothy, redtop, sorrel), or barnyard or poultry manure, in quantities corresponding to 10 gm. of dry matter. These mixtures were put in large jars and kept in the open for two months and then in a room, the optimum moisture content being maintained throughout the nine months of the experiment.

Results.—During the first two weeks the lime requirement of these mixtures decreased by about one half, whereas that of the control lots did not change. An increase in the lime requirement was then observed which subsequently greatly exceeded that of the soil at the beginning. At the same time the nitric nitrogen content increased continually till it was double that of the control lots. This increase in nitrogen alone is not sufficient to account for the increase in the lime requirement.

Similar experiments made with the same green manures previously dried gave the same results, except that the changes were lower.

Analyses showed that, at the end of the experiment, the soils with green manure contained more organic matter than soils without this fertiliser, although quite three-fifths of the vegetable matter added had disappeared during the experiment, the remainder having formed humus soluble in dilute alkalis. The plants added in a dry condition were as decomposed as those added when green. The lots with stable or poultry manure always contained more nitric nitrogen than the controls.

Conclusions.—In an acid soil, such as that of the experiment, fresh green manure decreases the acidity when first dug in, but increases it later. Nitrification occurs under favourable temperature, moisture, and aeration conditions, and the nitric nitrogen content of the soil increases, in spite of its acidity. The increase in acidity is not due, or largely so, to nitrification, but seems to depend on the organic matter added or its fermented residue, though the experiments gave no exact indications on this subject.

The Chemical Effects of Applying Lime to the Soil. (I.) *D. R. Hoagland and A. W. Christie;* (II.) *A. W. Christie and J. C. Martin, Soil Science, Baltimore.*—I. THE EFFECTS OF CALCIUM OXIDE AND CALCIUM CARBONATE ON SOIL REACTION.—For some time this question has aroused great interest among agriculturists in connection with the form in which lime should be applied to the soil as a fertiliser. It is known that quicklime (CaO, CaO_2H) is sometimes injurious immediately after application even if it be admitted that carbonation takes place so rapidly that its ultimate effect is the same as that of the application of calcium carbonate ($CaCO_3$). Nevertheless the authors considered it advisable to make a closer study of these phenomena by using the hydrogen electrode method for determining the hydrogen-ion concentration in soil suspensions.

Three types of soil are used :—(1) clay adobe, (2) sandy loam, (3) silty clay loam. When added to the soil the calcium oxide first caused a strong concentration of hydroxyl-ions, which decreased after a few days and continued to decrease slowly. Nevertheless the treated soils were very alkaline, even after some months, as compared with untreated soils or those to which calcium carbonate had been added. A large excess of calcium oxide may, in certain soils, maintain such a high hydroxyl-ion concentration as to inhibit nitrification. The ultimate effects of calcium oxide and calcium carbonate are not necessarily identical, and more exact observations should be made of the reaction (hydrogen-ion concentration) caused by lime in its chemical and biological effects.

II. EFFECTS OF CALCIUM OXIDE AND CALCIUM CARBONATE ON THE WATER-SOLUBLE NUTRIENTS IN SOILS.—Three types of soil were examined : Three sandy loams, two silty clay loams, and one clay adobe. In some cases the concentration of the soil solution was increased by the addition of calcium oxide, the effects of which were more marked than those of calcium carbonate. The effect of lime on soil depends partly on the previous treatment of the soil, especially on the concentration of its solution. The effect was more pronounced in recently cultivated soils or those with a low initial concentration.

Liming increased the water-soluble potash in two soils only and decreased it in two others. The soluble magnesium content was increased in four soils and decreased in one. The soluble sulphates were increased in four soils. In two soils only was there any appreciable increase in soluble phosphates.

The data concerning the solubility of the nutrients were controlled by determinations of the freezing-point and electrical conductivity.

Conclusions.—All soils do not react chemically to lime in the same manner, and a single soil may react differently according to the different concentrations of its solution due to cropping or fallowing. Though it is not possible to explain the reasons for the changes, it is clear that the addition of lime compounds modifies the equilibrium of the complex soil solution and that the effects are varied and impossible to predict. To explain these phenomena satisfactorily it must be possible to determine all the elements concerned in liming.

Twenty Years' Work on the Availability of Nitrogen in Nitrate of Soda, Ammonium Sulphate, Dried Blood and Farm Manures. *J. G. Lipman and A. W. Blair, Soil Science, Baltimore.*—The problem of the availability of nitrogenous fertilisers has occupied the attention of the principal

European experiment stations for about thirty years. About twenty years ago this question began to be studied in America as well, and the results obtained there confirmed, on the whole, those of European workers. The authors describe a series of investigations lasting over twenty years (1898 to 1917) made with five-year rotations grown in galvanised iron cylinders set in the earth. The sub-soil used was gravelly sand and the top soil loam. The basic fertiliser was made up of ground limestone, 640 lb. per acre of superphosphate and 320 lb. per acre of potassium chloride. The first rotation, begun in 1898, included: (1) maize, (2) oats or millet, (3) oats or maize, (4) wheat, (5) timothy. The second rotation, begun in 1903, included the same crops except that the oats might eventually be replaced by maize. The third and fourth rotations were similar to the second except that, in the third, rye and oats were grown together instead of wheat. The nitrogenous fertilisers used were farm manure at the rate of 16 tons per acre, of sodium nitrate 320 lb. per acre, of ammonium sulphate and dried blood the equivalent of 320 lb. of sodium nitrate per acre.

RESULTS.—The amount of sodium nitrate used gave better results than the equivalent amount of ammonium sulphate or dried blood. During the first ten years these two fertilisers gave results almost equal to those obtained with sodium nitrate, but after this period increased the yield less and less. The average amount of nitrogen recovered in the crops during the twenty years was 62·42 per cent. with sodium nitrate, 47·48 per cent. with ammonium sulphate, 38·69 per cent. with dried blood, and 32·69 per cent. with cow manure. Cow manure applied at the rate of 16 tons per acre gave yields slightly superior to those obtained with sodium nitrate, but the difference was not sufficiently great to justify the higher cost of applying nitrogen in this form.

CONCLUSIONS.—Sodium nitrate as the sole source of nitrogen can, if suitably supplied, maintain high yields for a long time. Nitrogen supplied in this form is more efficacious than an equivalent amount of nitrogen supplied in an ammoniacal or organic form. The effect of sodium nitrate is to produce larger crops per unit of nitrogen. At the same time the crops leave in the soil a larger quantity of crop residues, so that, when calcium carbonate is added to dissolve them, a sufficient supply of organic matter is obtained to keep the soil in good physical condition.

The Effect of Gypsum upon the Solubility of Potash in Soils. *P. R. M'Miller, Jour. of Agric. Research, Washington.*—Previous investigations into the solution of potash in soil by gypsum have not been undertaken in the field. The author, therefore, carried out experiments in which soil with which gypsum was mixed was kept for several months under moisture conditions similar to those existing in the field. This moisture in fine-textured soils in damp districts when evaporation is low and plants absent is somewhat below the moisture equivalent.

Five different types of loam were used, and to each was added 1 per cent. of gypsum and the amount of water necessary to maintain approximately the moisture equivalent. These samples, as well as the controls, were kept in covered flasks, then extracted with water. The potash content of the filtered solutions was then determined by the chloroplatinate method. In the soils to which gypsum had been added there was a considerable increase (almost the double) of the soluble potash content as compared with the extracts of the control soils. The fact that in previous investigations the action of gypsum did not cause such an increase in soluble potash is probably due to the conditions of contact between the soil and the gypsum which differed from those found in the field and reproduced by the author in his experiments.

Meat Production in Relation to the Capacity of Cattle to gain Weight: Investigations made in Italy. *E. Aruch.*—One hundred steers were chosen at Parma, all having special capacity for gaining weight, and 20 steers with the opposite characters. The two lots were kept under observation during 30 days under identical conditions, and were fed identical rations. At the beginning of the experiment the 100 steers chosen weighed 88,651 lb., and at the end 94,740 lb., *i.e.*, their live weight increased by 6089 lb. in 30 days, or 2·29 lb. (or 0·221 per cent.) per head daily. The corresponding figures for the 20 unselected steers were 20,565 lb., 21,025 lb., 459 lb., 0·76 lb. (0·073 per cent.).

In a similar experiment made at Lodi, 50 selected steers gave, from September 12 to October 12, 1917:—initial weight 39,188 lb., final weight 41,406 lb.,

increase in live weight in 30 days 2218 lb., daily gain per head 1·73 lb., percentual gain 0·221. The corresponding figures for 20 unselected steers were :—20,108 lb. 20,603 lb., 495 lb., 0·825 lb., 0·105 per cent.

The two experiments, carried out independently of each other, gave, therefore, results which are in perfect agreement and of great importance. The author recommends the time taken up in central depots for observation and the necessary rest to be utilised in obtaining the greatest possible increase in live weight by removing the steers with low fattening qualities first and those with high fattening qualities last. He himself uses this method with excellent results and without any disorganisation of the service.

Spread of Sheep Lice and Ticks in Australia. *T. H. Williams, Jour. Dept. Agr., South Australia*, vol. xxii., 1918.—In recent years a great increase has been noted in the numbers of the sheep louse (*Trichodectes sphærocephalus*) which, imported to Australia on Lincoln sheep some thirty years ago, now infests every breed, and has become acclimatized even in the northern districts. It has been estimated that should the pest be allowed to increase as it has done in the past two years it will account for an annual decrease of from 15 to 20 per cent. in the State wool clip. Energetic measures are therefore demanded, and in order to check the sheep louse, and the sheep tick as well, dipping has become compulsory from September 1918, throughout a wide area, under heavy penalties for neglect. Sheep still infected after January 1919 must be reported to the chief inspector, may not be moved without permission, may not travel along roads, and may not be exposed in any sale-yard.

Egg-Producing Values of Some Texas Feeding Stuffs. *R. N. Harvey, Texas Agric. Experiment Station Bull.*—The aim of the experiments described was to determine (1) whether rations composed entirely of vegetables are as profitable for egg-production as those containing animal products (meat scraps, whey); (2) the comparative food value of skim milk, cottonseed meal, meat scrap, and peanut meal for laying-hens. The experiment, begun on December 20, 1916, lasted 24 weeks. The hens were White Leghorns of good strain, and were kept in enclosures. The rations consisted of milk, bran and shorts, with a protein supplement composed of skim milk for Lot 1, cottonseed meal for Lot 2, meat scrap for Lot 3, and peanut meal for Lot 4. The protein foods were given in such quantities as to supply equal amounts of protein, taking that of meat scraps as a basis. The average egg production per hen for the 24 weeks was for each lot respectively :– 89·95, 59·95, 75·31, 56·80. The cost of producing one dozen eggs was $0·166, $0·199, $0·172, $0·205, respectively. The number of pounds of food required to produce 1 dozen eggs was 9·41, 5·75, 4·86, 5·8 respectively. The lots costing most per hen gave the highest profit per hen. Hens receiving animal product were more profitable than those receiving only vegetable food. Vegetable food with a high protein content does not seem capable of replacing animal products in the ration. The hens preferred the ration containing animal products, and ate it in large quantities. Sour skim milk appears more profitable than meat scraps as a source of protein when obtainable at a reasonable cost.

Deterioration of Eggs Considered from the Point of View of Sanitary Inspection. *Martel, Revue Scientifique, Paris.*—Candling in a dark room is the best method of testing eggs. The author's investigations led him to classify the spots reported by professional candlers. He shows that Germain's hypothesis, that eggs with mobile spots are practically exempt from bacteria, is subject to exceptions.

Mobile spots usually show beneficial changes—thick chalazas, foreign bodies, dark yolk, autolysis of the white with setting free of chalazas, embryo little developed.

Eggs with so-called "*red rot*" are distinguished by the presence of diffused shadows or cloudiness, and the contents are reddish, showing the broken yolk to be mixed with the white (eggs rarely rich in bacteria, but attacked by mycelium where the yolk is in contact with the shell). On account of the very marked and often disagreeable smell and flavour of these eggs, they are refused by the consumer.

Long incubated eggs show the same characteristics as those with red rot.

In *very old eggs* the yolk adheres to the shell at a point diametrically

opposed to that on which they are resting; turning the eggs sharply during candling prevents this adherence.

Mouldy eggs have spots, called "mouldy or damp," which are always immobile and very obvious; the centre of these spots turns black, sometimes red or violet (presence of chromogen bacteria). The large, fixed spot is observed especially in eggs on sale at the end of summer or in winter. Numerous damp spots are found especially in summer in badly packed eggs or those sent by sea (Moroccan or Russian eggs). The ascomycetes most commonly found are *Aspergillus* and *Penicillium* (in the ratio of 3 : 1 in 114 hens' eggs studied by the author). Eggs showing, when candled, concentric halos round the mould spot contain colonies of bacteria which can easily be distinguished from the moulds, even with the naked eye. Mouldy eggs often contain no bacteria. Eggs which have recently become mouldy may be used in biscuit-making, but mouldy eggs containing bacteria give off a disagreeable smell and are unfit for consumption.

Eggs with so-called "*black rot*" are often spotted eggs, the central black part of which has spread gradually till it has invaded the whole egg. All forms of putrefaction has not yet been described.

Badly frozen eggs[1] (faulty packing, insufficient freezing) usually show at first small, red spots of dampness which become large black spots and rapidly spoil the egg.

The putrefaction of eggs preserved in lime is easily distinguished. In addition to the characteristics of the shell (roughness, fragility, great porousness) the white of such eggs is very transparent. The yolk is also extremely mobile, and appears, through the watery white, as a shadow of marked outline, and of a colour varying from tawny to sepia-black, according to the degree of putrefaction. The yolk of very bad or "*burnt*" eggs does not adhere to the shell, but when broken gives off a disagreeable smell. The yolk is dark and liquefied, the white almost always reddish and rich in bacteria. Deterioration affecting the taste and colour are not shown by candling. Fresh eggs very slightly affected by bacteria during development have all the characters of healthy eggs.

These data, whilst showing the difficulties with which a service for the sanitary inspection of eggs has to contend, prove that, in most cases, candling may be satisfactorily adopted.

Crushing Locust Beans. *A. Gouin and P. Andouard, Jour. d'Agric. Pratique, Paris.*—The authors do not agree with M. R. Gouin as to the necessity of crushing locust beans. M. R. Gouin quoted cases of mishaps to horses which he attributed to feeding on whole locust beans. In the experiments made by the "Association agricole" the beans were fed chiefly to pigs and horses and no ill effects were reported. Nor did the experiments justify the fear of harm being done by the woody ends of the bean. Moreover, the pods have been fed to horses from time immemorial in districts where the plant grows.

Two mares were fed on whole locust beans. One gained 908 gm. daily as compared with 821 gm. before, and the other 893 gm. as compared with 570 gm. before. Pigs gained 667 gm. daily on rations $\frac{3}{4}$ of which were formed of locust beans, the remainder being composed of cake and bone powder. The food value of the locust bean is due chiefly to the digestible carbohydrates which an analysis made by the authors showed to be present in the proportion of 41·65 per cent.

Curative Treatment of Horse Mange. *E. Torti, Turin.*—Before the war horse mange attracted the attention of practicians in a limited measure only, on account of the easy treatment and the facility of prophylactic measures, but during the war it has assumed such proportions in all the armies that it alone has given more work to the veterinary surgeons than all the other diseases put together.

As the author had the opportunity of treating a group of 300 horses, he proposed to find the experimental answer to the following questions: (1) Does a remedy exist that can prevail absolutely over the others? (2) which treatment is preferable from the standpoint of economy and rapid action? (3) Can horse

[1] The air chamber of well frozen eggs is slightly enlarged. The yolk is not mobile, as in other eggs preserved for a long time. The white becomes reddish.

mange be cured by an exclusively mechanico-detersive treatment without the intervention of any medicament?

The treatment consists in:—dipping followed by washing twice all over with a 5 per cent. sodium carbonate solution; carefully cleaning the epidermis; curative treatment (5 applications at successive intervals of 4, 5, 8, 13 days) with the mange remedy tested (which, for the different groups of animals was one of the following:—Creoline; phenolised extract of tobacco; sodium hyposulphite and hydrochloric acid; soap solution of formol; sulpho-alkaline soap; Helmerich pomade; mercurial ointment); currying; douches; cleansing and disinfection of the stables, etc.

Six weeks after beginning treatment (*i.e.*, after 5 applications), 20 per cent. of the animals were cured; this percentage belonged mostly to the groups treated with pomade; the rest of the animals received two or three applications of Helmerich's pomade or mercurial ointment, or simply melted horse fat, and were then washed all over with the phenic extract of tobacco. After 20 days 50 per cent. of the animals that were still affected were cured, and after two and a half months the malady had entirely disappeared.

CONCLUSION.—(1) Of all the mange remedies tested by the author there is no one that is absolutely superior as regards its therapeutic efficiency.

(2) In the case of severe mange of long standing, the best treatment is the mixed one, consisting in the use of a watery solution and a fat, while, in less severe and recent cases, a simple watery solution suffices (*e.g.*, phenic extract of tobacco); manual care should be considered as an integral part of the treatment.

(3) A simple mechanico-detersive treatment (very diligent manual attention, washing with water, and, in the graver cases where this treatment does not suffice to detach the epidermal crusts, anointing with horse fat) suffices to cure mange, no matter how serious or of long standing it may be.

Vole Plague in Hampshire. *A. Trevor-Battye, Gardeners' Chronicle*, 1919, p. 134.—In 1917 unusual numbers of Field and Bank Voles appeared in Hampshire, in 1918 the numbers vastly increased, so that one gardener trapped during the year more than 700, and this year a still greater increase in numbers is noted. The account recalls the vole plague which in 1892 affected some 30,000 to 40,000 acres of the Scottish Lowlands, rendering some 12,000 to 15,000 acres "entirely useless," but in Hampshire the distribution of the superabundant voles appears to have been very local up to the present time. Nevertheless, the unusual supply of food is said to have accounted this year for the "unusual appearance" of sea-gulls on the pasture lands, and for the "quite phenomenal" number of kestrels which were seen last year. Perhaps the efforts of these destroyers will avail in keeping the Hampshire vole plague in check.

The Agricultural Utilisation of Tanks and Heavy Tractors. *A. Cadoret, Les Alpes Industrielles.*—To level trenches and shell holes the author suggests the use of tanks and heavy tractors for hauling digging ploughs, double mould-board ploughs and heavy levellers. Coupled in pairs, at adjustable distances, the cultivator tanks would soon fill up the cavities. A leveller placed between two tanks, capable of moving 1 or 2 cubic metres, would finish off the rough work.

The shell holes would at first be attacked simultaneously on all four sides with digging ploughs, following immediately after with the leveller. Once the rough general levelling is done, the large tractors would be used, transformed into hauling tractors or agricultural tractors, to finish all the operations preliminary to sowing.

Powerful chain or wheel tractors are available which require only fitting out. The tanks could also be used for opening the ditches bordering on the roads or for drainage. Tanks or tractors fitted with cable drums could be adapted to do digging work by the Fowler method.

The International Harvester Corporation's Sheaf Shocker. *Implement and Machinery Review.*—Description of the sheaf shocker made by the International Harvester Corporation of Chicago. As the bundles come from the binder deck they are transferred by a fork to the shock setter, the bundles being alternately deposited first on one side of the setter and then on the other, the butts being spaced and the tops overlapping, so as to make a wedge-shaped

shock. When the setter has received sufficient bundles to make a shock, a trip is automatically operated, this causes the shaft of the shocker knotter to rotate and to operate the compressor arm and the needles, which compresses the bundles and ties them together. The shock setter is wider at the rear than at the front to assist in making shocks that will stand well when discharged. It is provided with an inclined bottom, which is pivoted, permitting it to tilt to the rear and discharge the shock after it is compressed and tied. The arm under the shock setter has a roller at the end which comes in contact with the shock setter bottom. This arm is rocked in such a way as to tilt the bottom of the shock setter with a quick movement which sets the shocks squarely on the ground. When the shock setter tilts to discharge the shock two tines spread the butts of the back and corner bundles to give the shock a substantial base. The crankshaft of the binder transmits the necessary driving power to the shocker, and the draft connection between the two machines allows the shocker to move independently of the binder when working on uneven ground.

This machine was much used in 1918 in American and Canadian harvest fields, but it will not be placed on the European market until its success has been completely established in America.

New Method for Using Explosives in Planting Trees and its Advantageous Use in the Rapid Reconstitution of Orchards in Devastated Regions. *A. Piédallu, Comptes rendus de l'Académie des Sciences.*—The author has noticed that wild plants grow with rare vigour on the edges of old shell holes or old trenches destroyed by explosives. This vigour is probably due to the cracking of the soil and its impregnation by nitrogen compounds. This fact recalls the experiments made in the Western United States on planting 2-year-old cherry trees in holes blasted out by dynamite. The cherry trees planted in this way reached a height of 10 feet, while the same trees planted with a spade remained weakly, barely reaching 5 feet in height.

The author has attempted to apply these observations and experiments practically with the collaboration of M. Malhoué.

They have found out the composition of an explosive that resists shock and damp, which can be moulded, is quite free from chlorine, is very powerful in small volume, and explodes only under the action of a fulminate primer. This forms a cartridge to which is added a bottom of fertilisers, varying according to the soil —phosphates, nitrates, potash, etc. The cartridge is formed of a celluloid tube, in strong paper or cardboard, serving as an envelope and ending in a cone or closed by a stopper of the same form. The compressed fertiliser is placed in the bottom of the tube round some explosive, then comes the cylinder of explosive, in which there is a hole to receive the fulminate primer. The whole is closed by a cork pierced with a hole, through which passes, in a somewhat tight fit, the bickford match attached to the primer. The explosive and the accessory bottom are paraffined on the outside.

To use the cartridge, a 60 cm. hole is made with an iron rod or other tools. In suitable soil the hole is made with a wooden cone of a diameter slightly greater than that of the cartridge, down to a depth of 60 cm.; the cartridge is inserted, the match lit, when those present retire to cover.

The explosion produces a spheroidal cavity nearly 80 cm. deep, with deeply cracked walls. The soil is left to absorb the vapours given off by the explosion, and all that remains to be done then is to plant the tree and beat down the soil round the roots. Under these conditions the tree finds all the elements necessary for its growth finely powdered and intimately mixed with the soil, so that it cannot but grow vigorously and fruit in the shortest possible time. This method would be specially useful in compact soils when the ordinary methods of planting leave solid walls which the rootlets are unable to penetrate.

This process can be used for all kinds of tree-planting, even in the colonies, as less labour is required and growth is favoured.

The Value of Tits. *W. E. Collinge, Country Life*, March 29, 1919.—The majority of gardeners and fruit growers are apt to condemn and destroy tits on account of the attention they obviously pay to buds on fruit trees. Naturalists, such as Newton and Yarrell, have considered this attitude a mistake, and the author's investigations confirm the opinion that the tit is on the side of good and not evil. The food of thirty-two specimens of the great tit, examined in 1917–18, consisted of animal matter 77 per cent., vegetable matter 23 per cent., and

66·5 per cent. was said to be composed of insects injurious to crops, 10 per cent. represented damage done by the tit, and 23·5 per cent. was neutral. In the case of the other common species, the blue tit, 78 per cent. of the food of fifty individuals consisted of insects economically harmful, 10 per cent. represented damage done, and 12 per cent. was neutral. Equally in regard to the great and the blue tit the evidence obtained by this method is overwhelmingly in their favour, and shows that these useful birds ought to be spared and protected.

The French Chambers of Agriculture before Parliament.—On 22nd November 1918 the Senate passed a proposal for a law tending to create Chambers of Agriculture.

The question is one of creating not only Chambers of Agriculture having a purely consultative character, but also organs of agricultural activity having sufficient budgets to allow them to undertake certain enterprises which will tend to ensure agricultural progress

The first characteristics of the scheme is that the Chambers will be neither cantonal nor attached to *arrondissements*, nor even departmental, but will represent whole districts, thus deriving necessary authority. The departmental sphere has been thought to be too narrow not only for agriculture but also for all economic interests.

The scheme sets up in each department a Departmental Agricultural Committee, to be elected by the direct votes of farmers and agricultural labourers and to have one member for each canton. This committee will, when it is formed, nominate certain of its members who will compose the Chambers of Agriculture, these being thus constituted by votes of the second degree.

The voters' list will include the names of farmers, owners of rural real estate, labourers who have been attached to one farm for two years and former cultivators. The vote is given to women.

The Senate has given a real independence to the Chambers of Agriculture, because it does not wish them to be looked upon as administrative organs.

Resolutions are exempt from all interference on the part of the ministerial or prefectoral administration, but this independence does not amount to a systematic exclusion of the services of the Ministry of Agriculture.

The Chambers of Agriculture will be compelled to meet at certain intervals of time.

In its entirety the scheme causes those interested themselves, in the person of mandatories they choose freely, to give their opinion to the government and take necessary initiative. It will even be obligatory to consult these Chambers on certain subjects connected with agricultural legislation, transport, customs and technical education.

The scheme was unanimously passed by the Senate and has been transmitted to the Chamber of Deputies.

The Co-operative Societies for bringing Land under Cultivation: France. *M. Louis Tardy.*—The Academy of Agriculture of France has thought it worth while to ascertain the results obtained by the co-operative cultivating societies, and M. Louis Tardy, the academy's correspondent, has made an enquiry of which the fruit can be resumed as follows:

Co-operative Cultivating Societies of Haute-Garonne.—The seven co-operative societies for the cultivation of abandoned lands formed in Haute-Garonne brought 135 hectares under cultivation in the spring of 1917 and sowed 353 hectares during the year. The estimates made on 30th November 1917 anticipated a profit of 34,104·46 francs, but it was only at the end of 1918 that the profit for the two years 1917 and 1918, taken together, could be distributed among those interested. These co-operative societies have had to overcome difficulties of all kinds. In spite of all these difficulties the results of the year 1918 were very encouraging. On the 30th of last August 807·74 hectares were being fully farmed.

Co-operative Cultivating Society of Eure-et-Loir.—This society has now brought 533 hectares under cultivation. From the harvests of 1918 a net profit of 30,000 francs may reasonably be expected.

Following the example set by the co-operative societies of Haute-Garonne and Eure et-Loir, similar associations have been constituted more or less everywhere in all districts of France.

The Co-operative Society for Forézienne Cultivation, which is completing the

formation of a syndicate for mechanical cultivation, is established in a certain number of farms on the plain of Forez. It has restored 300 hectares to cultivation. It will work to order for a certain number of landowners, and contemplates harvesting on from 1500 to 2000 hectares next summer. It had to encounter difficulties of all kinds last summer and happily met with success. It has already wrought a notable improvement in the lodging and diet of agricultural labourers and farm servants. These various co operative societies have received State advances.

In passing we will notice two interesting forms of profit sharing.

In Dordogne, in case of work done to order, the net profits realised are divided into three parts: 40 per cent. goes to the co-operative society, 30 per cent. to the tractor drivers, and 30 per cent. to the employers in proportion to the quantity of fuel each of them has used.

The contract which the Co-operative Society for the Cultivation of Abandoned Lands in the Plain of Forez concludes with a farm provides that the farm-wife will, with her family, be lodged and boarded, will be paid 100 francs a month, and will be paid, in addition to her fixed wages, 10 per cent. on the dairy produce, 10 per cent. on the produce of the poultry-yard, and 5 per cent. on the sale of pigs, calves or fattened cattle, and that these bonuses may not amount to less than 800 francs or more than 1200 francs. Two-thirds of the sum will go to the farm-wife herself, while one-third is distributed among her and her assistants. She will also have the right to 2 per cent. of the profits of the farm.

Certain farms which the co-operative society takes will serve as demonstration farms, and girls will be able to spend terms on them in order to learn modern methods as practised on farms. These farms can thus be in some sort housekeeping schools.

In Orme the departmental branch of the *Union national des mutilés et réformés* wishes to form a co-operative society which would make use of discharged and partially disabled men and farm 100 hectares, including 60 hectares of arable land.

Co-operative Cultivating Societies in the Invaded Districts.—In the districts which have suffered by the events of the war, and where most frequently all boundaries have disappeared, it is almost impossible to avoid cultivation in common. The general inspection of credit and of subsidised agricultural associations took a direct part in founding a certain number of co-operative societies, but the German offensive of the spring of 1918 did not allow many of them to be really constituted. Moreover, a few were associations rather than true co-operative societies. Some withdrew into the various interior districts of France.

Some former sugar manufacturers are also proposing to form co-operative cultivating societies in the north, in Oise. Those which were founded in Somme will doubtless again become active.

Thus more or less everywhere co-operative societies for restoring abandoned lands to cultivation are being constituted. These societies are in fact preparing for that redistribution of lands which is so necessary in a large number of districts, indispensable in the north and east, for restoring the devastated districts to cultivation. They have contributed in Haute-Garonne to raising once more the value of land which was being increasingly depreciated before their formation. A property belonging to a member of one of the co-operative societies in this department, which would not have found a market at 45,000 francs in 1915, was sold for 120,000 francs in 1918. As for the part co-operative societies play in increasing agricultural production and in the work of reconstruction, it is more and more considerable.

LEGAL DECISIONS AFFECTING AGRICULTURE.

Valuation of Sheep Stock. *Fletcher* v. *Robertson.*—The Inner House of the Court of Session has now issued its decision in this case in the Appeal against Lord Ormidale's judgment which is referred to in a previous number of the JOURNAL.[1] Lord Ormidale dismissed as irrelevant the action raised by Mr.

[1] Volume i., No. 2, p. 229.

James Douglas Fletcher, proprietor of the estate of Pitmain, against Mr. Donald Robertson, outgoing tenant of the sheep farm of Kerrow, in which he sought reduction of the award pronounced by Mr. Robert M'Diarmid, who acted as oversman in a reference between the pursuer and the defender for the purpose of fixing the sum due by the pursuer to the defender in respect, *inter alia*, of the *bona fide* sheep stock of the farm. The pursuer reclaimed against the Lord Ordinary's decision to the Inner House, and sought reduction of the award on the grounds :

(1) That by the submission the oversman was restricted to the average current prices at certain specified markets as the basis of his valuation; and that his valuation was not based on such average prices, but included a substantial allowance for acclimatisation value; and
(2) That the oversman included in his valuation stock which was not the *bona fide* sheep stock of the farm.

The Court held that if acclimatisation value were a factor in fixing the market price, it would appear in the market price ; if it did not appear in the market price, then the arbiter was not entitled to take it into account at all, or to make a separate allowance for it, and accordingly the Court have now remitted back to the Lord Ordinary to allow to the pursuer a proof of his averments, but limited to the averments made on record as to the actings of the oversman in valuing the stock taken over by the pursuer, and as to the basis of valuation on which the oversman proceeded, whether he had regard to the prices realised at certain markets, and also whether he included in his valuation a separate allowance for acclimatisation over and above the prices realised at said markets. On the question of the *bona fide* stock, the Court held that the pursuer, having full knowledge of the nature of the stock that was tendered to him and having taken over that stock and dealt with it as his own without protest, could not, after the valuation had been made, raise the question of whether the stock that was included was all *bona fide* stock.

Arbitration under the Corn Production Acts. *Whitlaw.*—An arbitration arising out of the exercise by the Board of Agriculture for Scotland of their compulsory powers under the Defence of the Realm Regulations has recently been concluded, and while it may not contain any strictly legal decision it is of considerable interest generally. The Board, in terms of Regulation 2 M of the Defence of the Realm Regulations, may, by notice served on the tenant of any land which, in the opinion of the Board, is not being so cultivated as to increase as far as practicable the food supply of the country, determine his tenancy of the land, and the Corn Production Act, 1917, as amended by the Corn Production Act, 1918, gives any person interested in the land a claim for any loss suffered by him. This arbitration arose in consequence of the Board, in exercise of their powers, serving a notice on 12th September 1917 on Mr. Samuel Ormston, farmer, Grovehill, Kelso, formerly tenant of Whitlaw Farm, near Lauder, requiring him to remove from Whitlaw at the term of Martinmas 1917. The natural termination of Mr. Ormston's lease was Martinmas 1919 as to the fallow break, Whitsunday 1920 as to the houses and grass, and the separation of the corn crop of 1920 from the ground. Mr. Ormston, in terms of the Board's notice, duly quitted his farm at Martinmas 1917, and having intimated a claim for loss in terms of the Corn Production Act, Mr. James Inglis Davidson, Saughton Mains, Corstorphine, was appointed sole arbiter to fix and determine whether loss had been suffered by the claimant, Mr. Ormston, by reason of the exercise by the Board of their compulsory powers, together with the amount of such loss, if any, in respect of the termination of the claimant's tenancy. Mr. Ormston claimed that he suffered loss on the following grounds :—

(1) In respect that he had to sell his stock at Martinmas 1917, instead of at a Whitsunday term	£1,076	2	3
(2) In respect of loss of profits for years Whitsunday 1918 to Whitsunday 1919, and Whitsunday 1919 to Whitsunday 1920	2,984	18	0
(3) In respect of loss of waygoing crop of 1920	1,330	0	0
(4) In respect of deprivation of residence and perquisites for 2½ years	150	0	0
Total	£5,541	0	3

The Board lodged answers to the claim, and after inspecting the ground and hearing parties Mr. Davidson issued his award, in which he assessed the loss sustained by the claimant at £750. Mr. Davidson discusses the position fully in the note appended to his findings. He states that in view of the position with regard to the land under cultivation when the Board served their notice, and the state of the staff on the farm, it was not surprising that the Local Food Production Committee (on whose recommendation the Board issued their notice) came to the conclusion that the call which was made upon all farmers in the district to plough up and crop a certain proportion of their holdings as a patriotic duty in a national emergency could not be carried out by the claimant, and that if the farm were to bear its fair proportion of the acreage called for, steps would require to be taken to ensure this being done; possibly also the Committee may have had in view that apart from cultivation there was ground for interference in respect of the manner in which the stock was managed. He also points out that there was undoubted evidence that the claimant was during his tenancy in possession of very considerable funds, but that he could not specify the profit of any particular year, nor condescend on detailed figures, and states that he did not accept the claimant's evidence as to the amounts of his profits.

From a comparison of the amount claimed with the amount awarded it is evident that, in the arbiter's opinion, an excessive claim was put forward, and this matter was taken into account by the arbiter in dealing with the question of expenses. While he directed that the expenses connected with the preparation of the Deed of Submission, the arbiter's fee, and the expenses incurred to the clerk and the legal assessor should be paid by the Board, he directed that *quoad ultra* each party should bear his own expenses of or incidental to the arbitration.

OFFICIAL ORDERS AND CIRCULARS.

THE following is the text of the scheme, approved by the Secretary for Scotland, for the Constitution of Agricultural Executive Committees and of the Scottish Council of Agriculture.

ELECTORAL BODIES.

(1) For the election of each Agricultural Executive Committee an electoral body shall be appointed in each County as follows :—

Agricultural Executive Committees and Scottish Council of Agriculture.

Representatives of the Highland and Agricultural Society, Scottish Chamber of Agriculture, National Farmers' Union of Scotland, together with a number of persons nominated by the County Council shall form the Electoral Body. The number of members to be nominated by the County Council shall be 12, and each of the other three bodies mentioned above shall nominate 4, the total membership of the Electoral Body thus being 24.

(2) The Electoral Bodies shall be constituted after the first meeting of the County Council subsequent to the triennial election, and shall be convened by the County Clerk. For the first election of members, however, the County Council delegates to the Electoral Bodies shall be nominated by the existing County Councils, and new Electoral Bodies shall not be appointed until after the second triennial election of County Councils thereafter.

(3) Representatives on the Electoral Body need not be members of the nominating authority.

AGRICULTURAL EXECUTIVE COMMITTEES.

(1) Save in exceptional cases, to be determined by the Board, one Committee shall be set up in each County, but it shall be competent for a Committee, with the approval of the Board, to delegate powers to Sub-Committees. The Board shall have power to group Committees for the purposes of electing representatives to the Council of Agriculture.

(2) Executive Committees shall consist of not less than 10 members and not more than the maximum number as given in the annexed schedule. No person can be a member of more than one Executive Committee. Executive Com-

mittees shall hold office for three years. The first Committees shall hold office until after the second triennial election of County Councils subsequent to their appointment.

(3) Not less than half the members of the Committee shall consist of tenant occupiers of agricultural holdings, of whom not fewer than 2 shall be occupiers of holdings of an annual value not exceeding £50; of the remainder not fewer than 2 shall be owners of land or their factors, whole time engaged in Estate management.

(4) In addition to the members appointed by the Electoral Body, the Secretary for Scotland will nominate to each Committee, after consultation with the Farm Servants' Union or other Association of Farm Workers recognised by the Board, 2 members to represent farm servants.

(5) Each Committee shall have an Executive Officer who shall also act as Secretary and shall give his whole time to the work. Such officer may be appointed to serve one or more Committees. These officers will be appointed by the Committee subject to the approval of the Board. The Board shall determine which Committees are to be served by an officer or officers in common, and shall convene joint meetings of such Committees for the purpose of appointing the officer or officers.

(6) The present Secretaries and Executive Officers shall continue to serve until 15th May 1919.

(7) The reconstituted Committee if constituted before 15th May shall not take over the executive duties of the present existing Committees until 15th May. They shall, however, meet to appoint representatives to the Council of Agriculture and also to appoint officials who may take over the work as from May 15th.

NOTE.—The Secretary for Scotland reserves the power of nominating the first Committees to act in the Island of Skye and in the Outer Isles at such time as he may think fit.

FUNCTIONS OF COMMITTEES.

(1) To elect representatives for the Council of Agriculture.

(2) To assist the Board in carrying out the provisions of the Corn Production Act.

(3) To undertake such other duties as the Board may from time to time approve.

THE SCOTTISH COUNCIL OF AGRICULTURE.

(1) Executive Committees shall appoint members to serve on the Council. Each County shall have not less than 2 representatives on the Council. Counties that have more than 200,000 acres under crops and grass shall have an additional member for each 100,000 or part of 100,000 exceeding 200,000 acres. Exception to this principle shall be made in the case of the Western Isles, where there shall be 1 representative on the Council from the Isle of Lewis, 1 from the Island of Skye, and 1 from the Committee for the Outer Islands when the Committees have been there constituted.

(2) In addition 20 members nominated by the Secretary for Scotland shall be added to complete the Council.

FUNCTIONS OF THE SCOTTISH COUNCIL OF AGRICULTURE.

To discuss any matter of agricultural interest that may be brought before it by the Board or by any member of the Council on due notice given, and to make recommendations to the Board thereon.

THE ADVISORY COMMITTEE OF THE COUNCIL.

The Council of Agriculture shall elect 9 of its members to serve on the Advisory Committee of the Council, and the Secretary for Scotland shall nominate 3 members.

FUNCTIONS OF ADVISORY COMMITTEE.

(1) To advise the Board upon any matter remitted to the Committee by the Board or by the Council.

(2) To raise any subject of agricultural or rural interest coming within the purview of the Board, and to make representations to the Board thereon.

SCHEDULE.

TABLE showing Number of Committees in each County, Maximum Number of Members of each Committee, *Total Acreages under Crops and Grass* in each County of Scotland, and Number of Members on Advisory Council.

Name of County.	No. of Committees in each County.	Maximum No. of Members in each Committee.	Acreage.	No. of Members on Advisory Council.
Aberdeen :—				
East Committee—L. G. B. Districts of Deer, Ellon, Turriff, Aberdeen	2	16	381,809	4
West Committee—L. G. B. Districts of Huntly, Alford, Deeside, Garioch		16	246,703	3
Argyll :—				
North Argyll — L. G. B. Districts of Lorne, Mull, Ardnamurchan	2	12	131,503	1
South Argyll—L. G. B. Districts of Kintyre, Islay, Mid-Argyll, Cowall		16		1
Ayr	1	16	314,961	4
Banff	1	12	159,294	2
Berwick	1	12	190,978	2
Bute :—				
Bute and Cumbraes ...	2	10	25,797	1
Arran		10		1
Caithness	1	12	107,531	2
Clackmannan	1	12	15,585	2
Dumbarton	1	12	47,777	2
Dumfries	1	20	248,190	3
Elgin or Moray	1	12	99,083	2
Fife	1	16	246,207	3
Forfar	1	16	248,333	3
Haddington	1	12	110,148	2
Inverness :—				
Mainland	1	16	148,899	2
Skye	1	—		1
Outer Islands	1	—		1
Kincardine	1	12	118,975	2
Kinross...	1	12	33,948	2
Kirkcudbright...	1	12	182,251	2
Lanark	1	16	250,364	3
Linlithgow	1	12	57,608	2
Midlothian	1	12	122,253	2
Nairn	1	12	25,478	2
Orkney	1	12	109,199	2
Peebles...	1	12	50,391	2
Perth	1	20	329,806	4
Renfrew	1	12	84,776	2
Ross-shire :—				
Mainland	1	16	137,808	2
Lewis	1	—	—	1
Roxburgh	1	16	177,561	2
Selkirk	1	12	29,760	2
Shetland	1	12	28,459	2
Stirling...	1	16	114,577	2
Sutherland	1	12	30,716	2
Wigtown	1	16	154,372	2

Grain.

The Oats Products (Retail Prices) Order, 1918:—A general licence issued under this Order authorises the sale of oat flour, oatmeal, rolled oats, flaked oats and like products free of all the restrictions imposed by the Order.

The Oats (Scotland and Ireland Restriction) Order, 1918, has been revoked. Oats can therefore be sent from Scotland to other parts of the United Kingdom without a licence.

Potatoes.

Inspection of Growing Crops of the Immune Varieties.—The following notice has been issued to the press:—"With a view to ensuring that an adequate supply of pure seed potatoes will be available for planting in those areas in England and Wales and Scotland that have been scheduled as infected with wart disease, the Board of Agriculture for Scotland have made arrangements for the inspection of growing crops of the varieties immune from wart disease. It is provided in the Wart Disease of Potatoes Orders issued respectively by the Board of Agriculture for Scotland and the Board of Agriculture and Fisheries that potatoes of the immune varieties cannot be sold for planting except under licence granted by the Boards. Such licences will be granted only when there is a reasonable assurance that the stocks are pure and the condition of the crop satisfactory. The most reliable guarantee of purity is the certificate issued in cases where the crops on inspection have been found to be true to type and free from rogues, and it is to be hoped, therefore, that all growers of potatoes of the immune varieties will make immediate application to the Board for the inspection of their crops."

Feeding Stuffs.

By a general licence issued under the Oils, Oil Cakes and Meals (Requisition) Order, 1918, the Cattle Feeding Stuffs (Requisition) Order, 1918, and the Cattle Feeding Stuffs (Maximum Prices) Order, 1918, trade in certain kinds of feeding stuffs was freed from all restrictions. The classes of feeding stuffs affected are given below:—

Home Manufactured Cakes and Meals.—Undecorticated ground nut cake, semi-decorticated ground nut cake, decorticated ground nut cake, palm kernel cake, rape cake, copra cake, sesame cake, soya cake, extracted palm kernel meal, extracted rape meal, extracted soya meal.

Imported Cakes and Meals.—Copra cake, palm kernel cake, Rangoon rice meal, Italian rice meal, Canadian rice meal, Egyptian rice meal, gluten feed maize meal cake, compound cakes and meals (made from two or more ingredients when no oil is expressed in the process of manufacture), cakes and meals containing not less than seven per cent oil and not less than twenty per cent. albuminoids, cakes and meals containing not less than six per cent. oil and not less than twenty per cent. albuminoids, cakes and meals containing not less than six per cent. oil and not less than seventeen per cent. albuminoids.

Live Stock.

In an amendment to the Live Stock (Sales) Order, 1918, the Food Controller gives instructions for the calculation of the price of an in-calf cow or an in-calf heifer sold for slaughter in cases where the weight of the calf and bag is found to exceed 28 lbs. The instructions read as follows:—

"Where any in-calf cow or in-calf heifer has been sold for slaughter, and the weight of the calf and bag exceeds 28 lbs., the price otherwise payable in respect of the cow or heifer under the provisions of the Order shall (except in the case of a sale by dead weight) be reduced by a sum ascertained in manner hereinafter mentioned, and where the price has been paid to the seller the Government buyer may recover such sum from the seller.

"The sum shall be a sum calculated on the weight of the calf and bag after slaughter, at the maximum rate applicable under this Order on the sale of the cow or heifer.

"The provisions of this sub-clause shall have effect notwithstanding that no proceedings shall have been first taken against the seller in respect of a contravention of Clause 1, and shall be in addition to, and not in substitution for, any penalties in respect of such contravention."

By the revocation of the Calves (Sales) Orders, 1918 and 1919, and those sections of the Live Stock (Sales) Order, 1918, that relate to calves, all restrictions on the sale of calves have been removed.

Milk.

The Milk (Summer Prices) Order, 1919:—An Order fixing maximum prices for milk during the summer months came into force on the 1st of May. So far as Scotland is concerned the prices may be summarised as follows:—

	Producers' Prices.	Wholesale Prices.		Retail Prices.
		(*a*.) * When Delivery is made to Buyer's Railway Station or at Seller's Premises.	(*b*.) When Delivery is made to Buyer's Premises	
	per gallon. s. d.	per gallon. s. d.	per gallon. s. d.	per gallon. s. d.
May	1 6	1 8	2 0	2 8
June	1 4	1 6	1 8	2 4
July	1 4	1 6	1 8	2 4
August	1 7	1 9	2 0	2 8
September ...	1 10	2 0	2 4	3 0

* The net railway charges (if any) paid by the seller for transportation from the seller's station to the buyer's station are to be added to these prices.

The full text of the Order in so far as it applies to Scotland is as follows:—

In exercise of the powers conferred upon him by the Defence of the Realm Regulations and of all other powers enabling him in that behalf the Food Controller hereby orders that, except under the authority of the Food Controller, the following regulations shall be observed by all persons concerned:—

1. A person shall not directly or indirectly sell or offer for sale or buy or offer to buy any milk at prices exceeding the maximum prices provided by or in pursuance of this Order.

2. (*a*) Until otherwise determined pursuant to this Order the maximum price applicable on the occasion of a retail sale of milk shall be, during the months mentioned in the first column of the following table, at the rate per imperial gallon set opposite the same in the second column thereof:—

Month of 1919 in which Delivery takes place.	Rate per Imperial Gallon for Delivery in Scotland.
	s. d.
May	2 8
June	2 4
July	2 4
August	2 8
September	3 0

(*b*) Where, at the request of the buyer, the milk is required to be delivered in bottles and is so delivered to the buyer's premises, charge may be made for bottling at the rate of 1d. per quart, provided the milk is bottled under proper and sanitary conditions at or before reaching the seller's premises.

(*c*) The foregoing prices shall include all charges for delivery, but the Food Controller, or any person authorised by him may from time to time fix for all or any of the milk sold within any area and not delivered to the purchaser's premises, a rate different from the rate for the time being applicable to milk which is so delivered.

3. (*a*) (i) Where milk is sold wholesale by or on behalf of the producer, the maximum prices chargeable for milk delivered during the months mentioned in

the first column of the following table shall be at the rate per imperial gallon set opposite the same in the second column thereof :—

Month of 1919 in which Delivery takes place.	Rate per Imperial Gallon for Delivery in Scotland.
	s. *d.*
May	1 6
June	1 4
July	1 4
August	1 7
September	1 10

together in each case with a sum equal to the net amount for the charges for railway transport actually incurred by the seller.

The rates applicable under this sub-clause are fixed on the basis that the milk is cooled over a refrigerator and that the milk produced in the morning is forwarded the same morning for delivery, and that the milk produced in the evening is forwarded the same evening for delivery.

(ii) Where the milk is not cooled and forwarded for delivery in the manner mentioned in sub-clause (*a*) (i) the maximum price for milk delivered shall be ascertained by deducting ½d. per imperial gallon from the prices specified in sub-clause (*a*) (i).

(iii) Where the milk is collected by the buyer from the premises of the seller, the maximum price shall be ascertained by deducting one penny per imperial gallon from the prices specified in sub-clause (*a*) (i).

(*b*) The rates applicable under sub-clause (*a*) (i) and sub-clause (*a*) (ii) of this clause are fixed on the basis that the milk is delivered at the seller's expense to the buyer's premises or (at the option of the seller) to the buyer's railway station, and that in the latter case all charges for transport beyond the buyer's railway station are borne by the buyer.

(*c*) No additional charges may be made for the provision of churns or other vessels.

4. Where milk is sold wholesale by or on behalf of any person other than the producer, the maximum prices chargeable shall, until otherwise determined pursuant to this Order, be as follows :—

(*a*) In the case of milk delivered by the producer to or for the account of the buyer, in accordance with the directions of the seller, the rate shall be ½d. per imperial gallon higher than the price chargeable to the seller by the producer.

(*b*) In the case of milk not so delivered, the rate shall be in accordance with the following table :—

Month of 1919 in which Delivery takes place.	Delivery in Scotland.	
	* Rate per Imperial Gallon when Delivery is made to Buyer's Railway Station or at the Seller's premises.	Rate per Imperial Gallon when Delivery is made to Buyer's Premises.
	s. *d.*	*s.* *d.*
May	1 8	2 0
June	1 6	1 8
July	1 6	1 8
August	1 9	2 0
September...	2 0	2 4

* In addition to the net railway charges (if any) paid by the seller for transportation from the seller's station to the buyer's station.

(*c*) The rates mentioned in sub-clauses (*a*) and (*b*) are fixed upon the basis that the cost of providing churns or other vessels is borne by the seller; and where the milk is not sold on this basis, then the rate shall be ascertained by deducting from the rate applicable under such sub-clauses the sum of ½d. per imperial gallon.

5. The Food Controller or a person authorised by him may—

(*a*) in any case where he is satisfied that the milk produced is of exceptionally high hygienic quality, increase the maximum price chargeable for the milk on a sale by or on behalf of the producer or on any resale of the same;

(*b*) with respect to any area, vary the maximum price applicable to sales by wholesale or by retail in the area.

6. (*a*) Where milk is sold to an establishment as herein defined by any person (whether he be the producer of the milk sold or not) in a quantity of not less than 17 imperial gallons to be delivered in any one day the maximum price (including charges for delivery to the buyer's premises) shall be, whichever shall be the lower of the following prices, namely:—

(i) 2d. per imperial gallon higher than the maximum price chargeable in the district in which the establishment is situate for milk delivered to the buyer's premises on a sale by wholesale by a person other than a producer; or

(ii) the maximum retail price for the time being in force in such district.

(*b*) Any other sale to an establishment shall, for the purpose of this Order, be deemed to be a retail sale, and the maximum price shall be determined accordingly.

(*c*) "An establishment" for the purposes of this Order shall mean a public or private hospital, sanatorium, convalescent or nursing home, workhouse, infirmary, asylum, corporation or company not established for the purposes of trading or profit, a religious or charitable community, a residential school or college, and a canteen.

(*d*) The Food Controller or a person authorised by him may—

(i) apply the provisions of this clause, whether with or without modification, to a sale of milk to any body of persons which, in his opinion, should be treated as an establishment;

(ii) vary the provisions of this clause in its application to any establishment.

7. Where a person who sells milk by retail sells such milk to a person buying for re-sale, the maximum price shall, as to the milk sold on any day, be 2d. per gallon less than the maximum price applicable to sales of milk by retail in the area in which the sales are made, if the quantity sold on that day to such person does not exceed 8 imperial gallons.

8. No milk shall be sold or offered for sale by retail otherwise than by imperial measure, except that nothing in this clause shall prevent—

(*a*) sales of milk by the pennyworth or two-pennyworth; or

(*b*) sales of any fraction of a gill, pint, quart or gallon of milk.

Provided that the maximum price is not exceeded.

9. No colouring matter shall be added to the milk or cream intended for sale, and no milk or cream to which any colouring matter has been added shall knowingly be sold, or offered or exposed for sale.

10. No water shall be added to the milk intended for sale, and no milk to which any water has been added shall knowingly be sold or offered or exposed for sale.

11. Except under and in accordance with the terms of a licence granted by the Food Controller, a person shall not, after the date of this Order, sell or offer or expose for sale as milk, or under any description of which the word "milk" forms part, any liquid in the making of which dried milk or condensed milk has been used.

12. No person may use for the purpose of his trade or business any milk can, milk churn, or milk bottle, which bears the name or trade name, or the trade

mark or trade device of some person other than himself or his employer, except with the consent of such person.

13. No person shall, in connection with the sale or disposition or proposed sale or disposition of any milk, enter or offer to enter into any fictitious or artificial transaction or make or demand any unreasonable charge.

14. A Food Committee may, subject to the consent of the Food Controller:—

(*a*) buy milk from any person and sell milk so bought at a price estimated to cover at least the cost of purchasing and distributing such milk; and

(*b*) make arrangements as to the distribution of milk in their area;

(*c*) give directions in their district for securing the purity, cleanliness, and wholesomeness of milk, provided that any directions so given shall not relieve local authorities of their powers and duties under existing statutory provisions in regard to milk, or relieve cowkeepers, dairymen, purveyors of milk, or occupiers of milk shops, from their obligations under any such provisions, and every person to whom any direction is given under the powers conferred by this sub-clause shall comply with such directions.

15. A Food Committee shall not, without the consent of the Local Authority or Authorities by whom they were appointed, exercise the powers conferred upon them by the immediately preceding clause in such manner as may involve an expense which is ultimately to be borne by such Authority or Authorities; provided that the validity of any direction given by a Food Committee under any such powers shall not be questionable on the ground that such consent has not been obtained.

16. Where any contract subsisting on the 1st May 1919 for the sale of milk provides for the payment of a price in excess of the maximum price fixed by this Order applicable on the occasion of such a sale, the contract, unless otherwise determined by the Food Controller, shall be avoided so far as concerns milk which is to be delivered on or after that date.

17. The provisions of this Order relating to prices shall not apply to milk sold for consumption on the premises of the seller.

18. For the purposes of this Order:—

"Food Committee" shall mean a Food Control Committee or a Joint Food Control Committee appointed under any Order of the Food Controller.

"Buyer's Premises" shall not include any road-side collecting place for milk or any other premises which the Food Controller shall in any particular case determine not to be buyer's premises for the purposes of this Order.

"Buyer's Railway Station" shall mean the railway station to which, in the ordinary course of business, the milk would be consigned by the seller to the buyer, or in cases to which Clause 4 (*a*) applies to the buyer's purchaser.

19 The Milk (Winter Prices) Order, 1918, as amended is hereby revoked as on the date when this Order comes into force, but without prejudice to any proceedings in respect of any previous contravention thereof.

20. Infringements of this Order are summary offences against the Defence of the Realm Regulations.

21.—(*a*) This Order may be cited as the Milk (Summer Prices) Order, 1919.
(*b*) This Order shall come into force on the 1st May 1919.

Cream Order, 1918:—A general licence issued under this Order allows cream to be used, sold, supplied or acquired free from restrictions.

Butter.

Several of the Orders dealing with the distribution of British made butter have been revoked. Farm butter may now be manufactured and sold in any quantity without restriction except that the maximum retail price of 2s. 6d. per lb. is not to be exceeded.

CORN PRODUCTION ACT, 1917.

Valuation of Benefits or Advantages for the Purposes of the Minimum Wage, 1st June 1919.

NORTHERN COUNTIES DISTRICT WAGES COMMITTEE.

COUNTY OF SHETLAND.

House and garden ...	Value last placed upon same in Valuation Roll.	
Oatmeal	42/- per boll.	
Bere meal	35/- „	
Flour	27/6 „	
Potatoes	By weight, £6 per ton; in drill, £4 per 60 chains (worker supplying seed).	
Milk	1/6 per imperial gallon.	
Board	Males over 16 years,	12/6 per week.
	Boys under 16 years,	7/6 „
	Females over 18 years,	7/6 „
	Girls between 16 and 18 years,	6/6 „
	Girls under 16 years,	5/- „
Lodging	All classes and ages. Males and females, 2/6 per week.	
Board and Lodging ...	Males over 16 years,	15/- per week.
	Boys under 16 years,	10/- „
	Females over 18 years,	10/- „
	Girls between 16 and 18 years,	9/- „
	Girls under 16 years,	7/6 „
Meals	1/- each.	
Coals	74/- per ton.	
Peat	Where employer provides the peat, the value will be the equivalent of coal.	
Keep of cow (cow being property of employer).	When given hay only cured by shepherd, £5 per annum.	
	When receiving straw, turnips, etc. £10 „	
	When artificial foodstuffs are supplied as well as hay, straw, turnips, etc. £15 „	
Keep of sheep ...	Shetland, 7/6 per ewe per annum.	
	Blackface and cross, 20/- „ „	
Grazing	Shetland cow,	30/- per season.
	Cross cow,	40/- „

These values were fixed on 23rd November 1918.

COUNTY OF ORKNEY.

House and garden ...	Value last placed upon same in Valuation Roll.	
Oatmeal	43/- per boll.	
Bere meal	30/- per boll.	
Potatoes	By weight, £6 per ton; in drill, £4 per 60 chains (worker supplying seed).	
Milk	1/6 per imperial gallon.	
Board	Males over 18 years,	15/- per week.
	Boys between 16 and 18 years,	11/6 „
	Boys under 16 years,	8/6 „
	Females over 18 years,	7/6 „
	Girls between 16 and 18 years,	6/6 „
	Girls under 16 years,	5/- „
Lodging	All classes and ages. Males and females, 2/6 per week.	
Board and Lodging ...	Males over 18 years,	17/6 per week.
	Boys 16 to 18 years,	14/- „
	Boys under 16 years,	11/- „
	Females over 18 years,	10/- „
	Girls 16 to 18 years,	9/- „
	Girls under 16 years,	7/6 „
Meals	1/- each.	
Coal	67/- per ton.	
Peat	Where employer provides the peat, the value will be the equivalent of coal.	

NORTHERN COUNTIES DISTRICT WAGES COMMITTEE—*continued.*

COUNTY OF ORKNEY—*continued.*

Keep of cow	...	(Without artificial foodstuffs), £15 per annum. Calf to belong to the owner of the cow.
Keeping poultry	...	£1 per annum.
Keep of sheep	...	30/- per ewe per annum.

These values were fixed on 23rd November 1918.

COUNTY OF CAITHNESS.

House and garden	...	Value last placed upon same in the Valuation Roll.			
Oatmeal	...	Per boll	£2	0	0
Potatoes	...	By weight per ton	6	0	0
		In the drill, per 60 chains (worker supplying seed),	4	0	0
Milk ...	...	Per imperial gallon	0	1	6
Butcher meat	...	Per lb.	0	1	5
Board	...	Male workers over 18 years of age (per week)	0	12	6
		Boys between 16 and 18 years of age „	0	9	6
		Boys under 16 years of age „	0	6	6
		Female workers over 18 years of age „	0	7	6
		Girls between 16 and 18 years of age „	0	6	6
		Girls under 16 years of age „	0	5	0
Lodging	...	For all workers, male and female, of all classes and ages „	0	2	6
Board and Lodging		Male workers over 18 years of age „	0	15	0
		Boys between 16 and 18 years of age „	0	12	0
		Boys under 16 years of age „	0	9	0
		Female workers over 18 years of age „	0	10	0
		Girls between 16 and 18 years of age „	0	9	0
		Girls under 16 years of age „	0	7	6
Coal	...	Per ton	2	1	0
Peats	...	Where the employer provides the peat, the value will be the equivalent of coal.			
Keep of cow	...	(Without artificial foodstuffs) (per annum)	15	0	0
		(With „ „) „	20	0	0
		(Where hay cut by shepherd; no hay bought in by employer) „	7	0	0
Keeping poultry	...	... ... „	1	0	0
Keep of sheep	...	Wholly on hill ground, per ewe „	0	10	0
		Partly on hill ground and partly on arable ground, per ewe „	1	10	0

These values were fixed on 23rd November 1918.

COUNTY OF SUTHERLAND.

House and garden	...	Value last placed upon same in Valuation Roll.
Oatmeal	...	44/- per boll.
Potatoes	...	By weight. £6 per ton; in drill, £4 per 60 chains (worker supplying seed).
Milk ...	...	1/6 per gallon.
Butcher meat	...	1/5 per lb.
Board	...	Males over 18 years, 15/- per week.
		Boys 16 to 18 years, 11/6 „
		Boys under 16 years, 8/6 „
		Females over 18 years, 7/6 „
		Girls 16 to 18 years, 6/6 „
		Girls under 16 years, 5/- „
Lodging	...	All classes and ages. Males and females, 2/6 per week.
Board and Lodging		Males over 18 years, 17/6 per week.
		Boys 16 to 18 years, 14/- „
		Boys under 16 years, 11/- „
		Females over 18 years, 10/- „
		Girls 16 to 18 years, 9/- „
		Girls under 16 years, 7/6 „

NORTHERN COUNTIES DISTRICT WAGES COMMITTEE—*continued.*

COUNTY OF SUTHERLAND—*continued.*

Meals	1/- each.
Coals	44/- per ton.
Peat	Where the employer provides the peat, the value will be the equivalent of coal.
Firewood	15/- per load.
Keeping poultry ...	£1 per annum.
Keep of pig	(Including straw), £7 per annum.
Keep of sheep ...	On hill ground, 20/-; on low ground, 30/- per ewe.
Keep of cow	(Without artificial foodstuffs), £15 per annum.
	(With „ „), £20 „
	(Where hay cut by shepherd; no hay bought in by employer), £7 „

These values were fixed on 23rd November 1918.

MORAY FIRTH DISTRICT WAGES COMMITTEE.

House	Assessor's Valuation.
House and garden ...	Do.
Oatmeal	Fiars' prices for the county in which the farm is situated.
Potatoes	£6 per ton.
Milk	1/9 per gallon.
Board	... ... 10/ per week.
Lodging	With attendance, 4/- „
	Without „ 2/6 „
Board and Lodging ...	With „ 14/- „
	Without „ 12/6 „
Meals	8d. per diet.
Coals	Wholesale controlled price in the district.
Peats	Local price.
Firewood	Do.
Light (including oil for light).	Wholesale price in the district (only where not given as part of lodging).
Free cartage ...	*Nil.*
Flitting expenses ...	*Nil.*
Keep of cow	(1) Where employer provides and feeds cow (without artificial foodstuffs) £21
	(2) Where employee provides cow and employer feeds it (without artificial foodstuffs) ... £15
	(3) Grazed £6
Keep of poultry ...	*Nil.*
Keep of pig	(Including straw when provided by employer), £2 per year.
Keep of pack	To be referred specially to Committee in each case.
Grazing sheep ...	

These values were fixed on 21st January 1919.

NORTH-EASTERN COUNTIES DISTRICT WAGES COMMITTEE.

House	As in Valuation Roll, failing which as shall be fixed by Committee.
House and garden ...	Do. do. do.
Garden and garden stock.	Unnecessary to fix any value.
Garden manure ...	To be fixed on application.
Oatmeal	41/- per boll.
Milk	2/- per gallon.
Potatoes	£6 per ton riddled; £5 per ton unriddled.
Board	Men above 16 years, 12/- per week.
	Boys under 16 years, 9/- „
	Women above 16 years, 9/- „
	Girls under 16 years, 7/6 „

NORTH-EASTERN COUNTIES DISTRICT WAGES COMMITTEE—*continued.*

Lodging	Men, boys, women and girls, 2/- per week.
Part Board	Valuation unnecessary meantime.
Coals	Price to employers, ex-rail, store or pier.
Peats	To be computed on the scale of eight loads of peat being equivalent to 1 ton of coal, at price of coal to employers, ex-rail, store, or pier.
Firewood	Cost to employer, but not exceeding £1 per annum.
Light	Valuation unnecessary.
Free cartage	Cost to employer, but not exceeding £1 per annum.
Harvest benefit ...	Valuation unnecessary.
Keep of cow (hill shepherd's).	Where shepherd provides own winter keep, £5 per annum. For whole year £17.
Keep of poultry ...	Valuation unnecessary.
Keep of pig	Do. do.
Keep of pack... ...	As the value thereof may be determined by the Committee on application.
Flitting expenses ...	Not reckoned as a benefit.
Grazing sheep ...	Hill ground 2d. per week per head. Low ground 6d. do.

These values were fixed on 14th January and 18th February 1919.

FORFAR AND PERTH DISTRICT WAGES COMMITTEE.

House or house and garden.	As in Valuation Roll, but not exceeding £6.
Bothy accommodation, including fire and light.	Without attendance—£10 per annum per man. With do. £13 do. do.
Garden manure ...	10/- per ton.
Oatmeal ...	43/- per boll.
Flour	28/- do.
Potatoes	£5 per ton undressed ; £6 per ton dressed.
Milk	2/3 per gallon.
Board	Men of 18 years and over 2/6 per day ; men and women under 18 years 2/- per day.
Part Board	1/- each meal.
Lodging	3/6 per week.
Board and Lodging...	Combined board and lodging rates as above.
Coals	36/- per ton.
Peat	Value equivalent of coal.
Firewood (logs) ...	12/6 per load.
Light	1/3 per gallon for burning oil.
Free cartage and flitting expenses.	£4 per annum per man.
Keep of cow or cows and followers.	(Without artificial foodstuffs) on hill land, £12 per annum. On low land, £21 per annum. (With artificial foodstuffs.) The above values, together with the actual cost to the farmer of artificial foodstuffs supplied.
Keep of pig	(Including straw), £8. Straw only, 15/-.
Keep of pack... ...	To be fixed by Committee on application.
Grazing of sheep ...	Do. do. do.

These values were fixed on 18th January 1919.

FIFE AND KINROSS DISTRICT WAGES COMMITTEE.

Oatmeal	Per boll	£2	2 0
Milk (fresh)	Per gallon	0	1 10
Cartage of coals and flitting		1	0 0
Annual value of bothy, cleaning, coal, light, cooking utensils, bed, bedding and towels (including the use thereof)		10	0 0

FIFE AND KINROSS DISTRICT WAGES COMMITTEE—*continued.*

House and garden, free of rates and taxes, to be as per Valuation Roll, and failing any entry in Valuation Roll, then at such value as should be fixed by the Wages Committee.

Potatoes (undressed) ... ... Per ton £4 10 0

These values were fixed on 23rd November 1918.

LOTHIANS AND PEEBLES DISTRICT WAGES COMMITTEE.

House or house and garden.	Value last placed upon it in Valuation Roll—if not in Roll £4 per annum.
Potatoes (dressed) ...	£6 per ton.
Potatoes in the drill...	Every 800 yards to be regarded as equal to a weight of 15 cwts. of dressed potatoes.
Oatmeal	4/4 per stone.
Milk	2/- per gallon.
Coal	30/- per ton.
Cartages	£1 per annum.
Entire keep of cow ...	(Without artificial feeding stuffs), £15 per annum.
Entire keep of hill shepherd's cow.	(Without artificial feeding stuffs) — (the shepherd making the necessary hay), £10 per annum.
Grazing only of hill shepherd's cow.	£3 per annum.
Followers of cows ...	1/6 per week each.
Board and Lodgings	20/- per week.
Lodging in bothy with coal and light.	3/6 per week.
Keep of pack and other benefits.	Not fixed meantime.

Those values were fixed on 22nd February 1919.

BORDER COUNTIES DISTRICT WAGES COMMITTEE.

House or house and garden	As in Valuation Roll.
Potatoes (dressed) ...	Per ton, £6.
Potatoes in the drill...	Every 800 yards to be regarded as equal to the weight of one ton of dressed potatoes.
Milk	2/3 per gallon.
Flour	2/3½ per stone.
Barley meal	3/3 per stone.
Oatmeal	4/4 per stone.
Coal	Cost price at nearest depot or railway station.
Cartages	£1.
Keep of cow	7/- per week.
Keep of followers ...	1/6 each per week.
Keep of hill shepherd's cow.	4/- per week.
Board and Lodging ...	Males 18 years and over, 18/- per week. Women 17 and over, 12/- do. Males under 18 years, 14/- do. Females under 17 years 10/- do.
Peats	(Less any necessary out of pocket payments by the workman for assistance in cutting and winning the peats.) 2/- per week or £5, 4/- per annum.
Keep of pack... ...	The value to be fixed by the Committee on application in each case by the parties concerned.

Those values take effect as from 24th February 1919.

DUMFRIES AND GALLOWAY DISTRICT WAGES COMMITTEE.

House or house and garden.	Valuation Roll.
Oatmeal	4/2 a stone.
Flour	2/8 a stone.
Potatoes	6/3 a cwt.
New milk	2/3 per gallon.
Skim milk	1/4 per gallon.

DUMFRIES AND GALLOWAY DISTRICT WAGES COMMITTEE—*continued.*

oard	(Men) 14/- per week. (Women) 12/- per week.
Lodging	2/- per week.
Board and Lodging ...	(Men) 16/- per week. (Women) 14/- per week.
Breakfast, dinner and supper, 9d. each.	
Coals	35/- per ton.
Peats	£4.
Free cartage	1/- per hour—not to exceed £1 per annum.
Keep of cow	(Without artificial foodstuffs) on hill land grazing with sheep, £8.
Follower—stirk ...	£5.
Keep of cow	(Without artificial foodstuffs) on arable land, £15.
Follower—stirk ...	£8.
Keep of cow	(With artificial foodstuffs) the foregoing sums and the cost price of the stuffs supplied.
Keep of pack... ...	On hill land. Twice the rental per sheep paid by the employer. On low ground, will be fixed by Committee on special application by the parties. When either employer or employee is of opinion that there are exceptional circumstances affecting the value of the benefit of the keep of any animal application may be made to the Committee to fix a special value.
Fat sheep	Current wholesale price per lb.

These values were fixed on 25th November 1918.

AYR DISTRICT WAGES COMMITTEE.

House...	As per Valuation Roll. The maximum value for "led" farm houses to be at the value of cot houses in the district, as same appear in Valuation Roll.
House and garden ..	Do. do. do. do.
Oatmeal	Current producers' wholesale price in the district.
Barley meal	No value—not used in the district.
Flour	Wholesale price current in the district.
Potatoes	Producers' wholesale price current in the district when the main crop is lifted.
Milk	Current producers' wholesale price in the district.
Board and Lodging ...	Men, including boys, 16/- per week. Women and girls, 14/- do.
Breakfast	6d.
Dinner	1/-.
Supper	6d.
Extra tea at hay, harvest, and threshing, etc.	No value fixed.
Fruit.	
Coals	The price per ton paid by the farmer.
Peat	*No value.*
Firewood	
Light, including oil for light	
Free cartage	
Flitting expenses	
Harvest benefit	
Garden stock...	
Garden manure	
Keep of poultry ...	
Keep of pig, including straw	
Keep of pack...	
Grazing	
Sheep	
Keep of shepherd's cow ...	Value left for amicable arrangement between employer and employee.

These values were fixed on 11th February 1919.

CLYDE AND FORTH DISTRICT WAGES COMMITTEE.

House or house and garden.	At value last placed upon them in Valuation Roll, or, if not on Roll, £5.
Oatmeal	£2, 3/- per boll of 10 stones.
Barley meal	Not fixed meantime.
Flour	25/6 per boll of 10 stone.
Potatoes	6s. per cwt. or £6 per ton.
Milk	2/3 per gallon (controlled price).
Board	Men over 18, 15/- 16–18, 12/- 14–16, 10/- Women over 17, 12/- 15–17, 10/- 14–15, 8/-
Lodging with attendance for all classes, 3/6 Do. without do. do. 2/-	
Board and Lodging ...	The combination of above rates.
Meals—breakfast, dinner and supper.	Males over 14, 9d. per meal. Females over 14, 8d. per meal. Boys and girls under 14, 6d. per meal.
Tea	(Extra tea at hay harvest, threshing, etc.), 6d. per meal.
Fruit	Not fixed meantime.
Coals	30/- a ton.
Peats	£4 per annum.
Firewood	No value.
Light (including oil for light).	To be fixed on individual application.
Free cartage	£1 per annum per workman.
Flitting	*Nil.*
Garden stock and garden.	No value.
Garden manure ...	10/- per ton.
Keep of cow	£14. With artificial feeding stuffs, £19.
Keep of shepherd's cow	Where hay is cut by shepherd and no other fodder provided by farmer, £5.
Keep of poultry ...	No value, if no feeding stuff supplied by farmer.
Keep of pig (including straw).	To be fixed on individual application.
Keep of pack... ...	Do. do. do.
Keep of sheep ...	Do. do. do.
Grazing	Do. do. do.

These values were fixed on 4th January and 22nd March 1919.

SOUTH-WESTERN HIGHLANDS DISTRICT WAGES COMMITTEE.

House and garden ...	Per Valuation Roll, and failing any entry in Valuation Roll such value as may be fixed by District Committee, but in no case to exceed £6 per annum.
Oatmeal	£2, 3/- per boll of 140 lbs.
Barley meal	Not fixed meantime.
Flour	25/6 per boll of 140 lbs.
Potatoes	£6 per ton, or 6/- per cwt.
Milk	2/- per gallon. (This figure is based on the average producer's price for the year.)
Butter...	2/- per lb. (This figure is based on the average producer's price for the year.)
Butchermeat	Not fixed meantime.
Board	Male workers of all classes 18 years and over, 14/- per week. Boys of 16 years but under 18, 10/6 per week. Boys of 14 years but under 16, 10/- per week. Women of 18 years of age and over, 11/- per week. Girls of 16 years of age but under 18, 10/- per week. Girls of 14 years of age but under 16, 10/- per week.

SOUTH-WESTERN HIGHLANDS DISTRICT WAGES COMMITTEE—*continued.*

Lodging	All classes and ages (with or without attendance), 2/- per week.
Board and Lodging...	Males of all classes—18 years and over, 16/- per week. Boys of 16 years but under 18, 14/6 per week. Boys of 14 years but under 16, 12/- per week. Women of 18 years of age and over, 13/- per week. Girls of 16 years of age but under 18, 12/- per week. Girls of 14 years of age but under 16, 12/- per week.
Breakfast, Dinner, Supper.	Males of all ages, 1/- per meal. Females of all ages, 9d. per meal.
Extra tea at hay, harvest, threshing, etc.	Not fixed meantime.
Fruit	Not fixed meantime.
Coals	£2 per ton.
Peats	£6 per annum for the customary supply for a year's fuel. (The farmer bearing the expense of cutting, carting and stacking peats.)
Firewood	Not fixed meantime.
Light, including oil for light.	Actual cost to farmer.
Free cartage	(Usual rate and custom, but not exceeding £1 per annum.)
Flitting expenses ...	Usual rate and custom of each district.
Harvest fee	*Nil.*
Garden manure ...	*Nil.*
Garden stock ...	*Nil.*
Keep of poultry ...	*Nil.*
Keep of cow ...	...(Without artificial food stuffs)— On hill land, where the hay is cut by the shepherd in his own time, £6. Where the hay is cut by the shepherd in the employer's time, or provided by the employer, £9. Where the hay has to be bought in, or where the cow is kept on arable land, £15.. (With artificial food stuffs)— On hill land, £10, plus the actual cost to the farmer of any artificial foodstuffs supplied. On arable land, or in any case where the farmer buys in the hay, £15, plus the actual cost to the farmer of any artificial foodstuffs supplied.
Keep of pig (including straw).	Actual cost to the farmer of anything supplied by him.
Keep of pack... ...	To be fixed by the Committee on special application by the parties.
Grazing	Do. do. do. do.
Sheep	Do. do. do. do.

These values fixed 7th and 14th January 1919.

NORTH-WESTERN HIGHLANDS DISTRICT WAGES COMMITTEE.

House and house and garden.	(1) as defined in general principles by the Central Committee.			
	(2) when not in Valuation Roll	£4	0	0
Oatmeal	(Per stone)...	0	4	4
Barley meal	„	0	3	0
Flour	„	0	2	3½
Potatoes	(Per ton)	6	0	0
Milk	(Per gal.)	0	2	3
Board	Per week—Men	0	14	6
	„ Women...	0	11	6
Lodging	„ „	0	2	6
	„ „	0	2	0
Board and Lodging...	„ „	0	17	0
	„ „	0	13	6

NORTH-WESTERN HIGHLANDS DISTRICT WAGES COMMITTEE —*continued.*

Meals	Breakfast—Men	£0	1 0
	„ Women	0	0 9
	Dinner „	0	1 0
	„ „	0	0 9
	Supper „	0	1 0
	„ „	0	0 9
Extra tea at hay, harvest and threshing	Per day „	0	1 0
	„ „	0	0 9
Coals	Wholesale price in the district, as ascertained and determined by the District Committee.		
Peats	Fixed on application.		
Firewood	Do. do.		
Light (including oil for light).	Wholesale price, 1/3½ per gallon.		
Free cartage and flitting expenses.	Time and country rate and custom.		
Keep of cow	(*a*) Without artificial foodstuffs—		
	In Lochaber and Wester Ross Districts	£12	0 0
	Skye	8	10 0
	Outer and Small Isles...	7	10 0
	(*b*) With artificial foodstuffs— The foregoing with the addition of the wholesale price in the district as ascertained and determined by the District Committee of any artificial foodstuffs supplied by employer.		
Keep of poultry ...	No charge to shepherd. All others for 20 hens, per annum, 1/–.		
Keep of pack... ...	Per ewe per annum (grazing and sheep included), £1, 10/–.		

These values were fixed 22nd January 1919.

STATISTICS.

PRICES of AGRICULTURAL PRODUCE and FEEDING STUFFS in April, May, and June 1919.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	APRIL.			MAY.			JUNE.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l w s. d.	per cwt. l.w. s. d.	per cwt. l w s. d.	per cwt. l.w. s d.
Aberdeen-Angus ...	84 8	78 0	73 4	87 1	80 1	74 11	86 2	79 5	74 4
Shorthorn . ..	84 11	79 0	73 10	87 0	81 0	76 0	85 0	80 0	73 4
Galloway	85 6	78 0	71 0	87 4	79 4	69 0	86 0	80 0	72 0
Ayrshire	83 11	74 10	67 2	84 6	74 5	66 5	85 0	74 8	66 0
Cross-bred	84 5	77 4	71 8	86 7	78 10	73 1	85 9	78 3	72 7
Blue Grey	85 0	78 0	72 0	88 0	80 0	70 0			.
Highland	84 4	78 6	73 0	...	.	...	...	.	..
VEAL CALVES	per lb. d. 9	per lb. d. 8	per lb. d. 6⅝	per lb. d. .	per lb. d. 7½	per lb d. 6	per lb. d. 23¼	per lb. d. 14⅝	per lb. d. 11
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot ..	17⅜	17⅜	17½	18⅜	18½	18¼	18	17⅜	17½
Half-bred ..	17⅜	17¾	17½	18½	18	17⅜	18¼	18	17½
Blackface	17½	17¼	16⅜	18¼	18	17¼	17½	17¼	17¼
Greyface	18	17¾	17¼	18¼	18	17½	18	17⅜	16½
Down Crosses ...	18	18	...	18½	...	...	18⅜	18¼	.
PIGS—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs	17 10	17 6	16 0	17 10	17 6	16 0	17 11	17 6	16 0
Porkers	17 11	17 10	16 0	17 11	17 10	16 0	17 11	17 11	16 0

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description.	APRIL.			MAY.			JUNE.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
STORE STOCK:—									
STORE CATTLE—	Per head. £ s.	Per head. £ s.	Per head. £ s.	Per head. £ s.	Per head. £ s.	Per Head. £ s.	Per Head. £ s.	Per Head. £ s.	Per Head. £ s.
Aberdeen-Angus:									
Yearlings	25 19	19 18	14 16	25 10	19 1	14 2	24 3	17 17	13 7
Two-year-olds ...	36 4	29 12	22 17	38 3	30 3	23 7	37 17	30 4	23 17
Shorthorn:									
Yearlings	26 10	16 11	14 7	..	...	...	...	...	...
Two-year-olds ...	32 5	25 10	22 7	...	...	...	...	...	...
Galloway:									
Yearlings	20 0	16 12	13 8	22 0	16 19	14 10	22 13	17 3	14 7
Two-year-olds ..	...	27 0	19 4	42 0	35 10	27 0	35 0	29 0	24 0
Ayrshire:									
Yearlings	...	...	10 0	15 10	13 0	9 13	16 10	13 15	11 0
Two-year-olds ...	...	21 15	...	32 0	21 10	18 0	23 0	17 0	...
Cross-bred:									
Yearlings	22 3	17 1	14 5	23 6	17 11	13 4	23 6	17 11	13 1
Two-year-olds ...	34 9	27 18	22 10	36 5	28 4	23 12	36 7	28 2	24 1
Blue Grey:									
Yearlings	21 0	.	...	23 0	17 0	15 0	22 0	18 0	15 0
Two-year-olds ..	...	27 0	21 0	43 10	36 10	28 0	33 0	30 10	26 0
Highland:									
Yearlings ..	15 10	12 10	...	15 13	12 8	...	15 0	12 0	...
Two-year-olds ...	30 8	27 15	.	23 18	20 8	16 5	22 5	18 15	...
Three-year-olds ...	...	...		34 14	28 2	24 0	..	25 10	22 15
DAIRY COWS—									
Ayrshire:									
In Milk	38 17	30 5	19 3	43 7	33 13	22 15	41 13	34 4	21 18
Calvers	43 12	31 7	20 19	47 1	33 17	24 3	47 3	34 11	24 0
Shorthorn Crosses:									
In Milk	54 9	40 4	28 6	54 13	42 8	30 11	53 3	42 0	29 10
Calvers	44 16	33 12	23 3	48 15	36 6	25 9	50 3	37 10	25 13
STORE SHEEP—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Cheviot Hoggs ..	65 9	48 7	37 11	63 3	57 1	51 6	65 0	52 9	45 5
Half-bred Hoggs ...	90 1	69 3	57 0	101 0	74 10	63 0	83 5	56 9	...
Blackface Hoggs ...	50 7	38 6	30 8	55 1	42 8	34 9	56 7	45 6	35 11
Greyface Hoggs ...	66 0	53 8	43 3	69 7	56 6	46 0	72 0	57 1	45 5
STORE PIGS—									
(6 to 10 weeks old)	62 3	47 1	...	70 3	53 7	...	79 10	58 10	...

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	APRIL.			MAY.			JUNE.		
		Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF :—		per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
Home-fed—										
Bullock or Heifer ...	1	12½	12½	12½	12⅝	12⅝	12⅝	12⅝	12⅝	12⅝
	2	12⅛	12⅛	...	12¼	12¼	...	12⅛	12⅛	...
Bull	1	12½	12⅝	12½	12⅝	12⅝	12⅝	12⅝	12⅝	12⅝
	2	12⅛	12½	. .	12⅝	12⅝	...	12⅝	12⅝	...
Cow	1	12½	12½	12½	12⅝	12⅝	12⅝	12⅝	12⅝	12⅝
	2	11½	11	12	11⅝	11	...	11⅝	11	...
Irish—										
Bullock or Heifer ...	1	...	...	12½	.	...	12⅝	...	...	12⅝
	2	...	...	...	...	...	...	...	..	...
Bull	1	...	...	12½	...	...	12⅝	...	..	12⅝
	2	...	...	. .	...	...	...	. .	...	...
Argentine Frozen—										
Hind Quarters ..	1	...	14⅛	..	...	12⅝	...	...	12⅝	...
Fore ,, ...	1	. .	10⅞	..	...	9½	...	...	8⅞	...
Argentine Chilled—										
Hind Quarters .	1	...	...	13⅜	..	...	. .	...	...	...
Fore ,, ...	1	...	. .	10⅜	..	...	...	...	...	...
MUTTON :—										
Hoggs, Blackface ...	under 60 lbs.	13¼	13¼	13¼	13½	13½	13½	13½	13½	13½
	60 lbs. and over.	13¼	13¼	..	13½	13½	...	13½	13½	...
,, Cross	under 60 lbs.	13¼	13¼	13¼	13½	13½	13½	13½	13½	13½
	60 lbs. and over.	13¼	13¼	..	13½	13½	...	13½	13½	...
Ewes, Cheviot	1	13¼	13¼	13¼	13½	13½	13½	13½	13½	13½
	2	13¼	...	..	13½	...	...	13½	...	...
,, Blackface ...	1	13¼	...	13¼	13½	...	13½	13½	...	13½
	2	13¼	...	...	13½	...	...	13½	...	...
,, Cross	1	13¼	13¼	13¼	13½	13½	13½	13½	13½	13½
	2	13¼	...	...	13½	...	...	13½	...	...
Argentine Frozen ...	1	...	13¼	...	...	11½	...	..	...	...
LAMB :—										
Home-fed	1	...	...	...	...	...	...	...	13½	...
	2	...	...	...	...	...	...	...	. .	...
Argentine Frozen ...	1	...	...	...	...	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	...

AVERAGE PRICES OF PROVISIONS AT GLASGOW.

(Compiled from Reports received from the Board's Market Reporter.)

Description.	Quality.	April.	May.	June.
		s. d.	s. d.	s. d.
BUTTER:				
Irish Creamery ... per cwt.	1	252 0	252 0	252 0
" " (Unsalted) "	1	252 0	252 0	252 0
Canadian ... ... "	1	252 0	252 0	252 0
" (Unsalted) ... "	1	...	...	...
Australian ... ... "	1	252 0	252 0	252 0
" (Unsalted) ... "	1	252 0	252 0	252 0
New Zealand ... ... "	1	252 0	252 0	252 0
" (Unsalted) "	1	252 0	252 0	252 0
Argentine ... ... "	1	252 0	252 0	252 0
" (Unsalted) ... "	1	252 0	252 0	252 0
CHEESE:				
Cheddar ... ... "	1	148 5	144 8	144 8
Cheddar Loaf ... ... "	1	...	. .	...
Dunlop ... . "	1	148 5	144 8	144 8
Canadian ... ... "	1	148 5	144 8	144 8
New Zealand ... ... "	1	148 5	144 8	144 8
BACON:				
Ayrshire (Rolled) ... "	1	226 6	227 6	227 6
Irish (Green) ... ... "	1	...	...	...
" (Dried or Smoked) "	1	214 0	...	...
Wiltshire (Green) ... "	1	...	. .	...
" (Dried or Smoked) "	1	...	...	...
American, Long Clear Middles (Green) ... "	1	181 5	181 0	181 0
American, Short Clear Backs ... ... "	1	150 0	.	...

Description.	Quality.	April.	May.	June.
		s. d	s. d.	s. d.
BACON (*continued*):				
American, Bellies... per cwt.	1	150 0	...	...
" Sides ... "	1	173 2	176 0	176 0
" Cumberland Cut "	1	173 6	175 0	175 0
Canadian, Sides ... "	1	177 7	180 0	180 0
" Cumberland Cut "	1	175 2	177 0	177 0
Danish, Sides ... "	1	...	...	...
HAMS:				
Irish (Smoked) ... "	1	...	...	...
American, Long Cut (Green) ... ... "	1	172 10	176 0	176 0
American, Short Cut "	1	171 2	174 0	174 0
Canadian, Long Cut "	1	174 5	178 0	178 0
EGGS:				
Country ... ... per doz.	1	3 6	3 5	3 4
	2	3 4	3 3	3 2
Irish... ... ... per 120	1	32 2	30 6	30 0
" (Duck) ... "	1	37 7	30 9	25 4
" (Pickled) ... "	1	...	...	...
" (Cold Stored) "	1	...	...	...
American ... ... "	1	26 6	27 6	25 6
Canadian ... ... "	1	27 0	29 0	26 9
Danish (Fresh) ... "	1	34 4	34 3	...
	2	32 4	32 9	...
" Pickled ... "	1	...	...	...
Egyptian ... . "	1	16 8	...	...

AVERAGE PRICES OF POTATOES AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

MARKETS.	Quality.	Second Earlies.	Late Varieties.			
			Red Soils.		Other Soils.	
		British Queen.	Langworthy.	Other.	Langworthy.	Other.
		per ton £ s. d	per ton £ s. d.	per ton £ s d	per ton £ s d.	per ton. £ s d
APRIL.						
Dundee	First ...	...	...	7 10 0	. .	7 10 0
	Second ...	...	...	...	...	...
Edinburgh... ...	First ...	. .	8 5 0	. .	7 10 0	...
	Second ...	...	. .	.	...	...
Glasgow	First ...	...	8 5 0	.	7 10 0	7 15 0
	Second ...	...	. .	. .	...	...
MAY.						
Dundee	First ...	...	...	...	..	7 10 0
	Second ...	. .	...	...	...	...
Edinburgh... . .	First ...	...	8 19 0	...	7 10 0	7 15 0
	Second ...	...	...	...	. .	...
Glasgow	First ...	...	...	...	7 10 0	7 10 0
	Second . .	...	..	...	...	...
JUNE.						
Dundee	First ...	. .	...	...	...	7 10 0
	Second ...	.	...	...	...	...
Edinburgh.	First ...	...	8 19 0	...	...	7 15 0
	Second ...	...	...	...	...	...
Glasgow	First ...	...	...	...	...	8 3 0
	Second ...	...	...	...	...	...

AVERAGE PRICES OF ROOTS, HAY, STRAW AND MOSS LITTER AT DUNDEE, EDINBURGH AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Markets.	Quality.	Roots. Carrots.	Roots. Yellow Turnips.	Roots. Swedes.	Hay. Ryegrass and Clover.	Hay. Timothy.	Straw. Wheat.	Straw. Barley.	Straw. Oat.	Moss Litter.
APRIL.		per ton. s. d.	per ton. s d	per ton. s d.	per ton. s. d.	per ton. s d.	per ton. s. d.	per ton. s. d	per ton. s. d.	per ton. s. d.
Dundee ...	1	.	36 9	44 7	...	. .	75 0	...	90 0	54 0
	2	...	31 3	40 11	...	...	...	...	...	...
Edinburgh	1	...	...	...	175 0	...	71 8	...	74 6	50 0
	2	...	...	...	145 0	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	50 0
	2	...	...	...	...	...	...	...	...	...
MAY.										
Dundee ..	1	...	...	48 0	...	...	75 0	...	90 0	54 0
	2	...	26 0	44 0	...	...	...	...	...	...
Edinburgh	1	...	...	57 6	181 3	...	69 5	...	75 0	52 0
	2	...	...	...	135 0	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	50 0
	2	...	...	...	...	...	...	...	...	...
JUNE.										
Dundee ...	1	...	...	64 0	...	...	75 0	...	90 0	54 0
	2	...	...	60 0	...	...	...	...	...	...
Edinburgh	1	...	..	...	183 4	..	61 8	...	66 8	50 0
	2	...	...	...	140 10	...	...	...	...	...
Glasgow ...	1	...	...	...		...	...	...	...	50 0
	2	...	..	...	...	...	...	...	...	...

AVERAGE PRICES OF FEEDING STUFFS AT GLASGOW AND LEITH.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	APRIL.		MAY.		JUNE.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Linseed Cake—						
†Home	19 0 0	19 0 0	19 3 9	19 0 0	19 5 0	19 8 0
Foreign	...	...	...	...	...	...
Soya Bean Cake ...	...	...	...	...	...	...
Decorticated Cotton Cake	...	...	...	..	...	...
Undecorticated Cotton Cake—						
Bombay ...	...	...	...	...	...	...
†Egyptian ...	14 13 0	14 10 0	14 6 3	15 0 0	14 5 0	...
Coconut Cake ...	...	...	...	...	...	...
†Palmnut Kernel Cake	...	13 15 0	...	...	...	...
Groundnut Cake (Decorticated) ...	...	...	...	..	...	...
Beans (Brazilian)...	20 0 0	...	18 0 0	...	17 10 0	...
Maize Meal ...	...	...	...	...	...	...
Rice Meal	...	...	...	...	...	...
Paisley Meal ...	16 8 0	...	17 10 0	...	18 0 0	...
Cotton Seed (Meal)	19 15 6	...	...	.	..	...
Distillery Meal ...	...	...	...	...	...	...
Beans (English) ...	24 10 0	...	24 10 0	...	24 7 0	...
Peas (English) ...	25 0 0	...	25 0 0	...	25 0 0	..
Locust Bean Meal	...	...	...	...	...	...
Maize	...	...	...	...	...	...
Oats	..	16 0 0	...	16 10 0	...	16 17 0
*Flour Millers' Offals	12 5 0	...	12 8 9	...	12 10 0	...
Malt Culms ...	...	...	...	...	...	...
Distillery Mixed Grains—						
†Dried	16 10 0	...	16 10 0	..	17 0 0	16 0 0
Wet	...	...	...	..	17 0 0	...
Brewers' Grains—						
Dried	...	...	...	...	..	...
Wet	..	...	...	...	...	...
Wheat—						
†Middlings (Fine Thirds or Parings)	...	12 0 0	...	12 0 0	...	12 0 0
†Sharps (Common Thirds)... ...	...	...	...	...	...	...
†Bran (Medium) ...	...	11 0 0	...	11 0 0	...	11 0 0
Bran (Broad) ...	...	...	...	...	...	...
Feeding Treacle ...	...	10 0 0	...	10 0 0	...	10 0 0
Crushed Linseed ...	...	...	...	...	...	...
Fish Meal	22 0 0	22 0 0	19 7 6	21 0 0	18 10 0	21 0 0

* Sold in 2-ton lots, sacks included, ex-Mill and ex-Distillery.
† Price of bags and authorised transport charges are not included

Printed under the authority of His Majesty's Stationery Office
By J. SKINNER & CO., LTD., 27 THISTLE STREET, EDINBURGH
(30.) 7997/189. 3750. 7/19.—J.S.&Co.Ltd. (E.)

The Scottish
Journal of Agriculture.

VOL. II.—No. 4.] OCTOBER 1919. PRICE 6d. NET.

PROBLEMS OF ANIMAL BREEDING.

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BRITISH breeders, and the animals they produce, enjoy a deservedly high reputation, and throughout the temperate regions of the world one finds a very large proportion of the improved live stock to be of British origin. Here and there, indeed, we see our breeds defeated in the race for popularity, as for example our draft horses by the Percheron in some parts of the United States, and our dairy cattle by the Friesian in certain other parts of the same country. But taking it all in all, Great Britain has well earned the appellation of the "World's Stud Farm."

That Scotland is at least not behind England in the art of breeding is shown by the comparatively high average quality of her live stock, and by the widespread and general success of Scottish breeds abroad—Clydesdale, Aberdeen-Angus, Scotch Shorthorn, Ayrshire, Border Leicester, and in less measure nearly every breed which we possess. The immediate reason for this is not far to seek; a remarkably large proportion of Scottish farmers have what is called a natural eye for stock. Anyone who has come in contact with farmers in different countries must have been struck by this fact. Real judges of stock—men with that finely critical, appreciative faculty which is the first essential in a breeder—are common nowhere, but they are far more frequently met in Scotland than elsewhere.

The present position of our pure-bred stock industry in Scotland is, on the face of it, highly satisfactory, for a great wave of enthusiasm for good live stock is spreading everywhere, and good specimens of nearly all our breeds are bringing unprecedented prices. Such a period of prosperity at once offers a great opportunity and constitutes a great source of danger—an opportunity to launch out in bolder and more enterprizing schemes, and a danger in that there is a certain tendency to assume that all is well, and that we have only to proceed along the old lines in order to maintain our position. The present is therefore an appropriate time to take a long view of the future, and to state afresh the problems that our breeders have to face.

Essential Factors in Breeding.—We may say that there are three essentials to success in breeding. The first, as has just been said, is the purely personal quality of being able to see and appre-

ciate the finer points of type and conformation, a faculty which comes only after years of training, and in many cases not at all. Just as some people can never make real musicians, because they have no ear, so there are others who can never be tolerable artists or stock judges because they have no eye. This faculty is of less importance if we have a direct test of the value of the animal, such as the racecourse for thoroughbreds or the milk-record for dairy cattle, but even then it is of great value. The other two essentials are a clearly conceived and fundamentally sound ideal type for the breeder to keep before him, and right methods of breeding, of selection, mating and so forth. We are fortunate in our supply of the human material out of which great breeders are made. But are our methods sound, and have we got in every case a right ideal type in view? There is room for a good deal of thought on both questions.

Ideal Types. — The question of a sound ideal type — of a logically conceived standard of points—is beset with difficulties. Not only must we be perfectly clear about what we are driving at, but we must try to ensure that our standard is based, in the main, on commercial utility. For it is according to the degree of economy with which an animal can produce meat or wool, milk or work, that it must and will be judged at the last. This should go without saying—set down as a definite statement it is indeed a platitude. Yet in practical breeding how often is it forgotten! The very fact that many of our Scottish breeders have so keen and highly trained an eye carries with it this disadvantage, that they can never rest satisfied with a good sensible commercial type of animal. Their eye craves a certain beauty of line and symmetry of form which is often quite unconnected with commercial value, and they are too often induced to sacrifice the stern utility points for such "fancy" considerations. This would be less regrettable if the requirements in the way of non-utility points could be definitely and permanently fixed, but they are subject to changes which are as purposeless as they are incapable of prediction. The result is that our breeders are half their time chasing will-o-the-wisps of fashion instead of following the true light of utility.

One has only to recall the official and accepted standard for Ayrshire cattle, as it existed up till a few months ago, to see how far it is possible for reasonable men to go astray in this matter. The Ayrshire being a dairy breed, it would seem natural and obvious that it should be judged by its capacity for milk production. While we may admit that a milk record, made, it may be, under highly artificial conditions, is by no means a perfect criterion of actual value for the dairy, it is still by far the best available. Yet not only were milk records left altogether out of account in judging, but it was pretty generally admitted by breeders themselves that the showyard standard was inherently opposed to a high yield of milk. One could not fail to admire the fine symmetry, level udders, and neat, squarely placed teats of the show Ayrshire. There is no doubt but that a vast amount of skilful effort had been spent in evolving it, and it is pitiful to think that the work and time have been so largely wasted. Some show animals indeed

have been good milkers, in spite of their show points, but a great number were indifferent or bad. Whether Ayrshire breeders will allow themselves to be guided entirely by the new standard and by common sense remains to be seen; the old show type will probably die hard. It is certain, however, that if Ayrshire breeders have been the worst offenders, they are by no means the only body who have laid themselves open to criticism.

Take, for example, our national breed of horses. The writer is a stout supporter — probably a prejudiced supporter — of the Clydesdale against any draft horse in the world, yet it is impossible to observe the present trend of fashion in the breed without the very gravest disquiet for its future. In this case the trouble is not that the ideal type is essentially a wrong one, as with Ayrshire cattle; but the standard of points as it is applied in the show ring is wrong, in that we have lost a true sense of the relative importance of the different points. An entirely disproportionate part of our mental score-card is allotted to feet and legs, and far too little consideration is given to depth of rib, strength of back, and weight of muscle. For if bones, pasterns and feet are necessary to ensure wearing qualities, big muscles are just as essential for strength, and the belly is the ultimate source of all the energy which the horse can expend. Action too is required to be so close that it is becoming well nigh impossible to combine it with the essential width and substance of body. Then consider the question of hair, more particularly of what is called "spat." How much effort has been misspent in developing, both by breeding and by artificial treatment, this totally useless embellishment—effort which could have been so profitably devoted to points of commercial value.

These criticisms are of course anything but original or new. They constitute in fact nothing but the general opinion of unbiassed judges throughout the world; and unless it be assumed that we in Scotland have a monopoly of horse-sense we should give them heed. A very shrewd American and a breeder of Percherons was recently giving the writer the impressions formed by him during an extensive tour of Scotland. He concluded with this remark: "You have a great breed in the Clydesdale—far greater than I ever imagined. But you are castrating all the wrong horses."

Horses.—Despite the truth of these criticisms, there is reason for a large measure of satisfaction when we take a broad view of the position of horse-breeding in the country. Good observers say that the average level of merit of our work-a-day farm and street horses has improved enormously within the past half-century, and it is doubtless still improving. Moreover the number of real undesirables, of small, unsound or mongrel animals that are to be seen in our markets is on the whole wonderfully small. This is the result of a systematic scheme of grading up by the continuous and almost exclusive use of pure-bred Clydesdale sires. The Clydesdale, even at his best, is perhaps not equally well adapted for all the forms of draft work which fall to be done, in town and country, on light soils and heavy, large farms and small; but it would be a grave mistake to depart from our present policy by the haphazard introduction of sires of other breeds. Anyone who has seen the practical results achieved in some parts of America, where

Clydesdale, Percheron, Belgian, Shire, and Suffolk have been indiscriminately crossed, will surely pray that we may be saved from a multiplicity of breeds.[1]

Cattle and Sheep.—To turn to cattle and sheep, there is a striking and significant observation which one can make in almost any of our markets. Nearly every sheep that one sees can be referred with certainty to one or other of the pure breeds or to a definite cross; which indicates that our sheep breeders are working with a clear and definite system, and that the existing breeds are fulfilling tolerably well our commercial needs. Whereas with cattle a large proportion are beasts which, while they may be fathered on the Shorthorn, or given the non-committal designation of "crosses," are nothing but nondescript mongrels. Many of them moreover are so bad, from any possible point of view, as to constitute a disgrace to a country which claims pre-eminence in stock breeding.

Cattle.—It is of course a fact that we are largely dependent on Ireland for our supplies of cattle, and Ireland must bear a considerable share of the blame for this unsatisfactory state of affairs But we ourselves are breeding too many mongrels, and are only less at fault. The blame cannot be laid at the door of any one section of breeders, for the Ayrshire (leaving out the old show type) and the Friesian would seem to meet any reasonable demand in the way of dairy cattle, and our Scotch Shorthorn, Aberdeen-Angus, Galloway and West Highland are certainly what they claim to be, viz, excellent beef breeds. The difficulty lies in the fact that what many of our ordinary farmers, more particularly our small farmers, require is neither the purely dairy nor the purely beef type. Their need is for an improved dual purpose cow, which will give a good yield of milk and produce beef steers. And it is a fact that we have almost none of this type of pure bred stock to offer. One could set forth an involved discussion of the question whether the perfect dual purpose cow is a theoretical possibility. But the fact remains that she is a practical necessity, and anyone who saw, for example, the display of milking Shorthorns at the last "Royal," must have been convinced that a wonderfully successful attempt is being made to evolve her. England is far ahead of us in this line, and if we are to maintain our position in the pure-bred stock business we should set to work in the same direction. Even in our Shorthorn and Angus herds a higher milk yield would be a great benefit, and could be quickly attained at very little sacrifice from the beef standpoint. The spectacle of the long row of nurse cows in so many of our Shorthorn men's byres is anything but a cheerful one to contemplate.

Sheep.—Sheep breeding has its own peculiar problems. Take for example our most numerously represented breed, the Blackface. The work of improvement in this case is subject to a severe limitation, in that it is essential that we should maintain an extreme degree of hardiness—we must, above everything, stick to a type of sheep which can live. The "strong" coat is supposed to be corre-

[1] This has of course no reference to the experiment in crossing Shires and Clydesdales which is apparently to be started by a well-known breeder. A systematic scheme of crossing, in the hands of a master, is a different matter.

lated with hardiness, and to last much better in the older ewes. On this ground our breeders have not only given up any attempt to improve the quality of the fleece, but are deliberately breeding for a type of wool which the wool man does not want. They may be right. But if they are bent on securing hardiness it cannot be said that they have shown themselves very consistent in their efforts. The methods that have been in vogue up to the present, of house wintering and pampering the rams, are hardly calculated to improve the breed's capacity to live and thrive on the mountain side. The question of type in Blackfaces—of what qualities are practically possible under its native conditions—is a most difficult one, and an ounce of ascertained fact would go farther towards a solution of it than all the arguments that have been adduced. It seems that there might be justification for the experimental attempt to produce a finer wooled type, while maintaining the weight of fleece, the hardiness and all the other valuable characters of the Blackface. It would be difficult, of course.

Perhaps the greatest affliction of Blackface flock-masters is the enormous death-rate on certain grazings from disease, braxy and louping-ill in particular. If it happens that our veterinarians and pathologists fail in their efforts to find a preventive which would be applicable in practice, there is another possible solution of the problem which might be worth consideration. Different races of animals and plants are known to vary greatly in the degree of their susceptibility to particular diseases. Sometimes it happens that one race is highly susceptible and another perfectly immune. There is therefore, on general grounds, some probability that if we instituted a careful search among both wild and domesticated sheep, we might discover a type possessing this natural immunity to braxy and louping-ill. Having done so, it would be a relatively easy matter to transfer the immunity, by crossing, to our native breeds.

Methods —To leave this somewhat vexed question of type, and assuming that we have got some clear and practical ideal in mind, how are we to proceed to embody it, as nearly as may be, in the living animal, and finally in a true-breeding race? Neither the greatest practical breeders nor the greatest exponents of genetics can show us any easy method by which this can be accomplished, but one or two broad facts can be stated which provide material help.

Mass Selection —What is called mass selection—the picking out for breeding of the best individuals irrespective of their pedigree—is the simplest possible scheme of improvement. It frequently, however, gives very unsatisfactory results, the fact being that the visible characters of an animal often convey but a very incomplete, and sometimes a misleading, picture of its inborn hereditary qualities. The reason, as given by scientists, is two-fold. Often the good or bad qualities of an animal are due to accidental, environmental causes, and such characters are never, it seems certain, inherited to any appreciable extent. Secondly, the Mendelian experimenters have shown us that certain characters can dominate over or mask certain others. So that a fine individual

animal may always contain hidden defects which will appear under certain circumstances in following generations.

How ineffectual this mass selection may be has been well shown by Dr. Pearl in his experiments with Barred Plymouth Rock fowls. For eight years he kept up a very rigid system of mass selection for high egg production, the actual test applied being that all pullets kept for breeding should have an egg record of 160 or over, and that all males should be from hens which had exceeded 200 in their first season. The nett result, in the way of improving the average egg production, was nil. It is obvious that the fowls in question must have had excellent "pedigrees of performance" in the ordinary sense, but this evidently is not enough. The explanation seems to lie in the fact that egg production is subject to a great deal of variation which is due to other than hereditary causes. Thus a great number of the heavy layers were only chance variants of low producing strains, and reproduced not their own characteristics, but those of the strain to which they belonged.

Family Selection.—How then are we to select? The answer is that we must endeavour to pick out the good families rather than the good individuals. In 1908 Pearl commenced a new system of record keeping whereby he found out the average egg production of all the pullets from a particular mating. Selection for further breeding, both of males and females, was confined to the good groups. Families which were poor on the average, even when they contained good individuals, were discarded entirely. The result was an immediate and very large increase in the average egg production of the flock. Such facts give us a key to the proper interpretation of pedigree, a matter of first importance, since it is only by a study of its pedigree that we can predict with any degree of probability how an animal may breed. The point which emerges from the foregoing is that we must judge a pedigree not so much by the individual merit of the immediate ancestors as by the degree of their success as breeders.

Inbreeding.—But even this is not enough. For it is well known that an animal which is produced by a violent out cross, no matter how good it may be or how well bred on either side, is generally an unsatisfactory breeder. We must therefore aim at some degree of similarity of type between the parents, and some measure of actual blood relationship. Continuous violent out crossing produces indeed a small proportion of good individuals, but it reduces breeding, which should be a fine art, to the status of a game of chance, with the odds against success. If we could inbreed closely and continuously we should doubtless arrive at a type which would breed absolutely true, but in practice such a result has never been approached without the gravest consequences in the way of reduced vigour and lessened fertility. How closely can we, or dare we inbreed? The fact is we have only the vaguest of ideas. In beef cattle and lowland sheep close breeding has been on the whole successful. In the early days, when types were rather mixed, matings of close relations—sire and daughter, full brother and sister, etc.—were sometimes continued for two or three

generations. In thoroughbred horses, on the other hand, it is hardly an exaggeration to say that an inbred animal has never won a race.

This is a question of much interest and much importance in practice. The latest scientific contribution to the problem is the suggestion that it is only a majority—perhaps generally a very large majority—of an inbred strain which suffer from the evil effects. The others may conceivably acquire all the benefits of in-breeding without any loss of size or vigour. If this be true it would open up new and interesting possibilities, for we should be able to introduce a degree of certainty into the business of breeding which has been quite unknown hitherto. Obviously some large experiments would be necessary to clear up the problem, experiments which are quite beyond the province of the ordinary breeder. This much can be said, however: the closer that an animal is bred—provided always that it is a good animal—the truer will it breed, and hence the more valuable will it be.

The "Family" Craze.—The essentials in evaluating pedigree are the breeding ability of the immediate ancestors, and the degree of consanguinity between them. By immediate ancestors we mean the parents and grandparents, or at most those of a generation beyond. The study of further back generations is, we are convinced, very generally overdone. An extreme and a pernicious form of this is the so-called family system which obtains with our Shorthorn and Angus breeders. To call an animal a Jilt or a Blackbird, a Clipper or a Princess Royal, conveys perhaps a certain atmosphere of aristocratic breeding, but the name is almost meaningless from any reasonable point of view. It means of course that the animal is descended in the direct female line (no matter through how many generations) from a particular cow. We recently took the trouble to work out the pedigree, for half-a-dozen generations, of a fine Angus bull, belonging to one of the rarer and somewhat highly-prized families. Of the 64 ancestors in the sixth generation, 27 were Ericas, 13 Prides, 4 belonged to other Queen Mother families, and of the remaining 20, only 1, the direct female ancestress, belonged to the same family as the bull himself. The system must be doing a good deal of harm. Females of fashionable families are being retained for breeding whether they are good or bad, and good animals are being thrown away because they bear no aristocratic names. An Australian breeder recently remarked to the writer that there was nothing he was more grateful for than the "family" craze, because it enabled him to buy good cattle, of no particular tribe, at half what they would otherwise have cost. Thomas Bates, great man as he was, must bear a good deal of blame in the matter. He was a faddist by nature with a special hobby for involved genealogy, and he is largely responsible for initiating the system. Our own Amos Cruikshank, who "cared nothing for families or for high-sounding names," would be a better model to imitate. Most breeders recognise the absurdity of the system, but it is obviously difficult for individuals to break away from it.

Conclusion.—The writer is aware that these remarks, if they

are considered by breeders at all, may possibly be resented, as coming from one who lays no claim to expert knowledge of any particular breed, and who is nothing but a spectator of the breeders' game. But our main plea is not for the acceptance of any of the particular ideas set forth. It is rather that practical breeders themselves should give careful and thorough consideration to the more fundamental problems connected with their objects and methods, and refuse to continue on the principle that what is, is best; in particular that they should shake themselves free from the tyranny of aimless fashions, whether of blood or type, and concentrate more on the one real end of commercial utility.

SCOTTISH PURE-BRED LIVE STOCK.

I.—ABERDEEN-ANGUS CATTLE.

JAMES R. BARCLAY,
Secretary, Aberdeen-Angus Cattle Society.

History of the Breed.—Aberdeen-Angus cattle, the black horn-less breed which derives its name from the ancient territories of Buchan, in the county of Aberdeen, and Angus, in the county of Forfar, are of very early origin, though it is but a comparatively few years since their establishment as a recognised, improved breed. Enquiry as to the origin of the black polled race of cattle which is indigenous to the north-eastern districts of Scotland yields but little practical result, for as there is no complete agreement, and probably never will be, as to the origin of our domesticated races of cattle, when we come to differentiate between the various breeds, the difficulty and uncertainty become even greater. Our surmises can never get beyond the region of the speculative, and regarded from the present-day practical point of view, it is of little value to say that representations of polled cattle are found depicted on monuments dating about 2700 B.C., or even that there is legal documentary evidence proving that black polled cattle formed a common market commodity in the county of Aberdeen as early as the first quarter of the sixteenth century. It is, however, of interest to note that the largest cattle dealers in the north of Scotland carrying on business in the early years of the nineteenth century testified that of all the cattle which they handled—and they were accustomed to sell some 8000 head yearly in the markets in England and the south of Scotland—they distinctly preferred "the true native, unmixed breed" of black polled cattle.

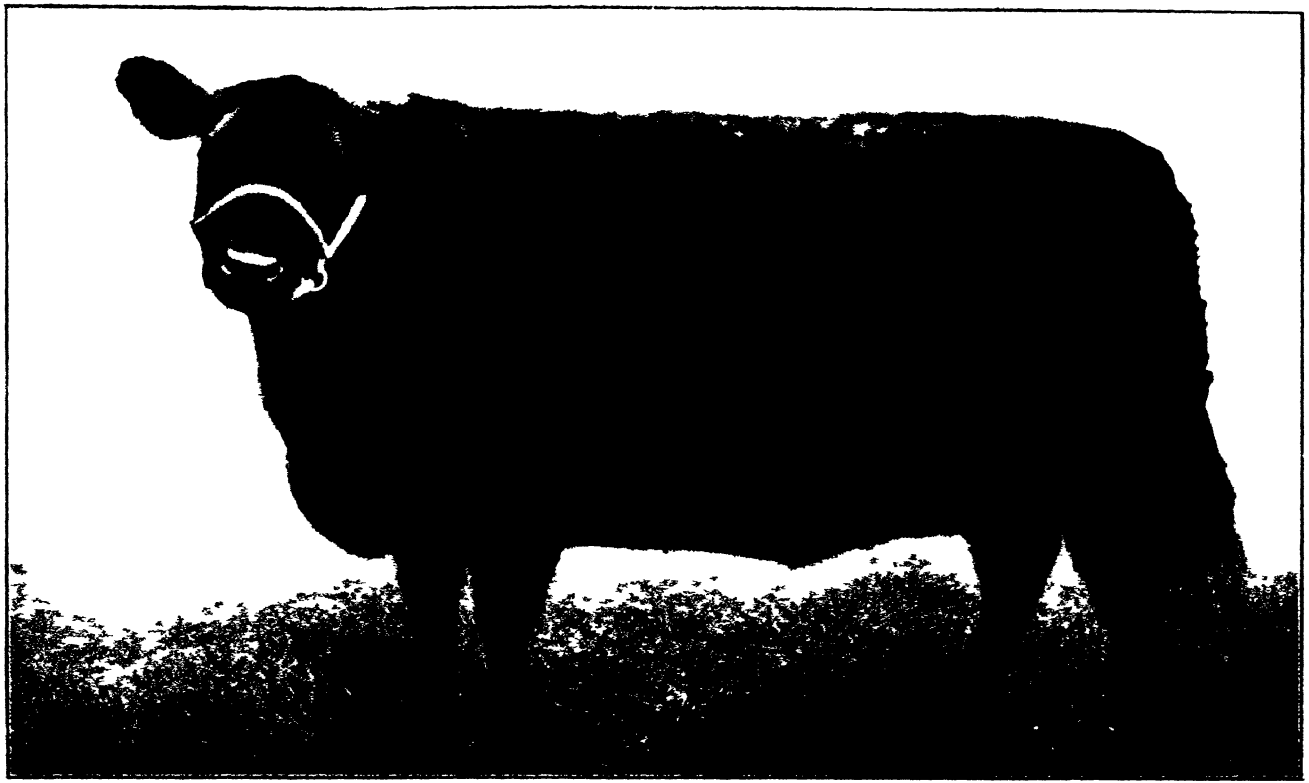
A good many of the Aberdeen-Angus herds could trace descent from 1800, and even before that time, but no very definite systematic lines were followed, and very few records were kept. The first attempt at breeding on systematic lines, on any scale at least, and with a definite object in view, may be said to have been made in 1808 In that year Hugh Watson, who is recognised as the earliest improver of the breed, began farming at Keillor, Forfar, and with a few of his father's cattle he started operations



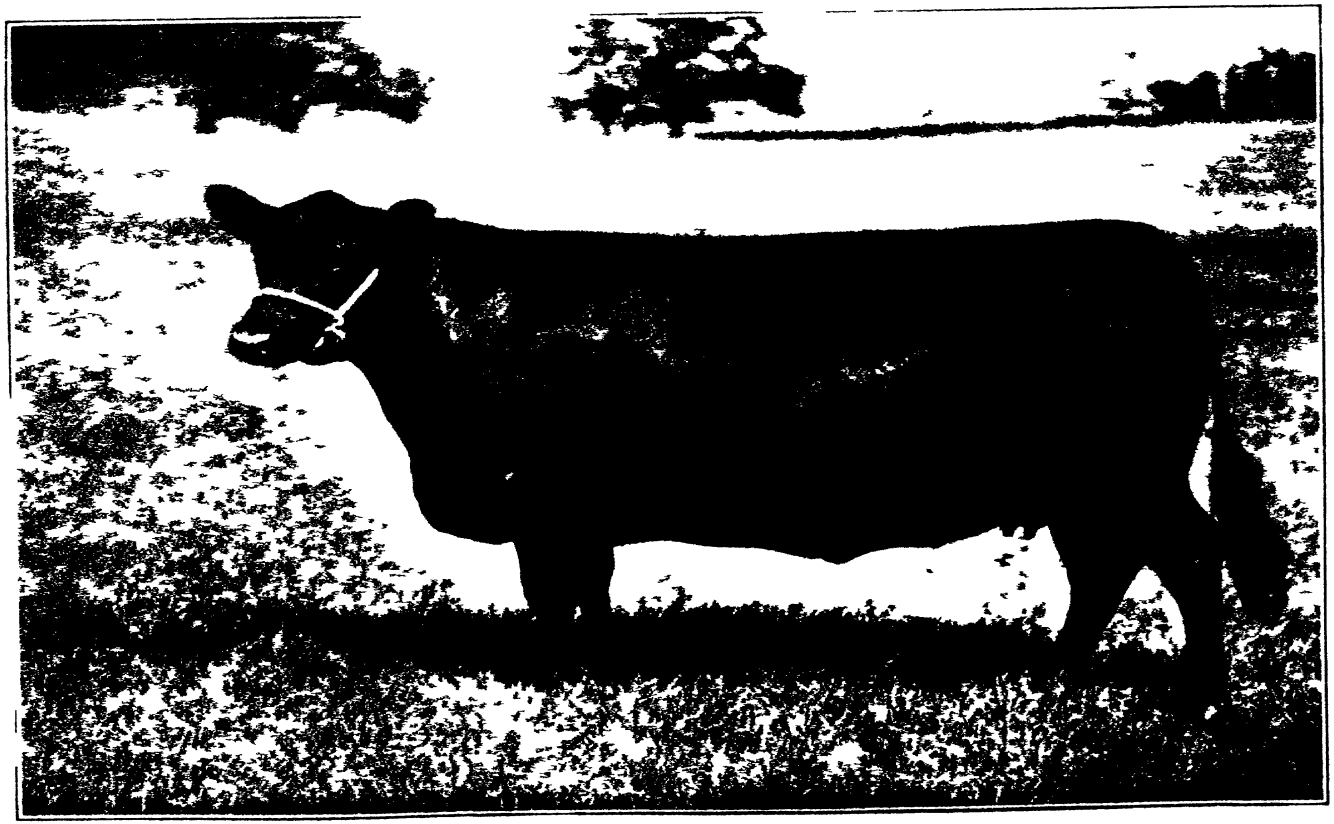
AN ABERDEEN ANGUS BULL



AN ABERDEEN ANGUS TWO YEAR OLD HEIFER



AN ABERDEEN A U WO YEAR I HEIFER



AN ABERDEEN ANGUS COW



ROLL OF ABERDEEN ANGUS CATTLE

which were to have a far-reaching effect. Mr. Watson was recognised as a man of great intellect and perseverance and of accurate judgment, and in securing and fixing the type he had in view he had resort to the closest of in-breeding, his system having little apparent regard for affinity of blood so long as type and characteristics were good on either side. In order to attract attention to his cattle, he devoted much care to their preparation for show purposes. Ninety years ago he was an exhibitor at the Highland and Agricultural Society's Show, his entries comprising an ox and a heifer which were later on the forerunners at the London Smithfield Show of the many representatives of the breed which have since won championship honours there.

There were of course other workers in breed improvement, although Hugh Watson occupies the place of prominence amongst the early pioneers. Lord Panmure (1771-1852) did a great deal for the improvement of the breed, being largely instrumental in forming the East Forfarshire Farming Society, which had for its main object the improving of the old polled cattle of the district. Wm. Fullerton, Ardovie (1810-1880), is also a highly honoured name in the establishment of the breed, while further north, the late Mr. Walker, Portlethen, in the county of Kincardine, had carefully reared a herd which had been in existence from the very early years of the nineteenth century. With the work of these and other contemporary improvers it will not be possible to deal in detail. In a hurried survey of the history of the breed three names stand out prominently, those of Hugh Watson, who is regarded as the founder of the breed, Wm. M'Combie, Tillyfour, the outstanding emancipator of the breed, and the late Sir George Macpherson Grant of Ballindalloch, who accomplished great and lasting work as a refiner of the breed. Each of these three names stands for a distinct era in the development of the breed, and in tracing their efforts towards improvement there will be indicated some of those qualities and characteristics which in the course of a comparatively brief period set the breed in the very forefront of the world's races of beef cattle.

From 1808 till 1860, when his herd was dispersed, Hugh Watson, as the result of his showyard successes with breeding and fat cattle, was able to accomplish a great deal for the breed. His mantle fell upon Wm. M'Combie, who founded a herd of the breed in 1830, very largely on stock selected from the herds of Wm. Fullerton, and of Alex. Bowie. Mains of Kelly, whose name ought also to find a place in the list of early improvers. Mr. M'Combie, a man of great force of character and determination, took up the breed at a very critical juncture in its history, for the craze for crossing which followed upon the introduction of the Teeswater or early Shorthorn breed threatened to bring about the entire extinction of the native race. Retiring from a very extensive trade in store cattle, Mr. M'Combie directed the whole of his energies to the rescue of the breed, and so successful were his efforts that he lived to see the breed raised from a local standard to a position of national and international importance. He too realised the value of the show arena, and especially of the interbreed contests there, as a means of advancing the interests of the breed. In 1867 he

carried off the championship of the London Smithfield Show with the steer Black Prince, the fame of which spread far and wide, for it was something new to the English agriculturists to find that a "Polled Scot" could beat the representatives of English breeds which had been undergoing systematic improvement for generations before the establishment on any recognised basis of the Aberdeen-Angus. One direct result of this victory was the establishment of a herd by the late Queen Victoria at Balmoral. This herd is still maintained, as is also a herd at Dartmoor on the Prince of Wales' Duchy of Cornwall, the breed having been specially selected on account of its hardiness of constitution and vigour to meet the conditions there. Since the days of Queen Victoria the reigning monarch has occupied the position of patron to the Aberdeen-Angus Cattle Society.

The Aberdeen-Angus breed has since that time won for itself a notable place in the history of the Smithfield shows, but the successes there and at other shows will be more fittingly dealt with in connection with what has to be said of the characteristics of the breed. The late Mr. M'Combie had a wider outlook for the future of the Aberdeen-Angus cattle than the confines of their native land, and he and a celebrated coterie of the early breeders such as Hugh Watson, Keillor, the Earl of Southesk, Kinnaird Castle, Mr. Walker, Portlethen, Mr. Bowie, Mains of Kelly, and that great Trojan of the breed, the late Sir George Macpherson Grant, Bart., of Ballindalloch, crossing the Channel, were enabled through the agency of the French Exhibitions to bring under the notice of a world-wide clientele the virtues and properties of the black polled cattle of the north-east of Scotland. This work was persistently carried on from the first Exhibition in 1856. but it was the successes gained in 1878, or just forty-one years ago, that served most effectively to draw the attention of the outside world to the claims of this comparatively "new" breed in beef production. At the Exhibition of the later year there were offered for competition two £100 champion prizes, one for the best group of cattle in the division foreign to France, and the other for the best group of beef-producing animals in the Exhibition. The prize for the best group for breeding purposes, competed for by representatives of no fewer than seventeen different breeds, was won by a group of Aberdeen-Angus shown from Tillyfour, while it has further to be noted that another group of the same breed, shown by Sir George Macpherson-Grant, was reserve. There were greater honours, however, in store for the "Blacks" from Donside, for the prize for the best group of beef-producing animals, open to every breed in the world, was also carried off by Mr. M'Combie's Aberdeen-Angus.

The winning of these victories marks a distinct epoch in the history of the Aberdeen-Angus breed. Hitherto the breed had been confined almost entirely to Scotland, though in the first volume of the Herd Book, published in 1862 there is evidence of the existence of two herds in Ireland, showing that the efforts of Hugh Watson were reaping some success at least. Between the publication of volumes 1 and 2 of the Herd Book a long hiatus occurred; a time when through the terrible visitation of rinderpest quite a number of the old herds in Angus were severely devastated. The

loss which the breed then sustained is incalculable. Writing in 1876 the late Mr. Wm. Fullerton penned this pathetic statement—a statement which related an all too-common experience—"My herd was swept off by pleuro in 1859, when, in five months, I buried a hundred head of, I believe, the best herd of polled cattle in Scotland at the time. . . . How my beasts caught the disease I could never say. I had more polled cattle than my farm would keep, and I had animals on several other farms, both on grass and turnips, which had, I suppose, brought home the fell disease. I had again got a considerable length to recoup my old position, but three times my herd was carried away." Fortunate indeed was it that at sales in 1843 and 1844 cattle bred by Mr. Fullerton had been purchased for the Tillyfour herd, and thus preserved for the future of the breed. Other experiences of a similar nature could be given, and it is little wonder that the result was a direct falling off of the interest in the formation and maintenance of pedigree herds. In 1871 the work of collecting pedigrees for another start was taken up, and by July 1879 there had been issued five volumes. In that year there was formed the Aberdeen-Angus Cattle Society with a membership of fifty-six, a number which has in the interval increased by nearly twelve times. During recent years the progress has been very marked, and entries for the Herd Book have well nigh doubled, numbering for the current volume 4580, drawn from herds in Scotland, England and Ireland.

The Breed in other Countries.—*North America.*—Having traced thus briefly the history of the breed at home, something may be said of its development, and of the position to which it has attained in other countries. In the United States of America the breed has made for itself a great name, though it is not yet fifty years since it was introduced there, and though in that country, as in other lands to which it had been taken, it had to fight for its place in popular estimation against long-established breeds. In 1873 there were introduced to a Kansas ranch three bulls of the Aberdeen-Angus breed, and the half-bred steers which were bred from the horned Texas cows made a great impression on feeders in the range country and also at the stock yards sales at Kansas. The breed immediately "caught on," and the late seventies and early eighties witnessed a remarkable export trade to America. Whole herds were acquired, and it has been estimated that from 1880 to 1883 there were imported 2000 head of Aberdeen-Angus cattle into the States and Canada. In 1883 there was formed the American Aberdeen-Angus Breeders' Association, which has a membership of over 5000, having far outgrown the Society in Scotland. The secret of this great progress is to be found in the admirable way in which Aberdeen-Angus cattle met the growing demands of the beef-producing industry. As in the old country, so in the new, it came out of the severest tests with flying colours. In crossing, bulls of the breed proved their outstanding prepotency, imparting to their offspring those characteristics of early maturity, natural flesh-forming properties, and robustness of constitution which defied the most trying conditions of feed and climate. Great indeed as has been the record of the breed at the

Smithfield Fat Stock Show—where over the past twenty-one shows it has won more championship honours than all the other beef breeds combined, while it and its crosses have been the exclusive championship winners in the Carcase Competition—it is eclipsed by the record at the Chicago International Show, which stands out without parallel in the annals of any other breed. As it is only by comparison that the relative position of any breed can be ascertained, we submit the following table showing the championship results at the Chicago International, which is perhaps the most exacting and comprehensive fat stock show held :—

Single Steer Champions.

Aberdeen-Angus ...	11
Hereford	2
Shorthorn	2
Cross-Bred	2

Steer Herd Champions.

Aberdeen-Angus ...	12
Hereford	1
Shorthorn	1
Cross-Bred	1

Carload Champions.

Aberdeen-Angus ...	13
Hereford	3
Shorthorn	1

Carcase Champions.

Aberdeen-Angus ...	16
Shorthorn	1

Such figures as these are more eloquent than words as to the supreme position in beef-production to which the Aberdeen-Angus breed has attained. And just to show how thoroughly the breed meets the requirements of the butcher's block under any variety of circumstances, and how well this final verdict, which was always kept in the forefront by Mr. M'Combie, is being upheld by the type which he assisted to perfect, statistics are available to show that at thirty-six points on the North American continent, where inter-breed competitions of beef cattle have been held, the Aberdeen-Angus has triumphed. "From the balmy climate of Jacksonville, Florida," writes an American correspondent, "where the New York millionaires spend their winters, to the frigid weather of Edmonton, Alberta, Canada; from the romantic soil of the ukelele and cocoanuts in Hawaii to the effete East of Syracuse and Buffalo, New York; from the ranges of the south-west, parched by three years' drought, to the clinging zero dampness of Manitoba, the Aberdeen-Angus has won its victories over all rivals."

Argentina.—The thrifty qualities of the Aberdeen-Angus are becoming more and more appreciated by the estancieros of Argentina, and as the movement advances for the grading of the meat as to quality, the demand for Aberdeen-Angus cattle becomes correspondingly keener. Though it is about forty years since the first representatives of the breed were introduced, the progress made was for many years slow, due it is to be feared to the fact that in too many cases the specimens exported were detrimental rather than helpful to the interests of the breed. More recently great progress has been made, and as with the butchers in this country, so the buyers in Argentina have shown through a practical monetary channel the enhanced value for beef purposes which they attach to the steer with Aberdeen-Angus characteristics. Steer

and block test grand championships have also fallen to the breed in Argentina, but it is confidently expected that that country will in the very near future provide a great field of development for Aberdeen-Angus cattle. The autumn sales of 1918 showed an increased average by over 30 per cent. on the previous year, while it may be noted that of the two bulls which reached the record price in this country at the Perth sales in the spring of 1919,—viz. 2800 guineas—one was to the order of a breeder in Argentina. An Aberdeen-Angus Association with a flourishing and steadily increasing membership was established in Argentina a few years ago, and since then the interests of the breed have been growing apace.

New Zealand.—Throughout Australasia the breed is not so widely known as its merits deserve. Since 1863 there have been Aberdeen-Angus in New Zealand, and practical handlers of the breed have testified that they proved its great capacity for economical beef production under natural conditions. "It is a phenomenal beef producer" testifies the owner of a herd of about 2000 head of the breed of which 900 are breeding cows. "No other type responds so quickly to feeding, nor comes to such fine beef condition in babyhood. The breed is acclimatised anywhere." Within the past four or five years there has sprung up an excellent trade in Aberdeen-Angus cattle between New Zealand and Queensland and other parts of Australia. Commenting on extensive shipments to Queensland, the New Zealand *Journal of Agriculture*, in course of a long article detailing the valuable characteristics of the breed, states that "the demand for the Aberdeen-Angus in Queensland has arisen from the fact that during the late droughts in that State it has unmistakably shown its superiority over all other breeds in hardiness or ability to resist such conditions. The breed has a reputation for hardiness, acquired in its original quarters, the north-east of Scotland, and the quality appears to exhibit itself as readily in respect to drought-resistance as to other circumstances."

In June 1917 there was formed the New Zealand Aberdeen-Angus Cattle Breeders' Association, and just to indicate the immediate prospects, it may be noted that at the dispersion of the Gladbrook herd in March 1918, prices ruled up to 510 guineas for an 18-month old bull, six young bulls averaging 316 guineas, while for 160 head the general average was £88, 12s.

Australia.—An Aberdeen-Angus Association is also in existence in Australia, where the breed does very well, though there have been comparatively few exports direct from Britain. As early as 1888 we find the championship over all beef breeds won at the Melbourne Show by an Aberdeen-Angus, and at Brisbane, Sydney and the Tasmanian shows the breed, either in the pure-bred state or through its crosses, has taken a prominent place. There also, as in the homeland, it has been exceptionally favoured by the butchers, while the pastoralists have found Aberdeen-Angus cattle active searchers for food, good thrivers on the poorest of land, hardy and robust, and able to come through the severe winters of the coldest districts of Australia satisfactorily.

Both New Zealand and Australia are likely to be large importers of Aberdeen-Angus cattle in the near future. Those Colonials who have recently been in this country and have had an opportunity of inspecting herds of the breed are enthusiastic over their natural fleshing qualities, and it is confidently expected that the more fully the merits of the breed become known in these countries, the more the cattle will be appreciated, and the greater must become the demand.

South Africa.—At present and for the past half-dozen years South Africa has proved the best market for the British breeder of Aberdeen-Angus cattle. The breed has had a comparatively brief history in that country, the first imports having been made less than twenty years ago, but even up to about 1912 Aberdeen-Angus cattle were practically unknown there. The awakening of South Africa to the great possibilities of a meat export trade has changed all this, and to-day the Aberdeen-Angus is the favourite beef breed over all that vast country from the Cape in the south to the Zambesi in the north. Breeders have in South Africa a field of the greatest possibilities, and hitherto the breed has done remarkably well, and by its conquests at the Johannesburg, Bulawayo and other shows has attracted the attention of the great ranching concerns, who are adding as extensively as they can to their holdings of Aberdeen-Angus cattle. In spite of present great difficulties in shipment, and heavy freight and insurance charges, a good trade is being carried on with South Africa, and what is even more satisfactory for the future of the breed, there is the fact that South African breeders are losing that conservatism in the matter of prices which characterised earlier shipments and are showing a disposition to raise appreciably the standard of the cattle they import. The South African Stud Book, which comprises all breeds, has reached volume 12, and since 1917 the interests of Aberdeen-Angus cattle in that country have been carefully fostered by the South African Aberdeen-Angus Cattle Breeders' Society.

Summary.—An indication of the extent of the export trade during the past ten years, and of the destination of cattle of the breed, may be gathered from the following table, showing the total number exported to each country during that period :—

South Africa	653	Brought forward	1459
South America (*ex* Brazil)	448	Germany...	3
Canada	164	Falkland Islands ...	2
Brazil	77	Russia	1
United States	71	Norway	1
New Zealand	24	Sweden	1
Spain	11	Tasmania	1
Australia	8	Jamaica	1
Japan	3	Cuba	1
Carry forward	1459	A total of	1470

The above is an interesting list and highly representative, but it is not nearly so extensive as one would reasonably expect of a breed which, under all the various conditions to which it has been

subjected, has given such satisfactory results. In considering this point it ought to be kept in mind that the birthplace of the Aberdeen-Angus cattle represented not only a comparatively small area, but a comparatively remote area. Until about the period 1845-50, there were no railways in the north of Scotland, and the natural result was that the breed was very largely circumscribed to those particular localities to which it is believed to be indigenous. Other breeds situated in districts where locomotion from one point to the other was easier, were therefore more favourably situated for an earlier development. But with the provision of an outlet the Aberdeen-Angus has grown steadily in public estimation, and the position it at present holds among the beef breeds of the world is testimony to the growing appreciation entertained for it as the result of the practical, utilitarian tests through which it has so successfully passed.

Characteristics of the Breed.—Of the characteristics and properties of the breed something has been indicated in the course of the notes already given tracing its development, for in the case of no breed of cattle can it be said with greater truth that the foundations for its adoption in new countries have had to be laid by the results of practical achievement against strong competition. In every country to which it has been introduced, it has had to make headway against established breeds, and wherever the production of high class meat has been the object in view it has been able to prove its superiority, either in the pure state, or through its crosses. It is a rather interesting fact that, over a period of twenty-one years, Aberdeen-Angus have won eleven championships at Smithfield, as against six for the more widely-distributed Shorthorn, and two each for the Hereford and the Cross-bred. It is an even more suggestive fact that at the latest fourteen shows of the same Club, which is the most critical test that this country provides, every championship in the carcase competition has been won by Aberdeen-Angus or crosses of the breed.

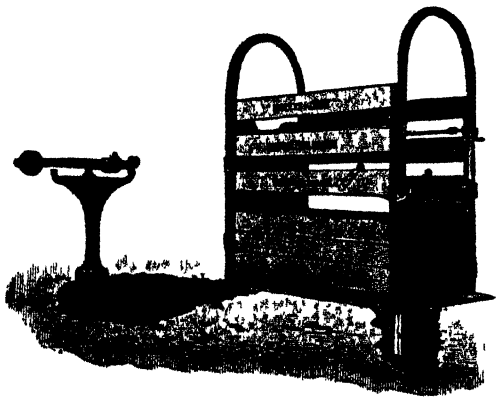
Aberdeen-Angus cows possess valuable dairy qualities, though the systems of stock raising have rather tended towards the overlooking of this characteristic. The milk is of exceptional richness, and it is generally admitted that for dairy purposes cows of the breed are as good at least as those of any other beef breed. Both at the London Dairy Show and in the milking tests at Dublin the breed has, on the rare occasions upon which it has been represented, made an excellent appearance. In 1892 for instance, at the London Dairy Show, an Aberdeen-Angus cow for quality of milk, fat and weight of butter was first with 140·8 points, the highest number of points ever gained at the Show up to that time, while at Dublin in 1901 the first prize in the milking test competition was won by an Aberdeen-Angus cow. The history of the breed teems with evidence of its milking properties, but these have not been developed, as it is along beef-producing lines that the breed has been found to answer best. Still there is nothing very far wrong when a cow can bring up her calf well, or when, as is quite a common practice in many herds, a cow can make a good job of a couple of heifer calves.

But the leading agency in the spread of the breed has been the steadily widening recognition of the value of Aberdeen-Angus cattle in beef production. Combined with early maturing properties and meat of the finest quality, the proportion of dead to live weight is unusually high. The world's record in this respect, so far as we have been able to trace it, is 76·75 per cent. of dead to live weight made by an Aberdeen-Angus Smithfield champion. Another valuable property is that of early maturity, and in this connection it is worthy of note, in these days when "baby beef" holds such a position in our normal-time meat markets, that the Aberdeen-Angus was the first to win at two years old the supreme championship at Smithfield, while it is the only pure breed that has produced a yearling champion at the Scottish National Fat Stock Show. The best types of cattle of the breed are short on the leg, and blocky. The smallness of bone may not give the impression of weight, but in this the eye, unless trained, is apt to be deceived, for they weigh much more than they look, and steers of 1600 lbs. under two years old ought surely to "fill the bill" as regards early maturity. Some readers may recall a two-year-old Aberdeen-Angus steer at the Edinburgh Fat Stock Show a few years ago which gave a return of just 2240 lbs. Normal-time tastes, however, as shaped by the retail meat market demands, do not encourage such enormous sizes. With the feeder the breed is a favourite on account of its attitude for putting on flesh, while with the butcher it holds first place because of the economic carcase it yields, marked as it is by a maximum of beautifully mixed, finely grained flesh, and by a minimum of waste fat. This is the reason why at, for instance, the great London Christmas market the plump, compact "Polled Scots" never fail to find a ready sale at the top quotations. Experience has further shown that so prepotent is the breed, and so strongly does it perpetuate its own characteristics on its offspring, that for crossing with other breeds for the production of a quickly maturing, high-class commercial type of butcher's animal, bulls of no breed can be used to better advantage than those of the Aberdeen-Angus breed. An interesting commentary on this fact is to be found in the very large proportion of Aberdeen-Angus bulls that are used by the Stock Improvement Societies registered under the Board of Agriculture for Scotland, through the medium of which most valuable work in stock improvement is being carried on. Being of hardy constitution, and capable of great endurance where conditions are adverse, the breed can lay claim to the further characteristic of longevity, and did space permit many interesting examples of this could be cited.

In these times, when the production of beef is likely to engage more attention even than hitherto, and when sources of supply are being steadily added to, breeders of Aberdeen-Angus cattle look forward with confidence, inspired by the past brilliant achievements of the breed, that the near future will be a time of great expansion. They have at least every reason to expect that the more fully the breed becomes known, the greater will be the appreciation of its many valuable qualities, and the wider will be the field which it will yet possess as the result of its unexcelled record in the realm of beef-production.

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AGRICULTURE IN THE OUTER HEBRIDES.

COLIN M'DONALD.

THE term "Outer Hebrides" is applied usually to that elongated series of islands (sometimes inaccurately but expressively enough termed "the long island") stretching from the Butt of Lewis to Barra Head, a distance of about 120 miles. The principal islands are Lewis and Harris, North Uist, Benbecula, South Uist and Barra. There are almost innumerable smaller islands lying adjacent to these, and in many cases separated from them by about a mile of space which at high tide can be crossed in a boat, and at low tide on foot or in a cart or trap Even the principal islands in the Uist group are thus separated from (or linked up with) each other. These crossings are known as "fords." The North Ford, separating North Uist from Benbecula, is 4½ miles broad, and "crossing the ford" is a proceeding that should never be taken lightly. They are treacherous places at best. Another peculiar physical characteristic of these islands is the great number of inland "octopus" arms of the sea, and also the numerous fresh water lochs. So striking is this confusion of islands, fords, lochs and sea, that one eminent visitor facetiously described the Outer Hebrides as "That country where the sea is all islands and the land is all water."

These islands, however, contain no fewer than 715,983 acres of land surface, of which 64,488 acres are in cultivation or permanent grass, while the population is 46,732. From the agricultural standpoint their importance may be measured by the fact that they have no fewer than 4151 horses, 25,195 cattle, and 124,190 sheep. There are only 35 pigs, however, in the whole area. It is interesting to note that James M'Donald, in his exhaustive "General Review of the Agriculture of the Hebrides" published in 1811, gives the population of the Outer Hebrides as 25,432, and the area of corn land and meadow as 62,682 acres. It would thus appear that the population has nearly doubled in a hundred years. Lewis mainly accounts for this increase. In 1811 its population was approximately 11,000, whereas in 1911 it has risen to 29,603.

In the work already referred to, the conditions of the Hebrides are generally depicted as miserable in the extreme. It states, for instance, "Three-fourths of the 40,000 cottagers in the Hebrides live in hovels that would disgrace any Indian tribe." This state of affairs has, however, practically disappeared in the Uists, while in Harris and Lewis very great improvements in this respect have taken place in the past thirty years, although it must be admitted that the housing conditions of some parts of Lewis are still far from satisfactory.

Amongst Mr. M'Donald's many interesting details relating to the agriculture of these districts in 1811, there is the story of the introduction of the potato to Uist by M'Donald of Clanranald in 1743. This proprietor brought over from Ireland a consignment of potatoes—the first ever seen in Uist—and gave them to some of his tenants to plant. This they at first refused to do, but ultimately

persuasions and threats overcame their objections. When the tubers were harvested, however, the tenants brought them all to the proprietors door with the remark, "You compelled us to plant them and harvest them, but you will never compel us to eat them!"

There were no Swedes grown in the Hebrides in 1811, and in 1809 turnips were grown on only two farms in Lewis, two in Harris and three in Uist. Hay from sown down seeds was practically unknown. The potato crop is now by far the most important in these islands, and turnips and hay are regularly grown on all the farms, but even in 1909 I found only a few small holders who had come to grow these crops regularly. This scarcity of turnips and rotation hay is sharply brought out by a comparison of the acreage under different crops in the Outer Hebrides. For 1918 the figures were:—

Barley (Bere),	5763	acres.
Oats,	8453	„
Rye (none in Lewis),	897	„
Potatoes,	6148	„
Turnips,	338	„
Hay (from rotation grasses),	545	„

Lewis.—There are some 3150 agricultural holdings in Lewis, of which number all but 20 are under £50 rental. The average rent of the 3130 holdings is just over £2. The system of agriculture on the few larger farms is now very similar to that practised on mainland farms in the north of Scotland, and does not call for special treatment. The small holdings are situated in groups or townships almost entirely along the sea coast, where there is a harbour, and a fringe of arable land partly "natural," but largely formed from "skinned" land, *i.e.* land from which the surface peat has been removed for fuel. The underlying clay has been laboriously worked up by spade, drained and manured, and the crops which such land produces are surprisingly good. The process of reclaiming land by this method can still be seen in various parts of Lewis, and it is not uncommon to see the coming winter's fuel drying on the top of a peat bank, while potatoes or oats are flourishing on the adjacent strip of land from which last year's fuel was extracted.

The soil in some of the old townships is remarkably fertile. In the Ness district, for instance, it is rich and loamy, and continues to give good crops of potatoes and cereals year after year and generation after generation without any "rest." At Barvas and northwards along the west coast there are belts of "machar" land, *i.e.* flat sandy stretches by the sea, where potatoes and "corc beag"—the bearded grey oat (*Avena brevis*)—can be grown continuously. Seaweed is applied lavishly as a manure. The extent of machar land in Lewis, however, is negligible in comparison to what there is in the Uists. The potato is by far the most important agricultural product of Lewis. In 1918 no fewer than 3520 acres were under this crop. Various methods of cultivating the potato are to be met with—the primitive "lazy-bed," where the potatoes are dibbled in; "cascromm", ordinary spade cultivation, as in a garden; "fur-about," where ploughs are used; and the modern

ridged drill. Until very recently probably most of the potatoes were cultivated by spade, but in the last few years hundreds of small "single-pony" ploughs have been introduced, and these make quick work of the spring cultivation. It is very noticeable, however, that if great care is not exercised in using these ploughs, they will prove a mixed blessing. The tendency is to simply "scratch the surface" with them, instead of going to an honest depth, as in the case of the spade. Properly used, however, these ploughs should prove an incalculable boon.

The "Champion" is still the favourite variety of potato. During the past eight or ten years several of the newer varieties have been introduced by the North of Scotland College of Agriculture. The new varieties almost invariably yield a larger crop and prove more disease-resisting, but the superior eating qualities of the "Champion" give it favour with the Lewisman over all newcomers. I have come across crops of potatoes in Lewis yielding up to 12 tons an acre, but the average yield in a fair year is less than half of this, and in a bad year (blight is very prevalent) the return is sadly diminished. The average annual total yield of potatoes in Lewis may be put at 16,000 tons. This should be enough to provide sufficient potato food for its population and leave a margin of 8000 tons for export, yet rarely are any potatoes exported. On the other hand, almost every spring there is a shortage, and food and seed potatoes have to be imported. This is accounted for by the fact that the cattle are fed largely on potatoes. A too lavish use is made of the tubers in this way every winter, and only when spring comes is the shortage realised.

Where turnips have been tried they have done remarkably well, and, of course, provide a much-required change in the cattle diet; but the pioneers in this respect are at a disadvantage in that their turnips prove as great a temptation to the Lewis boy as an orchard of apples does to the mainland youth.

The only cereals grown are oats and barley (bere). Bere occupies about 2200 acres and oats over 3400. Sandy is the favourite variety of oat, and, of course, "core beag" on the machar.

It is still customary in some parts to pull the barley and preserve the straw for thatching the houses. The old thatch becomes impregnated with soot from peat smoke percolating all through it during the winter, and is removed in early summer to be carefully hoed in as a manure to the growing potato crop, and a very stimulating manure it is too.

Every year a large proportion of the grain is ground into meal for home consumption. The grain is invariably kiln-dried at home on the old-fashioned "aath." In some cases the dried grain is sent to a modern mill for grinding, but in many cases it is carried by the owner to one of the primitive little mills situated on a convenient burn. At Borve there are half a dozen of these mills on one burn within a mile of each other. They consist simply of a vertical wooden shaft with wooden wings, a circular stone about 4 feet in diameter attached to the top of this shaft and another similar stone above that, with a hole in the middle through which the grain is poured. The water from the burn is directed so as to strike on the wings of the shaft; this causes the shaft and the

stone attached to the top of it to revolve. The top stone is stationary, but is so placed that its pressure on the grain on the lower stone can be regulated. When the mill is put into motion the grain is poured through the hole in the upper stone and is ground between the two. The meal and husks are caught as they come out at the edges, and the one separated from the other by means of a sieve. Every man is his own miller. This method of milling, though primitive, is quite effective, and has a peculiar old-world charm about it which is absent in the more efficient methods of modern manufacture.

Cattle.—It cannot be said that there are no good cattle in the island; there are some very good ones, and particularly in the parish of Uig; but, generally, the Lewis cattle show too much evidence of a mixed ancestry. The original Kyloe characteristics and those of the Aberdeen-Angus, Ayrshire and Shorthorn are often met with in the same animal. One cannot help thinking that it would be an inestimable boon to the Lewis crofter if a serious effort were made to improve the cattle by introducing some hardy single breed, and fixing a type suitable for the island, but in this connection it may be said that until the Lewisman's tendency to overstock his holding with cattle is checked, no breed can be brought out to advantage

So far as I know, Lewis is the only district in which the old custom of going to the shielings is still observed. Every summer, for six or eight weeks, all the cattle are sent up to carefully selected spots of good pasture in the hills The women and old men, and sometimes children, go out to tend them. The people live in shielings or turf houses, which are put into fresh repair each year, and are wonderfully snug and healthy. It is during this time that most of the butter and cheese is made. At the end of the season, cattle and people go back to their homes greatly improved in health and condition as the result of this spell of the simple life.

Horses.—There are now many fine hardy little ponies to be met with, although again there is evidence of indiscriminate breeding. The Lewis pony most conforming to type is from 12·2 to 13·2 h.h., fine-limbed, well-ribbed, and very hardy and active. There is a tendency to breed a larger type, mainly because the larger beast brings a bigger price, but the policy of breeding out the original hardy type is a very doubtful one, as, if persisted in, the Lewisman will soon have on his croft a larger, softer beast, which will be a big drain on his keep without conferring a corresponding benefit, so far as the working of his holding and the carting of his peats are concerned.

Sheep.—There is a total of 58,700 sheep in Lewis. On the larger farms Blackface ewes of a superior quality are kept. These are crossed with Border Leicester rams, and the Greyface lambs from these often top the Dingwall sales. On one or two farms a good class of Cheviots is kept, but the average crofter's sheep (which is mainly of the Blackface type) is distinctly poor when contrasted with, say, Ross-shire mainland or Sutherland crofters' stock. The reason for this is largely to be found in the fact that

practically the whole of Lewis, with the exception of the cultivated parts round the coast and the hill grazing attached to farms, is an open moor, where the crofters' sheep roam at pleasure, male and female, indiscriminately mixed, and no serious attempt at systematic breeding is made. Indeed, on such a huge tract of land, and with over 3000 different lots all running together, any attempt of the kind would be futile.

To summarise the position of agriculture in Lewis, it may be said that, every circumstance considered, the quantity of grain, potatoes and stock raised in the island is considerably more than is generally supposed. Improvements could, however, be effected. I have already indicated the line of improvement in regard to the live stock. Spraying of potatoes should be regularly done. As a result of the efforts of the College of Agriculture officials, ably supported by a few progressive local people, this practice has been firmly established in one or two districts, with quite extraordinary results. Demonstration plots were first sprayed and careful note taken of the effect on the crop. Over a large number of experiments it was found that the average increase of sound tubers was well over 2 tons per acre. Assuming that the whole area under potatoes were sprayed, this would mean an increase of between 7000 and 8000 tons, and the cost would be trivial compared with the increased value of the crop.

At Barvas, where spraying is now firmly established, the result was most noticeable last spring, for while in almost every other district of Lewis there was a serious shortage of potatoes for food and seed, Barvas had an ample supply of both. Enclosing the arable land, too, would bring about a substantial increase of all crops. With the land unenclosed, as it nearly all is at present, anything like a rotation of crops is out of the question. A few enterprising crofters have made an attempt at establishing a rotation, including hay and turnips, but with these crops unprotected, the whole of the stock of the neighbourhood congregates on the young grass in spring, with, of course, disastrous results to the hay. Similarly with turnips if unprotected at the back end of the year. A very few crofters have enclosed their land with fences, and the improvement in the crops on these holdings is very noticeable. If I were asked to enumerate briefly the principal measures necessary for the further improvement of agriculture in Lewis, I should say :—

1. Enclose the arable part of each holding so as to make the adoption of a rotation possible, or otherwise head fence the arable land of each township from the hill pasture.
2. Subdivide the hill pasture by fencing it off into sections, so as to allow of proper management of the sheep stock.
3. Appoint Grazing Committees, and see that they do their work thoroughly.
4. Strictly debar overstocking as regards cattle on the holdings ; this is very important One good cow, properly kept, is more valuable than two badly bred and underfed.
5. Make the spraying of potatoes compulsory. In the interests of the holders themselves this is just as important as the dipping of sheep.

On the larger question, the squatter problem, as affecting agriculture, I propose to say very little in this brief sketch. The Lewisman is more a fisherman than he is a crofter, and cherishes a love for his native island that is quite unique. So long as he sees a prospect of earning a modest livelihood on his native soil and from the surrounding seas, he would sooner live in Lewis than in any land under the sun. It is this trait that has led so many of them to cling to the island, even when no land could be got. These are the squatters. There are squatters in hundreds, living in houses built on the crofters' land. In some townships the squatters have as much stock on the grazings as the regular crofters. This leads to overstocking and friction, which everyone interested in Lewis deplores. The squatters claim that a scheme whereby they would be offered even 2 or 3 acres of land on landholders' tenure, where they could build houses and on which they would feel they had a right to live, would go a long way towards relieving the present distressful state of affairs. The land need not necessarily be arable land. It is not suggested that these holdings would be economic agricultural holdings in the ordinary sense, or that a man could make a living for his family off one of them. The man would look mainly to the sea for his living, but the holding would be a standby, and he would have the feeling, which means so much to a Lewisman, that he had a home on his native soil. Incidentally, the abstraction of the squatters and their stock from the existing crofting townships would materially improve the crofters' lot.

Harris.—Harris is part of Inverness-shire, but it and Lewis form one island, and the remarks as to stock, crops, etc. which apply to Lewis are also generally applicable to Harris Of all the Outer Hebrides, Harris has the rockiest surface. Its total area is 123,752 acres, but less than 2000 acres are in actual cultivation. The rest is rugged, rocky hills and mountains. No more bleak and barren aspect can be imagined than Harris presents as one approaches it for the first time. Yet it is much more genial than it looks. The rocks catch and reflect the heat of the sun, to the great advantage of what soil there is. The pasture on the ledges and terraces of the rocks, too, is excellent and produces the finest flavoured mutton in the world.

Except on the south-west and at one or two other spots where the land is flat, the cascromm and the spade are the chief implements of husbandry. Altogether the marvel is not that Harris is so backward agriculturally, but that its people extract what they do from its forbidding surface.

There are just under 20.000 sheep of all classes, mostly of the Blackface type, somewhat small in size, but, as already stated, yielding a very fine quality of mutton. Braxy is a deadly enemy. One farmer informed me that on one occasion he risked keeping a hundred of his ewe lambs at home instead of sending them as usual to be wintered on the mainland of Ross-shire, and that in April only forty-four out of the hundred were living. The same farmer stated that some years previously Professor Hamilton, Aberdeen, had experimented on a lot of his lambs with the drench

treatment, and that not one of the treated lot died from braxy. For some unexplained reason this treatment, which proved so effective, was discontinued. In Harris, at any rate, its revival would be welcomed.

Like the Lewisman, the Harrisman takes his livelihood impartially from the land and from the sea, and it is a passion with him to have a little bit of land on his native island.

The Uists and Benbecula—Here the holdings are much more substantial than in Lewis and Harris, and kelp-making is the great subsidiary industry instead of fishing.

Taking North and South Uist and Benbecula together, there are 1287 agricultural holdings, of which only 20 are over £50 rental. The average rent of the remaining 1267 is just over £4, but a large proportion of them run at about £10 rental.

In some of the old-established townships in Uist the arrangement as regards the land is most ingenious and interesting. No fewer than four distinct types of land go to form a holding, viz.:—

Machar—(flat land by the sea).
Dubhthalamh—(black land).
Gearuidh—(superior hill pasture).
Monadh—(higher hill pasture).

The machar stretches inland from the sea for, in some cases, nearly a mile. It is held on a form of run-rig tenure. The dubhthalamh begins where the machar ends, and this forms the croft proper on which the house and steadings are. At Bulemore, for instance, the dubhthalamh extends inland for another mile, and each croft runs to the full length of this. The result is that the crofts are not more than 20 to 30 yards broad and about a mile in length, but as the slope is not steep, this is not so inconvenient as it would appear

The gearuidh lies just inland from the dubhthalamh. It is common to the township, and it is here the milking cows and young cattle stock are mostly grazed. Further inland still there is the monadh or hill-pasture—again common to the township, and the principal grazing ground for sheep. Usually a fence or ditch or fail dyke separates the one section from the other.

The machar land is laid off in large "scatts" or fields. Each scatt is divided into as many rigs as there are crofts in the township. There may be a dozen scatts in all, and usually half the number are lying out in natural pasture, but they are put under crop in rotation, so that each year one or two scatts will be brought into cultivation and other one or two left out after a course of cropping. When a scatt is to be brought into cultivation the township "constable" (who holds sway under the district ground officer) appoints a day for allocating the rigs. The rigs are numbered, and then ballotted for. There is a double ballot, *i.e.* first the men approach the hat in any order and pick out a number. This is to decide as to the order in which they will approach the hat in the second draw; the second draw then decides the number of the rig. The crofter retains the rig while this particular scatt remains in cultivation—usually for a period of two or three years. As a rule the whole of the scatt is laid down with one crop only, potatoes or

barley, as the case may be. Next year corc beag goes in, and rye is usually the third crop. The land is manured with an incredible quantity of seaware, and the effect of the whole arrangement is very striking when the crops are ready for harvesting. Splendid crops of barley, potatoes, corc beag and rye are taken from the machar. When three crops are taken in succession, the scatt is left uncultivated for possibly half-a-dozen years to recuperate. It is of little use for the first two years, but after that a mixed herbage of natural plants becomes established and the grazing is of some value.

From the dubhthalamh good crops of barley, oats and potatoes are taken, and it is pleasing to notice that turnip growing and the sowing of grass seed are now being more generally adopted. Most of the cattle are turned out to the gearuidh in early summer and put in charge of a buachail (herd). The herd is assisted each day by one member from each household in the township in turn, so that in a township of twenty every holder's turn to supply an assistant to the buachail occurs once in every three weeks. The buachail also gets his meals from the house which supplies the assistant. The cattle get a change of pasture occasionally on the machar land which is not in cultivation. The cows are milked in the open every evening and then turned into a fold (stone enclosure) for the night. In the mornings they are let out and milked before starting off to graze. The whole of this arrangement strikes one as peculiarly ingenious and interesting.

Each croft has a "souming," and the souming is reckoned in "calep." A calep is an eighth part of a cow. A three year old is reckoned as 6 calep, a two year old 4 calep, a stirk 2 calep, and so on. While an outsider would require a book and pencil to calculate as to whether a holding is overstocked or otherwise, the practised native can tell at a glance the exact position, no matter how mixed the ages of the lot may be.

Cattle.—Uist may well be proud of its cattle. The Highland breed predominates, and in these islands the general standard of the breed is very high. One of the oldest and best folds in existence is at Balranald, North Uist, and the opportunity thus afforded of procuring good bulls has for generations been taken full advantage of Apart from the Oban sales, where the cream of the "Highlanders" are annually shown and sold, the Uists can produce a better class of this breed than any community of small holders anywhere in Scotland. At the Uist Agricultural Shows the turnout of great animals, well coated and beautifully headed, was a striking feature. These cattle are in great demand by north of England and south of Scotland graziers. There is an annual market in July and another in September at which dealers from these parts and elsewhere attend. This year for the first time auction sales were held at various centres in the islands. Something of this kind was much required, and it is to be hoped that the enterprise will meet with the success it deserves. Some idea of the importance of cattle raising in the Uists will be gathered from the fact that in 1918 there were exported from North Uist and Benbecula alone 1405 cattle Stot stirks sold at an average of £12 each, and heifers at an average of £17.

Horses.—In this line too the Uists have a great reputation. The Uist pony is a substantial beast of up to 15 hands, and is in great demand. One hundred and sixty-seven horses were shipped from North Uist and Benbecula in 1918 at an average price of about £38, and the figures for South Uist would compare favourably with these as regards numbers and prices.

Sheep.—Having regard to the excellence of their horses and cattle, it is regrettable to have to state that their sheep are decidedly inferior; and this is the more surprising in view of the local demand for wool for home-made tweeds. When the Uistman takes the same grip of sheep-stock management as he has of cattle and horse breeding, he will be hard to beat as an all-round stock raiser. On the larger farms both Blackface and Cheviot sheep are kept, and the flocks will compare favourably with those of the mainland. As a rule either Grey-face or Half-bred lambs are raised on the farms.

Possible Development.—For the improvement of the crofters' sheep there is need for properly constituted Grazings' Committees, who would be strong enough to make rules and regulations for proper breeding and management. and to take steps to enforce these rules.

Then with regard to the machars (of which there are thousands of acres), an outsider cannot help thinking that more could be made out of these great tracts of sandy soil. It may be considered fantastic or impracticable, but these machars always appealed to me as offering a great opportunity for developing an early potato trade. Carrots too would grow there to a great size. (The machar is crowded with wild umbeliferous plants.) This would be a new venture entirely, but one that is well worth considering. When, some fifteen years ago, a herd of Ayrshire cows was established on a farm in Benbecula with the idea of manufacturing cheese from their milk, it was regarded locally as a hopelessly impractical venture. Yet the originator of this scheme is now admitted to be one of the best and most prosperous cheese makers in Scotland. I feel certain that if a part of the machar were enclosed and laid down with early varieties of potatoes, duly sprouted and properly manured, etc, the result would be equally surprising. There must be some 20,000 acres of machar altogether in the Uists and Benbecula, and if even a fourth of this were devoted to early potatoes for export each year, the great possibilities in this suggestion are obvious. Moreover, it might not necessarily interfere to any great extent with the production of cereals on the machar, because instead of leaving large tracts out of cultivation for several years to recuperate, as is now the custom, the machars could be worked on a regular rotation, which would include the sowing of suitable grass seeds, and this would do away with the necessity for a prolonged period of "rest."

Both the Scottish Agricultural Organisation Society and the Scottish Smallholders' Organisation have been active in recent years in their propaganda for the establishment of co-operative societies all over the Hebrides, and several societies in the Uists are now doing a good business. So far the chief effort has been in

the direction of co-operative marketing of eggs and the purchase of seeds and feeding stuffs, but if one is to judge from the success which has attended these efforts, there are great possibilities of the further development of this movement.

Improved methods of cultivation, the introduction of more prolific varieties of oats and potatoes, and the more frequent changing of seed of the old varieties, also the more general use of grass seeds, turnips and fertilisers, are matters to which the officials of the North of Scotland College are successfully devoting their energies. As in Lewis, too, spraying of potatoes is becoming more generally adopted, with distinctly encouraging results.

With a view to providing practical evidence of the advantages to be derived from adopting these more modern methods of farming, the North of Scotland College of Agriculture instituted demonstration crofts at various centres in the Hebrides in 1910. On these demonstration crofts, M.P. ploughs, metal rollers, turnip sowers and zig-zag harrows have been introduced—implements not hitherto used by Uist crofters. The whole of the croft has been gradually brought into the regular six shift rotation, and generally the methods of an up-to-date Easter Ross crofter are followed. The war interfered somewhat with the supervision of these holdings, but ultimately they should serve a useful purpose.

While it may appear sacrilegious to an Uist man to suggest that his land and himself (and his cart and his horses) would benefit if he used less seaware, there is something in this statement Nature's lavish provision of seaware on the Uist coasts is a mixed blessing to the natives. Undoubtedly it is invaluable as a manure on the machar soil, which is porous and can stand wareing every year; also the ware provides the lucrative subsidiary industry of kelp-making. But heavy and continuous applications of ware to his dubhthalamh has certainly reduced its fertility, and as this land is further from the shore, the labour involved in manuring it with ware is very great. It is not an exaggeration to say that an industrious Uist holder of say 65 years of age has spent thirty solid years of his life in working at seaware in one way or another. There is nothing to be said against this so long as his time is profitably employed, as in kelp-making and manuring machar; but when it is unprofitably employed—as I am convinced it largely is in the case of the dubhthalamh—it seems a great pity. A man could earn in a week at kelp-making as much as would purchase fertilisers for his dubhthalamh for a year. This would incidentally save a month's laborious work of carting ware to it, and in a few years' time the superiority of farmyard manure for this class of soil, supplemented by a judicious application of artificials, should become very evident. It is a common complaint that white oats fail to grow on what appears to be good heavy soil. This is doubtless due to over alkalinity from overdosing with seaweed. Forty years ago the same complaint was common on the coast of Caithness, when seaweed was the principal manure. Gradually seaware went out of use there, until now there is practically none used, with the result that heavy crops of white oats can be grown in any field in the district.

Barra.—Barra lies at the extreme south of the Outer Hebrides. It resembles Lewis and Harris in that its population is mainly a crofting-fishing class, but as it also has a considerable extent of machar land, its agricultural methods more closely resemble those of the Uists, and except with regard to its ponies it does not call for special description.

Its total land surface is 22,222 acres, and of this about 1100 acres are in regular cultivation. There is a population of 2620, and its stock numbers are:—

Horses	...	...	...	402
Cattle ...	...	...	...	1589
Sheep ...	...	...	...	5436

There are 360 smallholdings averaging slightly over £2 rental, and only three farms with a rental exceeding £50. Agriculturally Barra is of interest to outsiders mainly in that it still breeds in its truest form the original small Highland pony. This animal rarely exceeds 13 and is often not more than 12 h.h.; square-headed, shaggy-maned, and as "hard as nails," the Barra pony is deserving of every effort calculated to perpetuate its kind.

OAT GROWING EXPERIMENTS IN SCOTLAND.

J. A. SYMON, D.S.O., M.A., B.Sc. (Agr.).

ACCORDING to the official returns for 1918 there were 1,240,000 acres in Scotland under oats. In Aberdeenshire alone the acreage devoted to this crop practically equals the combined acreages of the whole wheat and barley crops throughout Scotland. In view, therefore, of the great importance of this crop, a great deal of experimental work has been done within recent years, and it is proposed in this article to set forth some of the conclusions arrived at in the area of the North of Scotland College of Agriculture.

During the war this work was at a standstill, and the results recorded here have reference only to those years immediately preceding the war. Some of the results then arrived at have proved of immense benefit to farmers, and have been acted upon to a very large extent.

Varieties.—One of the most interesting changes which have taken place within recent years is the tendency for farmers farming good land to give up growing the older varieties (principally Sandy and Potato), and to make use of some of the newer cross-bred or foreign varieties. In particular, the Swedish oat, Victory, has of recent years been most popular. Until within a few years ago, Sandy and Potato oats held indisputable sway over Scotland. They suited both soil and climate, gave a fair yield of grain and a very large yield of good feeding straw.

Gradually, owing to the efforts of the various agricultural colleges, new varieties were introduced. At first Canadian and

cross-bred oats were used, and although good results were attained, farmers had occasionally unfortunate experiences. These were due mainly to the newer varieties being sown on unsuitable land, or to worthless and degenerate varieties being sold for seed, frequently under false names. Gradually Swedish oats were introduced, and farmers, recognising the consistently better results obtained by using these oats, yearly devoted more and more land to these varieties.

The following table gives the average results of the 1914 experiments conducted in the North of Scotland area :—

TABLE I.

AVERAGE RESULTS OF EIGHT EXPERIMENTS COMPARING TYPICAL VARIETIES OF OATS.

Variety	Origin.	Seed Sown	Yield per Acre.	
			Grain	Straw.
		Bushels.	Bushels	Cwts
Potato ..	—	5¾	58¾	40½
Banner	Canadian [1]	5½	65¼	33¼
Leader	Cross Bred	8	68¼	34⅛
Victory .. .	Swedish	7½	68¾	34

[1] Canadian seed was used in this experiment Home-grown Banner seed would have required a seeding of 7 bushels per acre.

A careful perusal of these results shows that the Swedish variety, having regard to the quantity of seed sown and the yield of grain obtained, compared favourably with the others. Taken all round, it is the most profitable oat, and although its straw is considerably less in quantity than that of the Potato oat, it is found in practice to have satisfactory feeding qualities. Moreover, in certain seasons, owing to its drought-resisting properties, it almost equals the Potato oat as a straw producer—see following table —

TABLE II.

AVERAGE YIELD OF THE POTATO AND VICTORY OATS DURING THE SEASONS 1912, 1913 and 1914.

	Potato		Victory.	
	Grain.	Straw.	Grain	Straw.
	Bushels.	Cwts	Bushels.	Cwts.
1912, 10 experiments ..	47¾	35½	56½	32¾
1913, 10 experiments ...	51½	39	58	36¼
1914, 8 experiments ...	58¾	40½	68¼	34
Average, 28 experiments ...	52¼	38¼	60½	34⅜

From observation and the results of the different experiments the following are the characteristics of the Victory as compared with the Potato oat:—

1. The Victory oat requires a heavier seeding—about 1¾ bushels more per acre.
2. Its standing power is better than that of the Potato oat.
3. It is deeper rooted and so resists drought better.
4. It produces more grain, especially on good land. The difference is on the average 8 bushels per acre, and on first-class soil may be from 16 to 20 bushels. The grain sells well; thus the financial benefit is considerable.
5. As a straw producer the Victory is inferior to the Potato oat, yielding from 2 to 6 cwts. per acre less. On light soils, however, the difference may be negligible.
6. On high-lying or poor land where the season is late the newer variety cannot compete with the Potato oat.

TABLE III.

AVERAGES OF TEN EXPERIMENTS CONDUCTED IN 1914 WITH A VIEW TO COMPARING THE DIFFERENT VARIETIES OF OATS SUITABLE FOR LATE DISTRICTS.

	Seed.	Date of Ripening compared with Sandy.	Yield per Acre	
			Grain.	Straw.
	Bushels		Bushels.	Cwts
Sandy	5	..	47	31½
Potato	5½	Same	50	31¼
Yielder	8	7 days earlier	50½	25¾
Golden Rain	7¼	4 days earlier	51	25½

A careful perusal of these results indicates that no advantage beyond that of earliness can be obtained from the use of such typical oats as the cross-bred oat Yielder or the Swedish oat Golden Rain. There seems, however, to be much need for an improved strain of Sandy or Potato in such areas.

Value of Wild White Clover as a Preparation for the Oat Crop.—The advantage of ploughing down a good green foggage as a preparation for the lea oat crop is known to every farmer. What is less generally recognised, however, is that the use of wild white clover in pastures gives splendid results in the succeeding oat crop. Farmers who have been using wild white clover consider that where this has been done they generally manage to reap at least a quarter more grain per acre than on the ground where they have used the ordinary grass seed mixture.

TABLE IV.

AVERAGE INCREASE IN CROP DUE TO USE OF WILD WHITE CLOVER—THREE EXPERIMENTS IN ABERDEENSHIRE IN 1914.

	Yield per Acre.	
	Grain.	*Straw.*
	Bushels.	Cwts.
Ordinary	54	33
Wild White Clover	64	37

The main reason why the wild white clover has had this effect lies in the fact that the clover in common with other leguminous plants is a nitrogen storer, and as such is an excellent preparation for a nitrogen-demanding crop like the oat.

Kind of Plough.—Within recent years a great advance has taken place with regard to the kind of ploughs used. Although in certain soils farmers still prefer the old swing plough, it is generally recognised that the short-boarded plough is easier in draught and is capable of turning over the ground at a faster rate.

TABLE V.

RESULTS OF DYNAMOMETER TRIALS CONDUCTED IN INVERNESS-SHIRE, 1914.

	Short Board.	*Long Board*
Ratio of Draught, 1st Experiment .	75·5	100
Ratio of Draught, 2nd Experiment .	81	100
Ratio of Crop	100	100

These results bear out the general conclusions arrived at by farmers relative to the merits of the short-boarded and old swing ploughs. The use of the skim coulter in the case of the short-boarded ploughs is of great advantage in completely burying any old grass which might otherwise prevent the furrows closing. The advantage, too, of having an extra inch or so in the breadth of the furrow means that the land may be ploughed in considerably less time by using the short-boarded ploughs as compared with the long-boarded ones.

Drilling *v.* Broadcasting.—With a view to ascertaining the effect of different methods of sowing in connection with the oat crop, a series of experiments was conducted in several different counties in the North of Scotland area.

TABLE VI.

AVERAGE RESULTS OF SIX EXPERIMENTS CONTRASTING METHODS OF SOWING.

Method of Sowing.	*Seeding.*	*Yield per Acre.*	
		Grain.	*Straw.*
	Bushels.	Bushels	Cwts
Broadcasting	7½	59	38
Drilling	5½	56½	36

From the results of these experiments it would appear that the question whether oats should be drilled or broadcasted is a very debatable one, and should be generally considered on the merits of the different farms, the kind of ploughing done, and the varieties of oats sown. Here it would appear that the advantage of saving some seed in the sowing is more apparent than real, since the harvested crop yields a slightly higher return in the case of the broadcasted seed. Generally speaking, broadcasting is suitable for the rougher and stonier farms, and should inevitably be preceded by good ploughing. On the other hand, practical farmers consider that drilling is more suitable than broadcasting where new varieties of oats are used.

Change of Seed.—An interesting series of experiments conducted in Orkney shows that the results of a periodical change of seed are invariably beneficial in that county. The variety used in all cases was the Sandy oat, the new seed being taken from Midlothian.

TABLE VII.

RESULTS OF SYSTEMATIC CHANGES OF SEED.

		Yield per Acre after Change of Seed.	
		Grain.	*Straw.*
		Bushels.	Cwts.
A.	Average of 4 Experiments—1st year	65·3	49·2
	2nd year	60·6	47·6
B.	Average of 3 Experiments—1st year	68·5	54·8
	2nd year	61·2	52
	3rd year	57·4	46·5

These results indicate that it is of great advantage for farmers in the late districts to change their seed as frequently as possible. By getting seed from early districts, not only is the crop earlier, but an appreciably larger crop is also obtained. The golden rule in this respect is to obtain seed from a district where the oat attains its most perfect development. Such districts as the Lothians, Forfarshire and Easter Ross are well known on account of the excellency of the seed they produce.

Destruction of Weeds.—Two of the worst weeds which affect the oat crop in the North of Scotland are Skelloch and Yarr. The former is much in evidence in clay districts, and affects both the lea and the clean land oat crops. The latter is generally found in the clean land crops only. Spraying with a 3 per cent. solution of copper sulphate is invariably successful in killing the Skelloch. Farmers are, however, apt to delay spraying until the crop has suffered very considerably. The proper stage is just when the Skelloch plant has formed its rough leaves, and is not more than an inch and a half in height. If spraying be delayed until the flowering stage is reached the cereal crop suffers very greatly, because of the great demand the weed has already made on the moisture and food material in the soil. An experiment carried out in West Aberdeenshire gave the following results:—

SHOWING THE RESULTS OBTAINED BY SPRAYING THE GRAIN CROP.

	Grain Bushels.	*Straw.* Cwts.
Unsprayed	41	43
Sprayed	56	47½

Yarr is not affected by spraying, but much may be done to prevent the weed seeds germinating by preventing the formation of a very fine mould at the time of sowing. Where land is likely to be affected by Yarr it is advisable to harrow as little as possible.

Manuring of the Oat Crop.—In the North of Scotland area it is customary amongst farmers to manure only the yaval or clean land oat crops. The accumulated fertility in the case of a newly broken up three-year-old pasture is such that many farmers consider it inadvisable to manure lea oats on account of the liability of the crop to lodge. Consequently, manurial trials have in general been confined to yaval oats or oats grown after turnips, although a considerable amount of experimental work has been done in connection with the manuring of lea oats in the poorer districts. The results show that the oat crop responds readily to applications of quickly available manures supplying nitrogen, phosphoric acid and potash.

TABLE VIII.

RESULTS OF MANURIAL EXPERIMENTS WITH OATS—YIELD PER ACRE.

	8 Experiments, 1912.		4 Experiments, 1913.		6 Experiments, 1914.		Average, 18 Experiments	
	Grain.	Straw	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bush	Cwts.	Bush.	Cwts.	Bush.	Cwts.	Bush.	Cwts.
1. No Manure	28 6	29·7	34 5	29·7	43·2	25	34·75	28·25
2. ¾ cwt. Sul. of Ammon. 2 cwt. Super. ... 1 cwt. Potash Salt	38·2	35·5	47·5	42·5	55	37	46	37 5
3. Same, but no Potash	35·7	33 7	41·5	40	52·5	30	42 5	34
4. Same, but no Phosphate	37·5	33·2	43·7	37·7	51·5	30	43·5	33·25
5. Same, but no Nitrogen	33·8	32·1	38·2	34·5	49	25·2	40	30·25

TABLE IX.

VALUE OF INCREASE PER ACRE LESS COST OF MANURES.

	Value of Increase, less Cost of Manures, 1914.	*Estimated Value, less Cost of Manure*, 1918.
1. Complete Manure	£1 1 6	£2 12 8
2. Same as 2, but no Potash ...	0 11 10	1 16 0
3. Same as 2, but no Phosphate ...	0 13 4	1 19 2
4. Same as 2, but no Nitrogen ...	0 3 9	0 9 4

The 1914 prices were estimated at 2s. 3d. per bushel of grain

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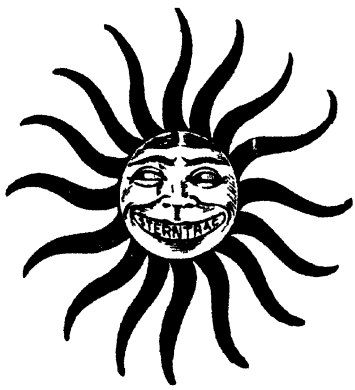
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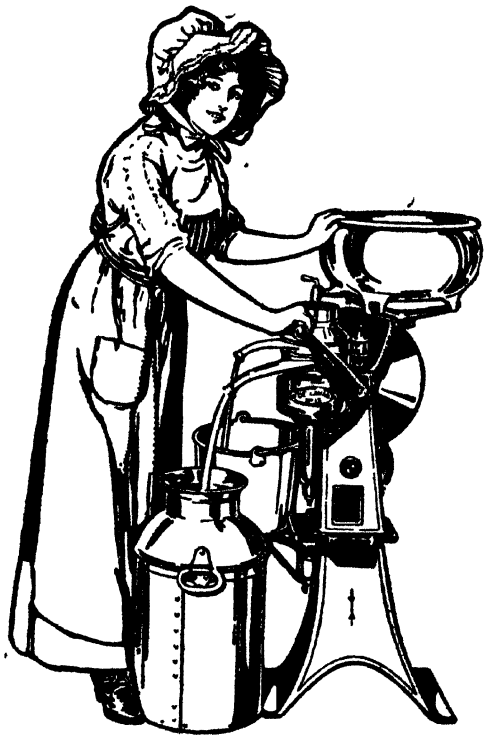
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and 2s. per cwt. of straw, and the 1918 prices at 6s. per bushel of grain and 3s. per cwt. of straw. Potash salt was calculated at 15s. per cwt.

The deductions from these results and from observation in the carrying out of the different experiments are that—

(1) The best and most profitable dressings are obtained by the use of complete and well-balanced manures;
(2) The use of a well-balanced manure does not stimulate the straw at the expense of the grain, or *vice versa;*
(3) The omission of nitrogen from the complete manure is very noticeable particularly so far as the straw is concerned, and such omission reduces the profits almost to vanishing point;
(4) The functions of phosphate are to develop the rooting system of the plant, increase the number of grains, and induce early ripening.
(5) The use of potash in a manure is attended by increased yields in both grain and straw, and also by a plumper grain and higher bushel weight;
(6) The present prices of grain and manures favour manuring on a more extensive scale than was the case before the war.

Conclusion.—The results set forth in this article show that the field for experimental and research work is a very wide one. One of the crying needs in the later districts is for an oat which combines the good properties of the Sandy and Potato with earliness and higher yielding powers. It should be possible, with the help of a Plant Breeding Station, to obtain such an oat. Hitherto all the experiments have been confined to trials of cross-bred or foreign selected oats, evolved primarily to meet conditions which are not entirely similar to those of Scottish farmers whose lot it is to farm in the later districts. Let it be remembered that in Sweden the results obtained from the establishment of their National Station at Svalof has been an increase of at least 25 per cent. in the grain yields in many districts Let it be remembered too that, as a result of the introduction of these improved Swedish oats, some Scottish farmers find that the value of the increase in yield as compared with the Potato oat yearly amounts to sums equivalent to the total rent of their farms. Again, although variety trials have naturally taken a very prominent place in the experimental work already accomplished, much requires to be done in other directions. There can be no doubt that the selection of a proper grass and clover seed mixture for a three-year-old pasture is a great factor towards obtaining a large increase in the lea oat crop. The problem, too, regarding the growth of red clover is very intimately associated with the oat crop, especially on farms where the hay stubble is ploughed up. Much more might be done in investigating problems of cultivation. The effect of good and bad ploughing, the type of furrow required, especially on light land, the necessity of getting rid of annual weeds, together with such matters as manuring and times for seeding and harvesting, all provide an ample field for the experimental work of the future.

RHIZOCTONIA DISEASE, OR STEM ROT, ON POTATOES.

D. G. O'BRIEN, M.A., B.Sc. (Agric.).

FOR a long time it has been known that species of the common fungus Rhizoctonia are parasitic upon a number of plants, and that they frequently cause "damping off" of young seedlings. Among the plants upon which they have been found as parasites are beet, sugar beet, charlock, cabbage, cauliflower, turnip, lettuce, cress, tomato, tobacco, bean, pea, parsnip, radish, rhubarb, raspberry, blackberry, potato, red clover, lucerne, and many different floricultural plants.

This article is concerned with the disease which Rhizoctonia sets up in the potato. It is in this crop that the disease is most prevalent and causes the greatest damage. The reason is that, owing to the method by which the potato is propagated, the fungus finds a very favourable opportunity for spreading.

At least two species of Rhizoctonia are known to attack the potato—namely, *R. solani*, Kuhn, and *R. crocorum* (Pers.) DC., or *violacea*. Of these the first is said to be the more common, although from observation among potatoes in the West of Scotland it would appear that the second species occurs quite as frequently as the first.

Until quite recently it was thought that these two fungi caused no serious loss to the potato grower, but it has now been convincingly shown that the economic loss caused by species of Rhizoctonia in America, and also in Europe, is so great that the disease must be considered one of the most serious affecting the potato.

It was about two years ago that the widespread distribution of this disease was noted by the writer in Scotland. Reference to literature shows that the disease is mentioned by Pethybridge in 1910 as occurring in Ireland, and further, that it was observed by Gussow in 1905 in England. Yet although the disease was little known to the scientific investigator until recently, from inquiry it seems that some observant farmers know of this plague, although unaware of its nature. One farmer known to the writer has for years made a practice of examining his sprouted sets before planting, and rejecting those showing signs of damping off. He knew that, if planted along with the healthy tubers, not only did the affected sets spread disease, but that often they themselves failed to come through.

Apart from the investigations of Pethybridge and Gussow, the disease seems to have been overlooked in Great Britain. In Scotland the disease has attracted singularly little attention, and there is no reference to its ravages in current literature. Yet from an examination of potatoes from different parts of Scotland the trouble seems to be very prevalent, and every year to become more pronounced. A large percentage of market potatoes are affected, and particularly those from the "red potato soils" of Scotland.

Characteristics of the Fungus Rhizoctonia.—The fungus has several distinguishing characteristics which mark it off from other

similar fungi. There are three distinct phases or stages in its life-history.

(1) *The Rhizoctonia Stage.*—This is the vegetative or growing stage, which attacks the potato stem. In this stage two kinds of hyphæ[1] may be recognised (Fig. 1)—(*a*) light-coloured hyphæ in the inner tissues of the plant, which may cause a wet rot of the affected part, and ultimately result in the death of the plant; (*b*) dark-coloured hyphæ in the outer tissues, forming a close web or felted covering, which forms a band or girdle round the stem.

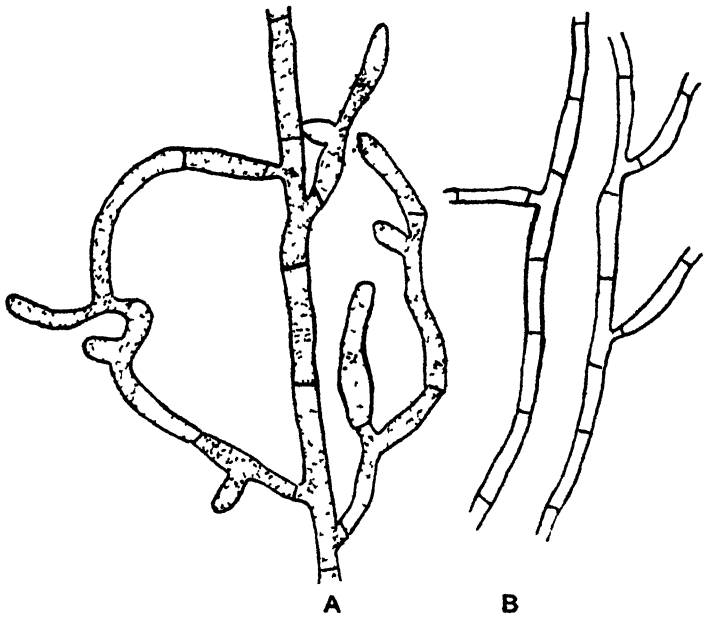


FIG. 1.—(*a*) Young hypha of Rhizoctonia solani, (*b*) Old, brown, and empty hyphæ.

If the disease has penetrated the outer layers of the stem only, there may be quite a normal development of the shaw, and the plant may even present quite a prolific appearance; and yet, although the fungus is only more or less parasitic upon the outer surface of the stem, it interferes very greatly with the normal physiological movements inside the plant, and prevents the storing up of the starch in the underground stems—*i.e.* the formation of tubers.

(2) *The Corticium or Spore Stage.*—This stage probably serves for the rapid spread of the disease during the vegetative phase.

Spores of Rhizoctonia were first observed by Rolfs in 1903 on the potato stems, and were considered by Burt to be a new fungus, which he termed *Corticium vagum* (B. & C.), var. *solani* (Burt); in Europe the same fungus is known as *Hypochnus solani* (Prill. & Del.). It is better, in order to avoid confusion, to regard these three fungi as identical.

[1] A fungus is composed of a number of long tubular threads or filaments, termed *hyphæ*, which may be branched or unbranched, septate or non-septate.

The spores are very small, and are formed only under favourable climatic conditions such as occur in a cool season with a heavy rainfall. This probably accounts for the great prevalence of the disease during the summer of 1918.

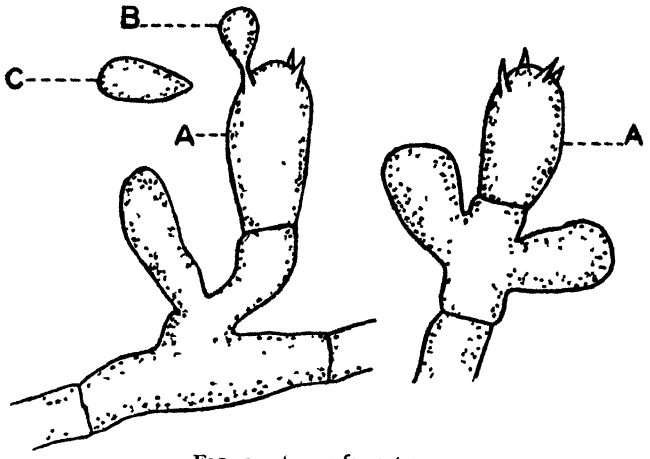


FIG 2 —Spore formation—
(*a*) Basidium, (*b*) Spore attached to Sterigma, (*c*) Spore detached

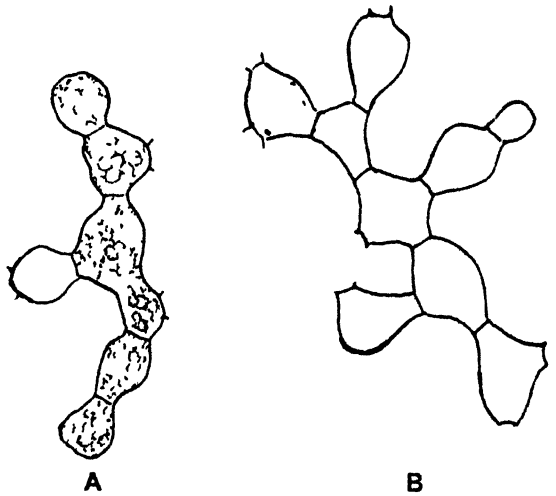


FIG. 3 —(*a*) Young barrel-shaped cells which compose the sclerotia of Rhizoctonia solani; (*b*) Older empty cells from the sclerotia.

The process of spore formation is as follows:—At the base of the growing potato the hyphæ of the fungus collect and form a fine network round the stem. The outer hyphæ of this layer bear club-shaped basidia,[1] with four spore-forming branches or sterigmata (Fig. 2) The spores are cast off, and each is rapidly transformed into the vegetative stage.

[1] The swollen terminal portion of a hypha, from which branches arise (generally four in number) which bear spores, is termed a basidium.

(3) *The Sclerotium*[1] *or Resting Stage.*—This phase serves to carry the disease over from one growing season to another. The sclerotia are found on the potato tubers at the end of the growing season (Plates I. and IV.). They can likewise be found on the shaws (Plate XI.). Each is composed of a closely woven mass of hyphæ, which at first is small, white and soft, but later becomes larger, dark and hard. The cells of the hyphæ composing the sclerotium are more or less barrel-shaped (Fig. 3), and they act as conidia.[2] Each under favourable conditions can germinate, and give rise to the vegetative or growing stage of the fungus (Fig 4).

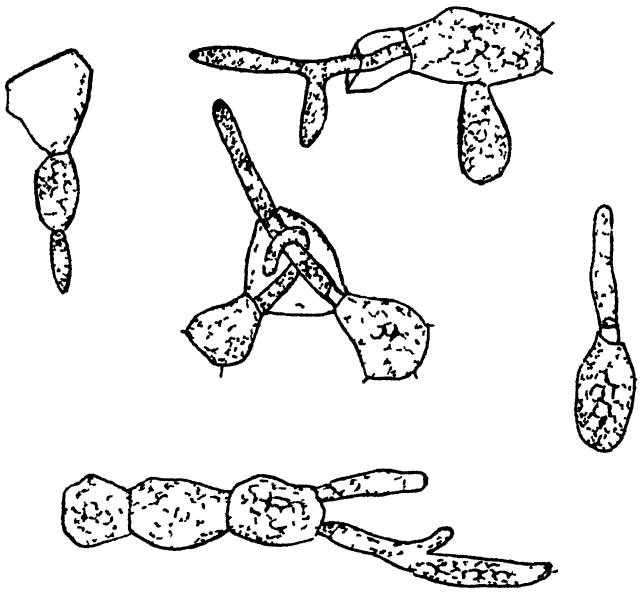


FIG 4.—Germinating sclerotial cells of Rhizoctonia solani.

It is comparatively easy to grow *Rhizoctonia solani* in pure culture on artificial media such as potato agar or corn meal agar, but *Rhizoctonia violacea* is more difficult to propagate, and has hitherto not been grown on artificial media.

Rhizoctonia on the Potato Plant.—The growth of Rhizoctonia on the potato plant will be considered for sake of clearness, under three heads.—

(1) *Rhizoctonia solani* on the Tuber.
(2) *Rhizoctonia violacea* or *crocorum* on the Tuber.
(3) *R. solani* and *R violacea* or *crocorum* on the Stem.

(1) *Rhizoctonia solani*, Kuhn, *on the Tuber*—Diseased potato tubers show on their surface irregularly shaped, slightly raised, dark

[1] Some fungi under unfavourable conditions become converted into a hard, dry, resistant, blackish mass, the cells of which are more or less round and stored with nutriment Such a mass is a sclerotium, and represents a resting stage in the life-history of the fungus

[2] When part of the hypha of a fungus becomes cut off and forms a spore by an asexual process, the spore is termed a conidium.

brown patches (Plate I.). These represent sclerotia, and they vary in size from a pin-head up to that of a pea or even larger. They apparently do not cause any serious injury to the tuber, and are only loosely attached to it by a few hyphæ penetrating the surface layer of the tuber. They are frequently regarded as small pieces of earth or soot adhering to the tuber, and can be readily detached by rubbing with the finger nail.

The fungus does not always remain on the surface, but enters the tuber through the lenticels.[1] In some cases its entrance is indicated by a curious cracking of the skin, which is often very marked, and giving to the surface a reticulate appearance (Plate II.). In other cases we get a scabby appearance (Plate III.), which is almost identical to that caused by ordinary brown or surface scab. The scab caused by Rhizoctonia is deeper than surface scab, and it frequently heals up and leaves an elevated round scar.

In America the type of scab caused by Rhizoctonia is known as Russet Scab. Probably it is very common in this country, where it is generally confused with Brown or Surface Scab, formerly recognised as caused by *Oospora scabies* (Thaxter), but now by *Actinomyces chromogenes* (Gasperini).

It is rather interesting to note that on lifting diseased tubers affected with Rhizoctonia one frequently finds on their surface small tubers—secondary growths, but whether *R. solani* is one of the common causes of these "second growths" of potato tubers has not yet been determined.

Diseased potatoes, in which the fungus has penetrated the tuber, often give rise to a peculiar wet rot when they are pitted, resulting in considerable loss.

It seems probable that there are several strains of *R. solani*, each producing its own typical wound or growth on the tuber, so many and varied are the types.

(2) *Rhizoctonia crocorum* (Pers) DC., *on the Potato Tuber* – This species is found very often on the Scottish potato, in fact it is even more common than the preceding.

In rare cases the whole surface of the potato may be more or less completely covered over with a thick felt-like mass of a dark-brown chocolate colour when dry, and violet when wet (Plate IV.). These masses are similar to the surface sclerotia formed by *R. solani*, but they are more extensive and differ in colour. These sclerotia frequently cause pitting and deep cracks in the tuber. If such an affected tuber be moistened with water, numerous small blackish areas can generally be seen immediately below the surface, which cause the skin of the potato to be elevated at such points (Plate V.). These areas are sclerotia. In shape they may be round, more or less oval, or eye-shaped, and in size five millimetres or even larger. An exaggerated idea is often got of their size from the fact that, if the potato is badly affected, several sclerotia may become confluent and form a large compound sclerotium.

In most of the diseased tubers which we have examined the surface sclerotia were scanty and confined to small areas By far the commoner form was the second type, where the skin had been

[1] Breathing spores on surface of tuber.

perforated at the lenticels and the sclerotia showed below the skin.

These sclerotia do not as a rule extend deeply into the tissues, but are mainly confined to the surface layers of the cortex of the tuber. In some cases, however, they make their way right into the "flesh" of the potato and do serious injury, causing discoloration, blackening, and, ultimately, rotting of the tissues. Some of the wounds produced often resemble the burrows made in potatoes by wireworms (Plate VI.). This type of injury has been recently called by an American investigator "Dry core."

(3) *Injuries to the growing Potato Stem by species of Rhizoctonia.* —It is almost impossible to discriminate between the two species of Rhizoctonia on the stem, but from observation the writer is of opinion that the most serious injuries are caused by *Rhizoctonia violacea* or *crocorum.*

Soon after the potato "seed" is planted the young sprouts are attacked by the fungus which has germinated from the sclerotium (Plate VII.). The result is that many of the sprouts from an affected set fail to reach the surface, because the tip of a sprout which has been attacked rots (Plate VIII.). Such a sprout branches below the injured part in an effort to overcome the attack of the fungus. This branch may be again attacked, and the process of branching many times repeated. Thus we find in a number of cases that numerous branches arise from the initial sprouts, the tip of each branch being killed almost as soon as formed, and so the whole substance of the tuber may be used up in the vain attempt of the plant to secure a healthy sprout This is what happens when the plant is badly attacked.

In other cases there appear above ground from the one plant either a few shaws or often an abnormal number, sometimes as many as a dozen, all either thin and weakly or short and stunted. If these shaws be examined each will be found to be encircled close to the ground surface with a dark band; or again the shaw just below the surface of the ground shows numerous blackish spots or areas. Many such potatoes give up the struggle; the shoots wilt, droop and die, but others apparently recover. We have seen potato fields where there were numerous blanks, all due to this fungus attacking the germinating tubers, as many as one out of every four sets sometimes failing. The cause of blanks in potato drills can almost invariably be traced to attacks of this fungus.

Stems which survive the first onset of the disease, or are attacked later, show characteristic wounds, often over an inch long, on their surface close to the ground. The fungus, though not apparently causing any marked damage, so far as external appearances indicate, yet quite evidently seriously interferes with transpiration and the translocation of food.

Some of these stems may be abnormal in length—in exceptional cases over six feet; they are soft and hollow, and lie flat on the ground. They are much branched, and the leaves are almost completely confined to the tips of the branches. When such potatoes are dug only a few small tubers are unearthed. It is, however, frequently the case that the stems are small and stunted,

the leaves being twisted and with prominent veins. All the foliage is crowded together. Such plants are easily picked out in a field, and the condition is known as "Potato Rosette" (Plate IX). Here again the yield of potatoes is small.

In other cases we find that, when the injury to the stem is deep and almost completely severs the plant at the ground surface, two alternatives are open to the plant. (1) It may form aerial tubers (Plate X.). These tubers are formed on the stem between the stem and a leaf base (*i.e.* in the leaf axils), and are simply attempts of the plant to store up the starch as it is manufactured in the leaves. (2) The second alternative is for the plant to form a large number of small tubers just at the ground surface. This latter condition is termed "Little Potato" (Plate XI.).

In many cases, however, the plant, if conditions are favourable, more or less completely recovers, and the only evidences that can be found of it having been attacked are that (1) the leaves show a tendency to curl, especially in dry weather; (2) sclerotia are found on many of the tubers; (3) the yield is much less than it would be if the potatoes were healthy; and (4) sclerotia can be found at the end of the growing season on the underground stem.

It is difficult to estimate, at the present time, the total loss accruing to the farmer in Scotland through planting sets affected with this disease, but it must be very considerable Loss may occur in the following ways —(1) From the complete failure of some sets to "come through"; (2) from interference with the physiological movements inside the plant during the whole of its growth, causing a light crop; (3) from the shaws going down very early, and causing early ripening, (4) from wet rot in the pits. Further, the market value of the potatoes may be considerably affected by their scabby appearance. Undoubtedly we are fast approaching the stage when it will be impossible to get seed free from this fungus. (This is the condition of affairs in several of the American States.) Some idea, however, of the loss to the farmer can be obtained from the results of an experiment carried out by the Colorado Experiment Station (Plate XII.). The yield of potatoes grown from affected seed is shown in Figs. 1 and 2, and from an equal quantity of unaffected seed (*i.e.* seed treated with a fungicide) in Fig. 3.

Source of Infection.—We have already indicated the main source of infection. Potatoes bearing sclerotia, if used as seed, will transmit the disease to the sprouting set, and probably this diseased plant will infect those around it. We have noted diseased areas in an otherwise healthy field that can be accounted for only by such an hypothesis. Diseased shaws from a preceding crop, *i.e.* stems or roots bearing sclerotia, will likewise spread the disease, while a third source of infection may arise from the sclerotia on the stems of weeds growing in the potato drills. The fungus has on occasions been found on all the common weeds. Lastly, the sclerotia seem to be able to exist in the soil, and this must not be overlooked as a potent source of infection.

Treatment.—No treatment, so far as is known, can save the growing plant when once it is attacked. It may partially recover,



PLATE I Sclerotium Blight of Groundnut



PLATE II Late appearance of super badly affected with Rhizoctonia

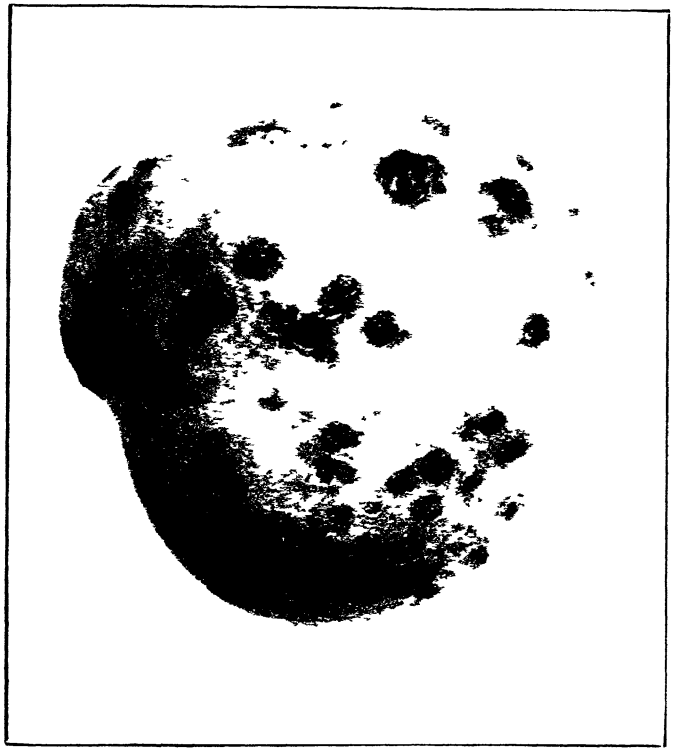


PLATE III. Potato tuber diseased by Rhizoctonia.



PLATE IV. Sclerotia of Rhizoctonia violacea on tuber.



PLATE V.—Sclerotia of Rhizoctonia violacea on tuber

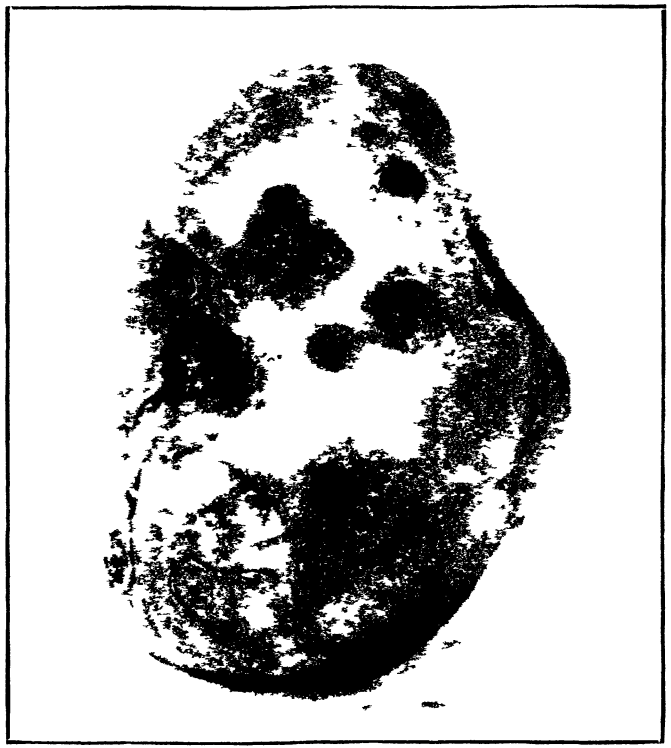


PLATE VI.—Pitting on tuber caused by Rhizoctonia



PLATE VII.—The young sprouts of a potato set attacked by the vegetative form of the fungus.



PLATE VIII.—Young sprouts attacked by fungus, those on right completely severed.



PLATE IX. Petit Knotte



PLATE X. Potato Plant attacked by Rhizoctonia, showing formation of aerial tubers

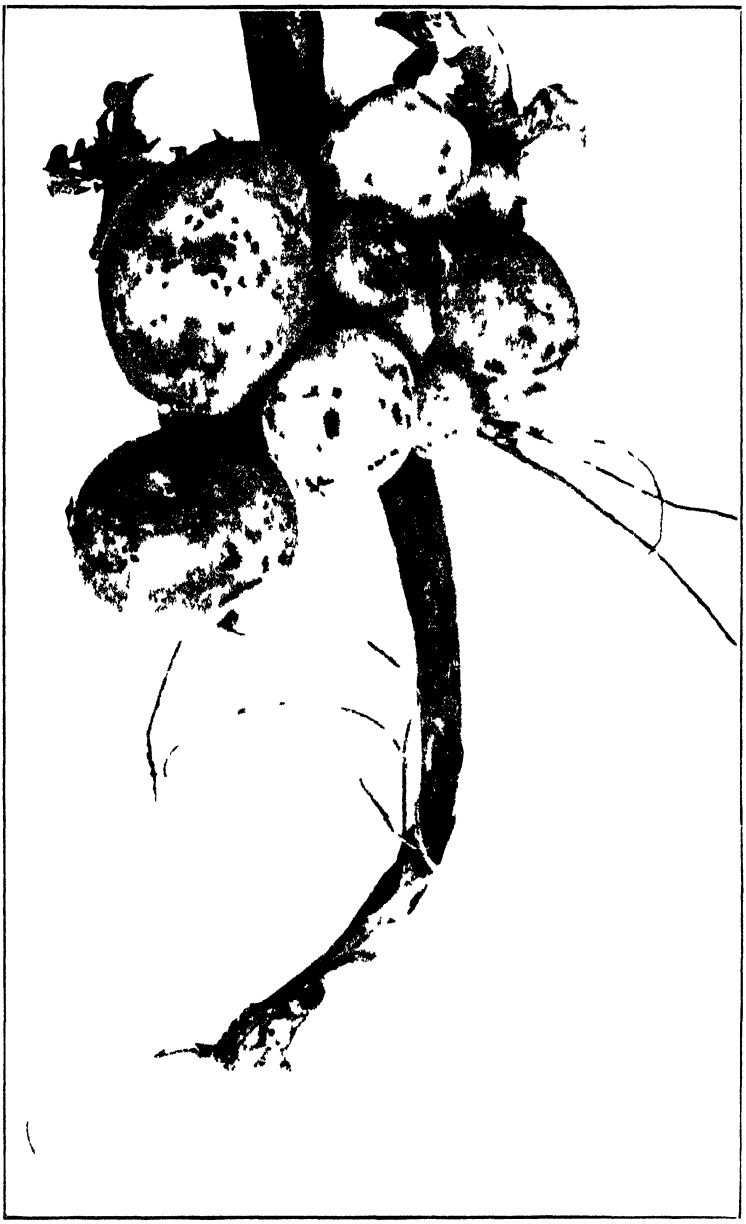


PLATE XI. Little Potato. Note the sclerenchymatous tubers. The original wounds on root tuber now filled up with sclerenchyma and appear thick.



PLATE XII – The yield of potatoes from two lots of affected seed is shown in Figures 1 and 2 that from a quantity of seed equal to that used in either 1 or 2 in Figure 3

in fact it generally does, but it will always be a more or less unprofitable plant, owing to the injuries caused to the stem.

It follows that all methods of treating the disease must be preventive, and these can be aptly summarised in the sentence: "Clean seed in clean soil will produce a clean crop."

The first essential, therefore, is to use clean seed. The seed must be free from sclerotia, and it must be remembered that these may be so small as to be almost invisible. Further, it frequently happens that the sclerotia are to be seen only when the seed is wet. It is better to reject all suspicious seed; although some believe in treating suspected and affected seeds with fungicides. Obviously if the sclerotia are present in the interior of the tuber, and not on the surface, no treatment will likely prove effective.

Two methods of destroying the fungus (the sclerotia) on the seed potato have been practised in America—(1) treatment with formalin; (2) treatment with a weak solution of corrosive sublimate. Of these the second has given the better results. The strength of the solution used is 4 ounces of corrosive sublimate to 30 gallons of water. In order to do this the potatoes are packed in crates, immersed in the solution, taken out and allowed to drain. After the solution has been used for three batches of potatoes it should be renewed.

It is doubtful whether these methods would prove effective in our country. In Scotland, at any rate, the sclerotia on diseased tubers are mainly below the surface, and we are of opinion that such methods of combating the disease would not be of much avail. But no experimental evidence on this point has been hitherto adduced.

A much more practicable measure is to go over carefully all the boxed seed before planting, and reject all sprouted sets showing damping off of the sprouts. This measure would be very effective were it not for the fact that the majority of the sclerotia germinate only when the set is planted in the soil.

If once the soil has become contaminated we have a much more serious problem to solve. The first measure that suggests itself is to lengthen the interval, as far as practicable, between successive crops, with a view to causing the death of the sclerotia present in the soil and on plant remains. Further, since Rhizoctonia is a parasite upon a large number of weeds, the cleaner the land is kept the less likely is the disease to persist over the interval.

There is much difference of opinion as to the value of applying lime to infected soil. Probably quicklime will kill a certain number of the sclerotia, and should always be applied when the soil is badly polluted. The application of lime will, in addition, improve the tone of the soil, and that will serve to keep the fungus in check. It is found that the disease is most prevalent under poor soil conditions, especially when soils are sour. Of course the application of lime may cause an increase of ordinary scab, but it will be necessary to choose between two evils, and surface scab is not nearly so serious a disease as the various Rhizoctonia diseases.

In particular we might draw special attention to the following points:—

(1) From close observation extending over two years the

disease is prevalent in Scotland, and, unless radical measures are taken to control it, great losses will be incurred by the farmers.

(2) There is a great and urgent necessity for a more detailed study of this and of all other potato diseases common in Scotland. We have diseases peculiar to Scotland, and yet we have even now to turn to other countries for information, which may or may not be of value in solving our difficulties.

A bibliography on this subject is appended, but much of the information contained in the various publications is mainly of historical value.

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COMPOSITION OF LINSEED RECOVERED FROM HOME-GROWN FLAX.

T. W. FAGAN, M.A. (Cantab.).

UP to comparatively recent times it was commonly believed that it was impossible to obtain from the same crop flax of good quality and linseed containing a high percentage of oil, for in order to obtain fibre of first class quality it is necessary to harvest the crop before the seed is quite mature. The general custom was to grow the crop either for one purpose or the other, thus in Ireland flax was grown almost exclusively for the fibre, the seed being of little consequence. In India, the United States of America and

the Argentine, on the other hand, it was cultivated almost solely for the seed, but in Belgium and Holland it has always been the custom to save the seed from the very finest kinds of flax.

Experiments carried out by Ivanoff (*Beihefte zum Bot. Central*, 1912-28-159) have shown, however, that the difference in the percentage of oil in the seed of plants grown specially for fibre and that of plants grown for seed is very small, and the investigations of Eyre and Fisher (*Journal of Agric. Science*, 1915-7-120) have confirmed Ivanoff's conclusion. These investigations show that the only difference between the seed from the fibre crop and that from the linseed crop is one of yield of seed per acre, there being little difference in the oil content between seed nearly ripe and that fully mature.

In season 1918 the Flax Production Branch of the Board of Agriculture and Fisheries, by arrangement with the Board of Agriculture for Scotland, undertook—as a war measure—the work of flax production in Scotland. This resulted in a great revival of the ancient practice of flax cultivation in the country, about 1300 acres being devoted to it in the county of Fife.

Although the crop in Scotland was grown with the object of producing fibre, the seed also was saved, and the opportunity was taken of obtaining samples of the seed for analysis, particularly for the determination of their oil content, it being thought that it would be of interest to Scottish farmers generally to know what percentage of oil might be expected in seed grown in Scotland under these circumstances.

Through the kindness of Mr. Thomas Young, M.B E., Secretary and Agricultural Superintendent of the Fife Flax Production Centre, a representative set of samples of the seed grown upon different farms in Fife was obtained in addition, a great deal of information was supplied by Mr. Young as to the type of soil, dates of sowing and harvesting, etc. of each sample. Full instructions for the guidance of farmers prepared to grow flax in Fife were given to all who undertook its cultivation, with the result that, within limits, the crop was raised under more or less similar conditions, more especially as to its place in the rotation, time of sowing and of harvesting, manuring, etc.

The seed supplied to the farmers was all from one source, being Dutch, a sample of which taken from bulk was found on analysis to have the following composition :—

Moisture	7·98 per cent.
Oil	39·20 ,,
Albuminoids	22·19 ,,
Fibre	5·33 ,,
Ash	4·74 ,,
Soluble Carbohydrates .	20·56 ,,
	100·00

The following particulars apply generally to the management of the crops from which the samples of seed were obtained The seed was sown broadcast either by hand or by machine at the rate of 126 to 140 lbs. per acre in loamy soils that varied from light to

heavy, and ranged in altitude from 100 to 560 feet above sea level. The place of the crop in the rotation was in the large majority of cases after grass or grain stubble, and the manure applied consisted of 1 cwt. of sulphate of ammonia, with the addition in some cases of 2 to 3 cwts. of superphosphate of lime. All the seed was sown in the month of April and the crop harvested in August.

It is generally agreed amongst flax growers that the time to harvest the crop is when it has reached that stage of its growth when the lower part of the stem to about one-third of its height has changed colour from green to yellow, and the leaves to this extent have withered and fallen, the seed within the capsule being at that stage when they change from a full green colour to a brownish tinge.

It was found impossible in Fife, owing to the difficulty of supplying the labour, to adhere strictly to this ideal time of harvesting in every case, with the result that on some of the farms the crop had gone a little beyond this stage at the time of harvesting.

The samples of seed received for analysis were of two kinds. The first represented linseed cleaned as far as it would be possible with the usual appliances that the farmer has at his disposal on the farm. A cursory examination of these samples showed that they varied greatly amongst themselves in the number of weed seeds they contained, and these on determination in the laboratory were found to make up from 2 to 14 per cent. by weight of the different samples, and to consist chiefly of *Polygonum Persicaria* (Redshanks), with dock, charlock, spurrey, and in cases a few Italian Ryegrass seeds.

The following table gives the average percentage composition of twenty samples grown on different farms in Fife, together with the composition of the samples containing the minimum and maximum percentage of oil respectively.

TABLE I.

	Average of Twenty Samples.	Sample containing Minimum Percentage of Oil.	Sample containing Maximum Percentage of Oil.
Moisture	12·35	12·40	12 96
Oil	32·49	27·50	37·50
Albuminoids	17·78	17·12	18·06
Fibre	7·43	9·00	6·50
Ash	4·12	3·40	3·74
Soluble Carbohydrates ...	25·83	30·58	21·24
	100·00	100·00	100·00

The table shows that the oil content varies from 27·5 to 37·5 per cent., the average of the twenty samples being 32·5 per cent. The variation is fairly wide even when the fact that all the samples were not harvested at the same time is taken into consideration. Although this may partly account for the variation, the more

important factor influencing the oil content in these particular samples is the variation in the percentage of weed seeds contained in the samples, and the effect of the removal of these on the oil content of some of the samples is shown in Table II., which gives the percentage of oil in the samples as received in the laboratory, and in the same samples after the careful removal of the weed seeds.

TABLE II.

PERCENTAGE OF OIL.

Sample No.	Sample as received in the Laboratory.	Sample after removal of Weed Seeds.
2.	31·15	34·02
3.	37·50	37·88
5.	27·50	34·35
7.	32·75	34·03
10.	28·10	33·74
20.	27·85	33·61
Average ...	30·81	34·60

The removal of the weed seeds is seen to raise the percentage of oil in all the samples, and as would be expected, the higher the percentage of weed seeds in the original sample, the greater is the difference in the percentage of oil between the sample when clean and uncleaned.

The second set of samples was finally cleaned linseed, containing very few weed seeds, and the linseed themselves, having been graded in the cleaning, were much more even in size than was the case with the samples referred to in Table I.

The following table gives the average percentage composition of sixteen of these samples, together with the composition of the samples containing the minimum and maximum percentage of oil :—

TABLE III.

	Average Percentage of Sixteen Samples.	Sample containing Minimum Percentage of Oil.	Sample containing Maximum Percentage of Oil.
Moisture	8·66	9·00	9·06
Oil	36·15	34·74	38·55
Albuminoids...	21·91	20·12	20·12
Fibre	6·78	6·00	5·95
Ash	3·75	3·60	3·78
Soluble Carbohydrates ...	22·75	26·54	22·54
	100·00	100·00	100·00

An examination of Table III. shows that these samples differ but little in composition, the difference in the percentage of oil

between the highest and the lowest being about 4 per cent.: the average percentage of oil in the sixteen samples is about 36 per cent.

On comparing the average percentage of oil in the samples in Table II., that is, the linseed after the removal of the weed seeds, with the average percentage shown in Table III., it is seen that the latter is a little higher owing to the removal, in the mechanical cleaning, of the smaller and the less mature linseed as well as the weed seeds.

It has frequently been maintained and often used as an argument against the growing of linseed in this country that British climatic conditions do not allow of the growing of linseed with as high a percentage of oil as that contained in imported seed; this belief has been shown to be quite incorrect, for at a number of English centres the home grown seed has contained as high a percentage of oil and in cases even higher. Eyre and Fisher instanced one case where the crop was grown for flax in which the recovered seed contained as high a percentage of oil as the imported seed sown (*Journal of Agric. Science*, 1915-7-125). In this connection a comparison of the Scottish seed recovered from the flax crop with the imported seed sown is of interest.

TABLE IV.

PERCENTAGE OF OIL.

Sample of Imported Seed (Dutch).	Scottish Seed.	
	Average of Sixteen Samples.	Maximum in any one Sample.
39·20	36·15	38·55

It is seen that the average percentage of oil is 3 per cent. and the maximum half a per cent. less than in the original seed sown, and when it is remembered that the seed was obtained from crops grown for fibre production, the high percentage of oil they contain is very striking.

Season 1918 in Fife was considered, taking it all through, to be probably more favourable for the production of seed than of fibre, the month of June—a critical month in the cultivation of flax—being generally dry and sunny.

The average yield of dressed seed per acre in Fife was 15 bushels (of 52 lbs. per bushel). That it is possible to obtain such a yield of seed containing on an average 36 per cent. of oil from a crop grown for fibre production, naturally raises the question whether it would not be advantageous to the farmer to cultivate the crop for the sake of the seed required for his own use, especially when the present high price of linseed is taken into consideration.

The Agricultural Department of the University College of North Wales, Bangor, as a result of a series of trials carried out in different centres in the northern counties of Wales in the years 1911 and 1912, came to the conclusion that if linseed remained at

the high price that ruled in these years there could be little doubt that it would pay farmers to grow what they required for their own use. In the years 1911 and 1912 the price of linseed in Leith was from £19, 10s. to £20, 10s. per ton. In June 1919 linseed was sold in London at £44 per ton, that is, more than double this price, and nearly four times the price at which it could be bought in the years just prior to the war.

At present prices there seems to be little doubt that, where possible, it would pay the farmer to grow the crop for seed for consumption on the farm. For when grown for this purpose the yield of seed might be greatly increased; the yield in England varied from 10 cwts. per acre on poor land to as much as 20 cwts. on good land, and the percentage of oil in the seed reached 40 per cent.

In addition to the seed, a valuable by-product is obtained in the process of de-seeding, known as linseed chaff; this consists of the capsules or receptacles in which the seeds are retained.

The following table gives the analysis of four samples of linseed chaff obtained from different centres in Fife, the yield of chaff being on the average 7 cwts. per acre.

TABLE V.

PERCENTAGE COMPOSITION OF "LINSEED CHAFF" CAPSULES.

Moisture	12·40	12 24	14·40	13 45
Oil	4·40	7 59	6 85	6 72
Albuminoids	5 00	6 25	7·19	6 85
Fibre .. .	31·75	32 15	33·65	31·55
Ash	7·96	9 73	8·29	8 81
Soluble Carbohydrates ..	38·49	32 04	29 62	32 62
	100·00	100 00	100·00	100 00

The samples are seen to vary slightly in their percentage of oil, due to the fact that all the samples contained a few small linseed, some samples having retained more than others. In Ireland, the capsule with the immature seed is ground and fed to stock in this form. The following is the result of the analysis of a sample of the mixture thus produced in Ireland:—

COMPOSITION OF A SAMPLE OF THE GROUND MIXTURE OF CAPSULES AND SEED.

Moisture	12·70 per cent.
Oil	12·35
Albuminoids	10·87
Fibre	29·35
Ash	9·04
Soluble Carbohydrates ...	25·69
	100·00

One factor which has had a retarding influence on the cultivation of flax on a large area of land well suited for the purpose in this country, has been the belief that the crop was a particularly exhausting one. So firmly was this opinion held at one time that

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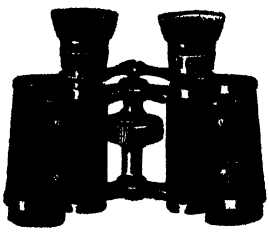
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it was not unusual to find clauses introduced into leases restricting tenants from its cultivation, or limiting the extent and frequency of the crop. Although this belief has been shown to be erroneous, determinations were made of the nitrogen, phosphoric acid and potash in the seed, in the de-seeded capsules or chaff, and in the stem and root of the flax crop grown in Fife, with the object of determining the average weight of these constituents removed from the soil by the crop.

The following table gives the average percentage of each of these constituents found in four samples of flax grown in different parts of the county :—

TABLE VI.

	Nitrogen.	Phosphoric Acid.	Potash.
Seed	3·20	1·41	1·26
Capsules (de-seeded)	1·01	0·445	1·40
Stem and Roots ...	0·23	0·255	0·57
Total ...	4·44	2·11	3·23

Knowing the average yield of flax from the various centres—careful records of all being kept—and the average amount of the manurial ingredients found in the different parts of the plant, the weight of nitrogen, phosphoric acid and potash removed per acre by the flax crop was calculated. These weights in lbs. per acre are given in the table that follows, and for comparison the weight of these manurial ingredients removed from the soil by average crops of wheat, oats, barley, potatoes and turnips (taken from *The Feeding of Crops and Stocks* by Hall) are also included.

TABLE VII.

NITROGEN, PHOSPHORIC ACID AND POTASH REMOVED FROM THE SOIL.

	Lbs. per Acre.		
	Nitrogen.	Phosphoric Acid.	Potash.
Wheat grain, 30 bushels	34	14	9
„ straw, 1½ tons	16	7	20
Total . .	50	21	29
Oat grain, 45 bushels	34	13	9
„ straw, 2¼ tons	18	6	37
Total ...	52	19	46

TABLE VII.—*continued.*

	Lbs per Acre.		
	Nitrogen.	Phosphoric Acid.	Potash.
Barley grain, 40 bushels	35	16	10
„ straw, 1 ton	14	5	26
Total ...	49	21	36
Flax seed, 7 cwts.	25	11	9·87
„ capsules, 7 cwts	8	3·5	11·00
„ stem and roots, 27 cwts. . .	7	7·7	17·23
Total ...	40	22 2	38·10
Potatoes, 8 tons	61	28	100
Swedes, roots, 20 tons	100	23	90

From this table it is seen that the weight of nitrogen, phosphoric acid and potash removed from the soil by the flax crop grown in Fife is just about the same as that removed by an average cereal crop, and the probability is that it owes its reputation of being an exhausting crop to the manner in which it is harvested. This generally consists in pulling the whole of the crop and leaving little, if any, of the roots in the soil; reference to the table shows that the stem and roots, although making up the greater part of the weight of the crop, do not remove from the soil anything like the amounts of nitrogen, phosphoric acid and potash that are contained in the seed and capsules, and if these are both consumed on the farm then the loss suffered by the land is not so great as in the case when cereal straw is sold.

SCOTTISH FARM LABOUR.

JOSEPH F. DUNCAN,
General Secretary Scottish Farm Servants' Union.

THE problem facing agriculture now as formerly, is how it may be possible to prevent the farm workers drifting away to other occupations and to other lands. The problem is not peculiar to Scotland. In all civilised countries, agriculture finds it a difficult task to retain its workers in competition with other industries. It is natural and desirable that a considerable proportion of the people reared in the rural districts should find their way to the towns, or fare even further afield, and no reconstruction of agriculture and no alterations in the conditions of the wage-earners are likely to interfere seriously with this general tendency. When, however, this drift from the rural areas drains agriculture of the

most adventurous and enterprising of the workers to the extent which was common in Scotland during the generation prior to the outbreak of war, it is time to see whether changes cannot be made which will enable agriculture to retain its fair share of the best of the workers. Whatever arrangements may be made either by legislation or otherwise to maintain a healthy agriculture in this country, it must be apparent that there are more strenuous times ahead for the industry, and that it will be able to hold its own only if it can retain in the ranks of its workers as good brains and ability as any other industry. In the long run, agriculture will survive just as it is able to do this, and not by any artificial stimuli which may be applied to it.

When reasons have been sought why agriculture finds it difficult to compete with other industries in retaining its workers, the usual replies given are that agricultural wages have been low, the hours long, and the housing conditions bad. No one who knows the facts will dispute the effect of these conditions. There are districts in Scotland where the lack of houses, and the consequently relatively small number of married men who can be employed, compels the workmen to go elsewhere if they mean to marry. The low wages and the unnecessarily long hours of labour drive away younger men to seek better conditions. But the Scots farm servant has always been able to make a better living than the English farm worker, yet it has been more difficult to retain workmen in agriculture in Scotland than it has been in England. Wages in Scotland never fell so low as they did in the Midlands and South of England, and yet labour in these low paid English counties was always more plentiful than labour in Scotland. Indeed, it was the surplus of labour in these counties in England which led to the rapid fall in wages during the eighties, and which kept the English farm worker in such an abject condition of poverty. The Scots farm worker was able to maintain a better standard of living because of the keener demand for his labour and the shortage of supply: nor was there such disparity between the wages of farm workers in Scotland and the wages paid in other employments, such as railways, carting and dock labour, to which the farm workers in Scotland tended when they left the farms, as was the case in England. I think it would be found too, if enquiry were made as to the conditions which obtained in the different counties of Scotland, that the shortage of labour was quite as acute in the counties paying higher rates of wages as in the counties where the lower rates prevailed. It is interesting to note, for instance, that emigration took its heaviest toll in the counties from Forfar to Inverness, where the single men were always able to command wages rather higher than the average secured by farm workers in Scotland. The fact that they were better paid made it easier for them to face the cost of emigration, and to begin life in the colonies with some little reserve of money.

Too much weight is also given to the effect of housing conditions in increasing rural depopulation. It is difficult to arrive at any estimate as to the extent of the actual shortage of houses for agricultural workers in Scotland. If the cottages on farms were occupied by farm workers only, there would be a considerable

surplus of cottages, taking Scotland as a whole. As it is, farm cottages are to be found, not worse in character than many of those at present occupied, for which the farmers have failed to find workmen, or which are not required by the farmers for housing workmen. This is a significant fact at a time when houses of any standard are at a premium. In the north-eastern counties, where large numbers of single men are employed, housed in bothies or boarded by the farmers and lodged in "chaumers," there has always been a demand by the farmers for more cottages, but the workmen allege that the farmers are anxious for more cottages because married men can be got for lower wages than single men. At the Whitsunday term, in spite of the difficulty of workmen getting houses away from the farms, the demand for married men was greater than the supply, and it is difficult to see how an increase in the number of cottages would enable agriculture to retain more workmen. If the matter is considered from the point of view of the condition of the houses actually available, a much stronger case can be made out for the effect of better housing in resisting rural depopulation, but it has to be remembered that the married workmen who have left agriculture to go into towns have not been attracted by the better housing conditions. They have had to go into houses no better in character than the ones they have left, with the added disadvantage of the congestion prevailing in the towns.

Agriculture will have to pay better wages, work shorter hours and provide better housing conditions. So long as agriculture compares so unfavourably with other industries in this respect, it will fail to attract the more vigorous and spirited workers, but these things in themselves will not make rural life more attractive unless the worker has a reasonable opportunity of securing a fuller living, with the better wages he earns, and of employing the greater leisure he secures in more interesting ways than are open to him at present. We hear a great deal about the monotony of farm work and the dulness of rural life. I do not find the workers complain of the monotony of the work. They complain of the unduly long hours, but they are interested in their work, and much keener on their craft than other classes of workers are. Rural life is not dull for those classes who live in the country, and who are able to provide their own social life and to take a part in the affairs of the community. It is because the workers have no social life and are excluded from any part in the life of the community that they find their lives dull and uninteresting. In Scotland this is much more the case than in England, owing to the workers being so thinly scattered, the lack of villages or common centres and the longer hours of labour rendering intercourse difficult. An even more disintegrating effect, however, is created by the continual migration which goes on amongst farm workers in Scotland, and until something is done to produce a more settled rural population in Scotland, it will be difficult to create any rural social life, or to develop a society in which they will feel they have a place. The upheaval which takes place once or twice a year all over Scotland, as the succeeding terms come round, makes it difficult to secure any continuity in the efforts to create a more interesting social life

for the workers. This problem is peculiar to Scotland, and I am convinced it is the most potent cause of rural depopulation.

Discuss this matter with any dozen farmers picked at random in any hiring fair, and you will find at least ten out of the dozen who are quite sure that things are steadily growing worse in this respect, and that the farm servants will never settle in a place. But if we go back to the New Statistical Account of Scotland which was prepared round the years from 1836 to 1842, we shall find the same complaint being made, and in pretty much the same terms as the farmers make it to-day. Read the reports of the Assistant Commissioners appointed by the Royal Commission upon the Employment of Children, Young Persons and Women in Agriculture in 1867, and the same complaints will be found, while the Assistant Commissioners appointed by the Royal Commission on Labour 1892/3 have the same tale to tell. The fact is that the farm servants in Scotland have always changed employers far more frequently than other workers. The system of hiring fairs, so universal in agriculture in Scotland, has often been blamed for the excessive migration, and many attempts have been made during the past hundred years to abolish the hiring fairs in the hope that a more settled population would result. All these attempts have failed, because they have been dealing with an effect instead of the cause. Hiring fairs are dependent upon the long engagement. When all engagements in a district have to be entered into and terminated at one time, some method of bringing together the employers in search of workmen, and the workmen in search of situations, at a convenient centre is necessary. They are simply the periodical labour markets, and until the employers and workers can agree on some other method of arriving at the market value of labour, they will continue to be necessary. A beginning has been made in this direction in about half the counties in Scotland, where conferences have been held between representatives of the parties and recommendations issued as to the rate of wages. This enables individual employers and workmen to make engagements on the basis of the recommendations agreed upon, and so lessens the necessity for the hiring fairs and tends to limit the amount of changing at the terms. The system of long engagements has the effect of raising throughout the whole district at the same time the question between every employer and his workmen whether or not engagements will be renewed. If any alterations are to take place in wages or working conditions, these have to be settled at these times and at these times only. The long engagement, by the mere fact that it raises periodically the question of whether or not the employer and workman are to continue together, of itself tends to unsettlement. In this connection it is interesting to compare conditions in the Midlands and South of England, where engagements are for a week or month, and where the rural population is a much more settled population, and employers and workmen remain much longer together than is usual in Scotland.

Most changes take place, however, because of the inability of the parties to come to terms as to wages. Where no arrangement exists for settling wages by collective bargaining, both employers and workers are at a loss as to the terms upon which engagements

should be made. The employer naturally does not wish to pay more for his labour than his neighbours are doing; the workman, on the other hand, as naturally does not wish to hire at wages below those which his fellows of about the same competence may receive, but both parties are quite in the dark as to what the rates are to be until the hiring fair is held. To get round this difficulty many farmers make the offer to the workmen to renew the engagement and to leave the terms to be adjusted after the hiring fair, on the promise that the workmen will get "the run of the market"; but experience has taught the workmen that this is not a satisfactory way of making a bargain, and that it is an exceedingly difficult thing to find out what is the run of the market, and many disputes arise on that very point. Besides, the workman who has any spirit and self-respect wants to make his bargain for himself, and not to depend upon the other workmen for making his terms for him. The result is that engagements are not renewed; both parties go to the hiring fair, and a good deal of shifting takes place that is quite unnecessary, and employer and workmen part when it would be better for both if they continued together.

It may be said that there is no necessary connection between the long engagement and the excessive migration which takes place amongst farm workers in Scotland. It is often very difficult to find the reasons why engagements are terminated. A farmer may be finding a workman not quite satisfactory, and when the term comes round he decides to make a change, without any certainty that he will fare any better with the next workman he engages A man feels that he is not getting on very well in his present situation, and so he decides to have a change at the term. The fact that there will be men looking for situations and farmers looking for workmen influences both to see what the market will give them It is very much a lottery on both sides, but as it may mean that employer and workman who are not very well suited must renew for a definite period of six months or a year, they are all the more inclined to risk the chances of the market. It is surprising the number of changes which take place at the term for which there are few sound reasons to be given on either side. From the point of view of the industry in its narrower aspect, the long engagement is a bad system. The workers come to think of their employment, at any particular farm, as service for a definite term of six months or a year. They know that at the end of that time the engagement will be renewed only if they can make satisfactory terms. If their engagements were as indefinite as those of other workers, they would not be so liable to look to the termination of the engagement; the question of their continuance in the employment would not be periodically raised, and the tendency would be for them to continue longer in their situations, just as in other industries.

When a farm worker in Scotland changes his employer he removes his home. All farm cottages in Scotland are "tied houses." The workman receives his house as part of his wages, and must remove from it when the engagement terminates, so that a change of employment means much more than a change of employer. It affects the workman and his family, and owing to

the frequency of such changes it is difficult for the workers to create any ties binding them to any district or to any community. They never get their roots down in any district; their houses are not homes to them, but merely temporary dwellings; the ties they make do not bind them. It is a matter of indifference to them where they may happen to move to, and so it becomes easy for them to move away from farm work altogether.

The effect of these frequent changes on the families of the workers has also to be considered. Any country schoolmaster will tell of the educational loss which the constant removals entail upon the children. In the districts where the changes take place at Martinmas the effect is particularly bad, as the changes occur in the middle of the school session. The young people become quite accustomed to these changes of residence, and grow up without any attachment to any locality. When their time comes to go out to work, if they live in the counties where the young people go from their homes to stay in bothies or to be boarded by the farmers, they are too early away from home influences, and the migratory habit becomes accentuated in their cases. In those counties in Scotland where it is the custom for the families to engage to one employer on a joint contract, changes have often to be made to secure employment for all the family together on one farm A lad is growing up who wants to get a pair for himself, or the daughters may be ready for employment, but no openings are available on the farm on which the father is engaged. It is very rarely that one hears of young men or women living at home with their parents and employed on farms other than those on which their parents are employed. The burden of frequent removals is very heavy on the housewives. They are always labouring to make a home of each temporary resting place. The engagements are usually made by the husband, and in most cases without any real knowledge as to the class of house he is to receive. The houses themselves suffer because of the frequent changes of occupiers, and because the tenure is usually so short. It is unreasonable to expect that they will give the same attention to maintaining the house in good condition, or give the little care so necessary to prevent minor defects from developing. The result is that at each removal the housewife is faced with the task of making the house habitable. She may spend a good deal of work in bringing the house to her mind, only to find at the end of a year that she has to strip it again and move off to some other house, where the same labour has to be undertaken A few such changes, and it is natural that the women should be discouraged, and be less and less inclined to expend either their money or work in making the best of the house, which may be in her care only for a short period. It is difficult to maintain pride in a house under such conditions, and so one of the most important ties one may have has little effect on the wives of the Scottish farm workers.

The long engagement and the tied house are linked together and react one on the other, and in my view have more to do with the unsettlement of the Scots farm worker than any other cause. If the worker had more security of tenure in his house and was not required to move his home every time he changed his employ-

ment, we should have a more settled population. Where the worker knew that he would be able to retain the occupancy of his house, it would become more of a home to him and to his wife and family. If he had a small bit of land (and it ought not to exceed half an acre), where he could erect his own pigsty, could keep hens and could grow vegetables, and, if he had the taste, do some gardening, that would go a considerable way to induce him to remain in that house. His wife too would be able to create a home in which she could take some pride. The family could be kept together, and could seek employment in different ways or at different farms. It would not be necessary for them to go out to the bothies or to the "chaumers," nor would it be necessary for the whole home to be moved when the younger members of the family came to the age when employment had to be found for them. Settled in a district in this way, the members of the family would be able to take their part in all local activities, and would feel themselves to be members of a definite community and not merely sojourners in a district, as they are at present

The objection usually taken to this method of housing farm workers in Scotland is that it is not possible to fit this system into the organisation of the Scottish farm. It is contended that the Scottish farms can be conducted only by having the workers resident on the farm in close proximity to the steading, because of the fact that practically all of the workers have either horses or stock to tend If we had to contemplate the continuance of the present hours of labour on Scottish farms, there would be considerable force in this objection When workmen have to be in the stable every morning at five o'clock and are not clear at night until after six o'clock, it is necessary they should live pretty close to the steading If we are to consider the conditions necessary to retain workers in agriculture on the basis of the present long hours, it is not worth while considering the effect of any housing scheme No housing scheme will be required, because the workers will simply not remain. It is absurd to expect that workmen in agriculture will go on with the long hours ranging from 60 to 70 a week, while other workers are securing a working week of 48 hours or even less. The shortening of the hours will largely remove the necessity for the tied-house system. It will always be necessary to have one or two houses on the farm for those in charge of stock, but it is not necessary that all the ploughmen and other workers should live on the farm. It is a simple matter to have the houses at convenient centres for serving several farms The workers will not object to living a little way from their work if they have the great advantage of having a more permanent home and more opportunity for keeping the family together.

Another objection taken is that the farmer cannot be certain of getting the necessary labour unless he has control over the houses in which the workers live. Such fears are the result of superficial thinking on the basis of the existing conditions. The farmer has always been accustomed to hire workers for whom he provides a house. If it is suggested that the workmen should have security of tenure, he thinks of the houses in existence to-day, and imagines what would happen if a workman left his service but refused to leave

the house, and there was no other house to which to bring the succeeding workman. He imagines the same thing would happen under the system suggested of housing workmen at convenient centres; but under the system I suggest, the workmen who left his service would have to find employment elsewhere in the district or move out of the district. Unless the demand for labour was much greater than the supply he would normally displace some other worker who would be available for the farmer's service. The change round might go through a good many more stages, but the effect would be the same unless the demand exceeded the supply; but if the demand exceeded the supply, the farmer would be in no better position even if the houses were tied houses. If, as I believe, this system produced a more settled population and tended to maintain the supply of workers, the farmer would be in a better position than he is at present to secure the necessary labour. It is true the workers would be more independent because of the fact that the farmers were not able to control the houses, but this greater independence is a necessary condition of the industry attracting the best type of men. It is because the workmen in agriculture have less freedom in their homes than other workmen that many of them prefer to leave the industry altogether. The farm worker in agriculture has a right to more freedom and independence than he has at present, and on broad human grounds is entitled to have a home of his own, and not to be under conditions which are a relic of serfdom and quite out of keeping with modern ideas. In any case the farmers will have to face some such system of housing as I indicate. Everyone is agreed that we must have more and better houses for farm workers. It is admitted that the landlords who have provided the houses in the past will no longer do so. A large number of the houses occupied to-day would not be occupied if the Housing Acts were strictly enforced, and we are likely to find much more pressure being put on the local authorities to secure enforcement of these Acts. The resulting shortage will have to be made good, and Parliament has rightly refused to assist in the building of tied houses from public funds. Under the new Housing Act the local authorities have power to build houses, but they cannot build tied houses. Unless, therefore, we are prepared to face a much more acute housing problem than we are faced with to-day, the only remedy will be the building of houses on the lines here suggested, and the sooner those interested in agriculture adjust themselves to the altered conditions, the better it will be for the industry.

There is another reason why the system of engagements and the housing conditions of farm workers should be remodelled to meet the altered circumstances. The new Education Act, with the system of continued education until 18 years of age, will in itself entail serious modification of the present methods of working Scottish farms. A considerable part of the labour on Scottish farms is done by young people under the age of 18 years. If the present method of engagement continues unaltered, there may be considerable difficulty in adjusting the industry to meet the requirements of the Education Act. The amount of opposition to the Act from the farmers is clear evidence of this. Fortunately for the industry, that opposition did not result in the exclusion of

agricultural workers from the benefits of the Act. It would have been a bad day for Scottish agriculture if the legislature had gone on the assumption that a less educated class of worker was required for agriculture than for other industries. Agriculture requires as well-trained brains as any other industry. If, however, the present unsettlement is to continue, and the younger workers are to move as frequently as they do at present in many of the counties, they are not likely to reap the same advantages from the education provided as they would otherwise do. If there were more real mobility in labour, as there would be under a shorter engagement, and less migration as I believe there would be, much better provision could be made to meet the educational needs of the young people, while it would be easier for the industry to adjust itself to the demands of the Education Authority if the rigidity of the long engagements were abolished. It would be possible too, with a more settled community, to develop the educational facilities and to make the school a centre of real social life and communal activity, and thus to do much to create a keener interest and a more interesting social life in the rural districts.

It has appeared to me to be necessary to lay special stress on the need for securing a more settled rural population because I feel that the excessive migration has more to do with rural depopulation in Scotland than any other single factor. A certain amount of changing of situations will always go on, and is in itself desirable so that the workers, particularly in the earlier years of their working life, may gain experience of different methods of farming, and may have the opportunity of learning their craft, but such changes ought not to mean the frequent changes of home which we have at present. It is only as we secure a more settled population that we shall be able to create a healthy rural society of which the workers will feel they are a part Happily, we hear less to-day of the foolish talk about brightening country life. The well-meaning people who used to talk in this way, perhaps quite unconsciously, treated the rural worker as a kind of neglected child for whom something required to be done. They usually suggested clubs, which merely bored the workers, or suggested village institutes, which the workers quite properly avoided. Other proposals were to provide travelling picture shows and so on. None of these schemes could have any real vitality, because they were not a natural growth from the people themselves. Nor will country life be brightened by bringing out certain of the city amusements for the entertainment of the rural worker. Given the necessary leisure, I am quite certain that the rural workers themselves will create their own interests. There is no lack of capacity amongst them—there is simply wanting the opportunities and the conditions for its employment. If an opportunity is taken in the reconstruction of our educational system with which we are faced, to make the school the social centre of the parish, and to provide meeting places for the adults as well as class rooms for the younger people, it will not be a difficult matter for various activities to be stimulated. The Women's Institutes have shown what can be done in the difficult work of bringing the women together and interesting them in

collective activities. A great deal could be done under the continuation class system to encourage the young people to develop their own societies in various directions. These things require only a beginning.

Rural people are becoming more accustomed in recent years to take their part in the various organisations. Co-operative societies are making headway, and trade organisations, on the part of both farmers and workmen, are covering the whole country. As the people become more accustomed to associated effort and to managing their own affairs, they will find outlet in various directions, and the development o social life will be a natural result of their association in other directions. These things all combine to create a greater interest in the community. As the workers begin to find there are other outlets for their activities, they will create more ties binding them to the country and to their particular communities, and in that way the towns will prove less attractive, and they will find in their own districts the interests they have been accustomed to associate with town life only.

WOODLANDS AND WOODLAND INDUSTRIES IN RELATION TO SMALL HOLDINGS.

JOHN SUTHERLAND.

PART II.

THE utilisation of forest products has been treated in the first part of this article only in respect of pitwood, the possibilities of which were forecasted as a source of employment. But this forest crop does not require the skill of the craftsman, nor is it cumulative in its operation on industry in the same way as other classes of wood which are used for building and other purposes.

Coppice Woods and their Products.—It is estimated that in Scotland there are about 220,000 acres of coppice woods. These woods have, as a rule, received but small attention. They grow in fairly large areas; some are quite good, but in many cases they are badly grown, wind-blown and gnarled or aged. The trees at present neither justify their own existence nor improve the soil from which they derive such vigour as they possess. The woods form a shelter for deer and for sheep and cattle in winter, but the grazing value of them is not of much consequence With scientific treatment and a small expenditure in labour the best coppice woods might be converted into small forests of really useful timber. The native birch may not be the most profitable crop in many localities, and in time it may be superseded by softwoods or other species, but for the present it should be managed and utilised to yield the best results. Birch was so freely imported into Britain prior to the war that the demand for the home wood was very small. Until the middle of last century there was a great and prosperous trade in native birch for fish staves and packing wood. This trade brought money and employment into the

Highlands, and the loss of it was a serious matter for the people. The foreign imports from America and from Sweden were well graded, cut exactly to trade dimensions and readily marketed. The wood of our home birch is in some ways preferable to foreign birch; it is more durable, but in order that it may gain a footing on the market it must be fashioned to suit the trade. Several thread and flax manufacturers have given the assurance that they would prefer to use home birch for bobbins, especially for spools of the larger type used in the factories, and they are, we believe, prepared to favour the local producer of the finished article or to buy the round logs and manufacture it themselves. It seems quite obvious that there is an immediate industrial possibility in the crop of these 220,000 acres, and the development of it should be comparatively easy if commercial enterprise were applied before the importer resumed his trade with this country.

The demand for bobbins is very large, and it is a steady one. From 1914 until the present time the thread and flax manufacturers have bought birch trees extensively, and they have installed plant at many centres for the sawing and manufacture of the wood into bobbins and spools. This arrangement benefits the rural worker only to the extent that he is employed to fell and load the trees on rail. The development which should be encouraged is the introduction of small and, in some cases, of large plants into country districts where the wood grows and the people live. A small 8 to 10 horse power turbine with a rack saw mill, two small benches, a blocking lathe and end boring machine, costing about £800 to £1000, will employ seven or eight people steadily throughout the year, and it will absorb about 30 tons of birch per week. A steam plant will, at present prices, be more expensive, involving an outlay of £1500, and therefore wherever water power is available it should be used. The average standing crop in fair coppice woods at present is between 4 and 5 tons per acre, and every small mill of this kind, on a basis of clear felling of mature wood, would effect the clearing of 350 acres per annum. In most of the districts in which the coppice lies there is water power, and there is usually a population only partially engaged in agriculture, and without any other wage earning possibilities at hand. The combination of wood manufacture with agriculture would have the advantages of independent labour and enterprise locally — the plant might be owned either by one person or by several in shares. The manufacture could be carried on during the wet season under shelter and not confined to short hours in winter, because the water power would drive a small battery for lighting. In the same manner, but with different plant, an extensive industry in brush handles and heads and other turned articles is open, and only requires an enterprising start. In this case 20 h.p. would be a useful unit, and the plant would comprise two saw benches, two lathes and a boring machine. The cost of this plant will vary, according to size, between £850 and £2000. In a small mill six or seven people would be engaged constantly. Birch is used for all classes of tools, and their manufacture is possible with much the same plant as for brush making.

There is likewise a constant demand for birch brooms for the

steel works. The twigs are used in the rolling mills for cleaning scale from the plates when they pass through the rollers. The brooms are consumed by the heat of the plates, and in burning remove the scale and leave the plates clean. For years various substitutes have been tried, but nothing has proved so efficacious as the birch branches. This industry is capable of material improvement, and could be undertaken with greater facility if the manufacture of the round wood otherwise became more general throughout the Highlands and Lowlands. These brooms are easily made, and where the supplies are found at present the workers earn substantial sums. But the trade is in the hands of a few contractors, who have developed a specialized organisation to deal with this product, and as the birch woods are usually situated in isolated places, there is little chance for the small producer until the subject is dealt with by co-operative methods.

Birch chips and small cuts have a ready sale to the fish-curer. This is a steady trade, not only for birch, but for practically all hardwood waste.

Birch is the principal crop of the coppice woods, but the other species found in them—oak, ash, elm and beech—can be used for bobbins and for turnery purposes generally. It has been found during recent years that only prejudice or custom, or both, have prescribed objection of certain woods for specific purposes.

A large and remunerative source of revenue from poor coppice woods, and for that matter from all the refuse of timber exploitations, might be the distillation of the crude form of acetic acid and tar and charcoal. The use of wood for these purposes in large centres is not so profitable as when undertaken in the immediate vicinity of the woods, for the timber used is bulky and heavy, and the carriage to railhead and from thence to the factory is a considerable oncost. On the other hand, a small moveable plant, costing about £600, can be procured, which will yield, it is said, if properly managed, a profit of about £1 per week after paying labour, depreciation and all other proper charges of the venture. Prior to the war, importation of these products was so extensive, and the price so moderate, that the production of them on a small scale was unprofitable; but during the first half of the eighteenth century the distillation was undertaken in many districts in Scotland. It is maintained that even now the prospect of re-introducing the industry is not great; but there is much in favour of it if the subject is taken up thoroughly and on commercial principles.

Birch is, of course, used for furniture, but this class of manufacture will probably be better undertaken away from the woods.

It is not improbable that the position of the coal supply will direct attention to wood for fuel to an extent hitherto unknown in Britain. Practically no importance was attached to fuel wood as an industry in the past. In areas cleared by the timber merchant the lop and top and off-cuts were usually burnt, and the clearing up of the exploitation was a duty unwillingly undertaken by the merchant. To-day 9-inch fire blocks sell in towns readily at £2 per ton. Attention to this trade might well be given now wherever the timber merchant is felling. At the price quoted, and at even less, there is a good margin of profit for the workman,

and there are great possibilities in the preparation of small wood for kindling purposes. Such wood is quite an important trade in continental countries. The wood is prepared, stacked and properly dried during summer, so that when the winter sets in it is ready for firing. The small twigs are bound up and sold for lighting in bundles along with the fire blocks, and serve the purpose just as well as the split sticks with resined ends so extensively marketed at home. That there is work for the people in this branch of wood industry is now recognised, but it will have to be developed on sound lines by individual enterprise.

Birch, with other coppice species, is specially mentioned in this paper because it is ready to hand. It can be exploited without injury to other interests; it can be cleared away entirely and its place taken by a new and better crop, such as spruce, or it may be retained and its cultivation gradually extended in localities where it thrives best and provides a manufacturing requirement near at hand.

An enquiry specially conducted recently into some of the birch woods in Scotland covered an area of about 60,000 acres. The past and existing uses of the wood, and the share which it occupies in trade, suggest that if an area of this extent is utilised now, it would, over a period of ten years, engage 12,000 men and women in the cutting, felling and delivery of it, and when passed to the mill or factory it would provide employment for 18,000 people otherwise for ten years or longer.

Dolls made of wood were used by the ancient Egyptians, and wooden tops were spun in England seven hundred years ago. Such toys, and the Noah's ark with its quaint stock of birds and beasts, dolls' houses, skipping ropes, small carts and all sorts of playthings can be made at home; with good promise of a market the development of such a home industry should be helpful to many communities. The wood for toys is not limited to any particular species; the quantity required would not be great, and there is no reason why we should leave this industry to Switzerland and other countries without an effort to compete at home.

The willow is a quick growing crop, as easily cultivated as any market produce of the garden. It is required in abundance by all kinds of trades for crating and packing. We became dependent upon Holland for the baskets for our yeast and for the hampers for our earthenware. Prior to 1914 about a quarter of a million pounds sterling was annually paid for baskets and basket ware received from abroad, and it would not be unduly optimistic to expect that in from five to ten years we might produce the willows to take the place of these importations if the cultivation were taken up properly without delay.

The possibilities of employment in wood industries are perhaps best illustrated by some pre-war records from other countries. For example, in France about 47,000 workers were engaged in cooperage, 52,000 in clog-making, 82,000 in wheelwrights' work, while the other wood industries employed 280,000 men. In Russia about 9000 peasants made spoons and ladles alone. In the United States in 1909 there were 48,533 wood factories with 907,514

employees. From a calculation based upon Board of Trade Returns of manufactured wood imported into Britain in 1913 it appears that during that year 95,000 to 100,000 workmen were engaged in other countries preparing this wood solely for our use.

Industries in wood are too numerous to list; they comprise construction of all kinds, fittings for buildings, fences, gates, furniture, boat building, box and implement making, matches, penholders, frames, rollers, and many more. Every trade has had to depend upon foreign timber, and many trades have been lost because in other countries, where the wood was grown, the timber was manufactured and doors and windows, beds, rolling plant, furniture, tool handles, oars and innumerable articles were sent to this country ready for use.

But the principal object of this paper has been to suggest immediate concentration upon those openings in rural industry which seem possible at the moment, when every effort should be made to utilise all our existing resources. The interests concerned are diversified, but they can be brought together by sympathetic and sensible treatment. In the first place the centres for operation should be selected, and in this selection the quantity of timber available for manufacture and the number of people resident and willing to co-operate should be the principal factors. Due regard should be given to the utilisation of water power wherever obtainable, for this power ought to be taken in preference to steam. The "operating" area of timber should be large enough to assure the promoters that any plant installed will be supplied from it for at least ten years, and the facilities for transport must be such that the product will pass to the market with regularity and at reasonable freights. The enormous improvement in motor traction during recent years has opened a possible connection with all railways and ports over the public roads, and it is expected that where any industry of sufficient stability, offering steady traffic, is established, the motor lorry will quickly be found to provide the necessary link with the railway or seaport. It may be maintained that the manufacture of wood on a large scale would be more economical at a few large centres; but this would have the disadvantage of drawing the people away from their country homes, or of leaving them without any steady occupation apart from agriculture. On the other hand the timber can best be worked in or near the wood in which it is grown. There is then but small haulage over road of the heavy round timber, and the burden of traffic over main lines will be lessened, because only the manufactured products will be carried by rail.

NOSEMA APIS IN HIVE BEES.[1]

JOHN RENNIE, D.Sc., University of Aberdeen, and
ELSIE J. HARVEY, *Research Assistant.*

WHILST there are numerous records of disease amongst adult bees, only a very few references exist in which the disease has been shown to be definitely associated with a causal organism. Donhoff

[1] This article was received by the Board on 2nd June 1919.

and Leuckhart (3) in a paper published in 1857 described a disease associated with an affection of the chyle stomach, which they showed to be infectious by feeding healthy colonies with syrup contaminated with the macerated stomachs of diseased individuals. They found in the chyle stomach numerous oval corpuscles which they regarded as the spores of a fungus. In the following year Higgins (5), in England, described the loss of a stock of bees associated with the presence of minute oval spore-like bodies in the dead bees. In both of these cases the spores were probably those of *Nosema apis*. In 1912 Graham-Smith, Fantham, Porter and Bullamore (4) in examining bees from the Isle of Wight claimed that a minute protozoan parasite found in the alimentary canal, and previously observed by Fantham and Porter in 1906, was the cause of the condition popularly known as Isle-of-Wight disease. Incidentally it may be mentioned that for reasons in part already given (Anderson and Rennie, 1) and (Rennie and Harvey, 7), and also from evidence here submitted, we dissent from this view. In 1907, Zander (9) described a disease of adult bees in Bavaria with which he associated as a causal agent the protozoan referred to, discovering it independently and naming it *Nosema apis*. In 1909 (10) he published an account of the main facts in the life cycle of this parasite. In 1912 Fantham and Porter (4) also described the development and life history of the same organism. So far as we know, this is the only organism as yet identified in association with disease in adult bees.

The parasite *Nosema apis* has a wide geographical distribution. It is well known in the British Isles. It occurs in Germany, where, according to White (8), "it has been encountered by a number of investigators"; it is known in Switzerland, and we have on a large number of occasions obtained it in bees forwarded from Italy. In these last cases it has never been associated with epizootic disease. In Victoria, Australia, it is well known, and it has there been the subject of extensive study (Beuhne, 2). White, in the paper already referred to, has found it "in samples of bees received from twenty-seven different states in the U.S.A., and in two samples of adult bees from Canada."

M'Cray and White, 1918 (6), report with reference to United States that "the disease weakens and even kills colonies. . . . The exact losses from it are not known, but in America they are less than has been attributed to it in some other countries."

Considerable doubt has hitherto existed as to what degree, and under what conditions, *Nosema apis* is pathogenic in bee colonies. In the accounts of the occurrence of *Nosema* given by Zander, he associates as a common feature the presence of dysentery in the affected bees accompanied by a high mortality. The bees die in large numbers within the hive, and also in many cases they leave the hive, dying outside. He attributes the condition known as "May sickness" to *Nosema apis*, but claims also that there may be a mortality from its presence at any time of the year. In April and May it is mainly young bees which are affected.

White, in the communication quoted, mentions that in spring especially "many weak colonies show upon examination a high percentage of *Nosema* infected bees. Quite often indeed in the

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Agriculturists will be well advised to carefully read the article entitled "The Temporary Ley," by Mr. R. G. Stapledon, in the February issue of the "Journal of the Board of Agriculture' (England), which contains much valuable information on a most important subject to the farmer

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examinations that have been made of such colonies, 50 to 90 per cent. of the bees in samples taken from them were found to be infected with the parasite. It is an interesting and important fact that a very large number of colonies which are strong and apparently doing well are found upon examination to contain at least a small percentage of *Nosema* infected bees." Anderson and Rennie (1) "found it to be present over prolonged periods in healthy stocks," and we have in recent years amply confirmed the observations upon which this conclusion was based.

Beuhne, 1916 (2) records a series of important experiments with stocks harbouring *Nosema*, the result of which showed that in Victoria, Australia, the parasite had not the virulent character described by Zander. *Nosema apis* in Australia is described as comparatively harmless during normal seasons. It was found to be present in almost every apiary in Victoria, and even wild bees in trees were affected.

With a view to obtaining further light upon the conditions under which *Nosema apis* is pathogenic to hive bees, to what extent and under what conditions the parasite is distributed, we have during a series of years made many systematic observations and experiments.[1] Typical examples of these are here recorded.

The Course of Nosema Infection in Observed Cases.

No. 1. **History of a Stock Artificially Infected with Nosema apis.**—On 4th May 1917, a stock of Dutch bees (No. 31)[2] was placed in a new hive upon a site not previously occupied by bees. This stock covered five frames, and there was a good supply of brood. Five additional new frames with new foundation were placed in the hive. On the same day thirty-two bees were caged and fed on candy contaminated with fresh *Nosema* spores. Two of these bees were examined on the 8th, and ingested spores were found in their chyle stomachs.

On the 7th forty-six bees were taken from the stock and their alimentary canals pulped. Six smears were examined with the object of determining the presence or absence of *Nosema* in the stock The result of the search was negative.

On the 9th the *Nosema* infected lot numbering thirty bees was placed on the frames of the main stock in an open cage.

During May the stock continued normally, and on the 1st of June it covered six frames, and again on this date bees fed on candy contaminated with *Nosema* were introduced. At this time the stock was doing very well, and on the 14th it was found covering ten frames full.

At this date several queen cells were seen and destroyed; three frames brood and bees were removed for other experiments, and two frames foundation placed in the brood nest. Again on the 29th queen cells were found and destroyed. The bees, notwithstanding the loss of those removed a fortnight previously, were covering 9½ frames with brood in all stages on 8½ frames.

[1] These researches are being conducted with the aid of grants provided by the Development Commissioners through the Board of Agriculture for Scotland.

[2] The numbers are apiary references only.

Examination of bees taken at the end of June showed that a Nosema infection was established in the stock. On the 4th July the stock swarmed.[1] On the 6th all the frames were gone over; fifteen queen cells were found and of these thirteen were destroyed. On the 25th a queen was seen upon the frames and the bees active, strong, well, and drawing out foundation. During August the weather was very wet, but the strength was well maintained, and at the beginning of September the bees covered nine frames.

On the assumption that the *Nosema* infection had largely been shed in swarming a third infection was made.

On the 22nd September, and again on 2nd October, *Nosema* spores were freely mixed with candy upon slides, and these were placed within the entrance of the hive and upon the top of the frames. The weather at this time was good and the bees were active. During the whole period the stock has been under observation there has been no dysentery and no other signs of disease have been observed.

On the 22nd October bees were taken at random off the frames and were examined for the presence of *Nosema*. The following are the results.—Six proved negative, one showed infection with intracellular stages, and spores were found in three, two of which were heavily infected.

On the 29th October three flying bees were taken from this stock at the entrance; all contained spores, and one meronts also, of *Nosema*. Four dead bees found in front of the hive all contained spores.

On the 3rd November two live bees were taken and spores found in both. The stock appeared reduced in numbers, but there were no signs of dysentery or other trouble. Nor have there been indications of Isle-of-Wight disease, such as crawling in front of hive, clustering, or climbing on grasses, etc.

On the 23rd of this month spores of *Nosema* were again found in bees taken for examination. During the previous weeks the stock had been well supplied with pure unmedicated candy and packed up for winter.

On the 23rd January 1918 the stock was looked at, and three live bees were taken and examined. No stage of *Nosema* could be found, and it was concluded that these were free from infection with this parasite.

During the winter the mortality was fairly high.

In the beginning of February the stock was found to be covering about five frames and to have plenty stores. Good progress was made in spring, and at the end of May it had a strength of ten frames, with brood on nine.

During June the strength was maintained and the bees were storing in a super. As there were signs of preparations for swarming the stock was divided, and a nucleus of four frames with the queen was made on the 18th of this month. The original stock now consisted of seven frames of bees with three sealed queen cells and plenty stores.

On 6th July the stock swarmed, and the swarm was returned

[1] Unfortunately this swarm was lost.

after the removal of two virgin queens and two queen cells. On the following day the queen was seen upon the frames.

During August and September the stock carried on normally, and at the end of the month there were eight frames of bees, including two of sealed brood. There were abundant stores for winter, and a small surplus (2 sections) had also been yielded.

During this second year bees from the stock were regularly taken and examined with the results shown in the accompanying table.

The following are the results of examinations made from January 1918 onward:—

23 1.18.	3 bees examined.	No stage of the parasite found.
5.2.18.	20 „ „	A very few spores seen.
22.2 18.	11 „ „	Eight contained the parasite
13 3 18.	9 „ „	All contained spores.
8 4 18.	11 „ „	No stage of the parasite found.
22.4 18.	12 „ „	Three contained spores.
10.5 18.	9 „ „	Do.
21.5.18.	5 „ „	All contained spores.
10.6 18	5 „ „	No stage of the parasite found.
26.6 18.	9 „ „	Do.
12.7.18.	18 „ „ (Pulped · 6 smears examined).	Do.
28.8 18	13 bees examined.	Do.
18 9 18.	58 „ „ (2 examined separately, 10 teased collectively, 4 examinations, 46 „ „ 4 „).	No stage of the parasite found.

On various occasions larvæ and pupæ were examined for *Nosema*, but we were never able to observe any traces of it in these stages of the bee.

Summary.—Reviewing the foregoing record we note that the stock in the course of two seasons yielded two nuclei and one natural swarm (the second natural swarm was returned). It maintained itself and yielded a small surplus of stores. The stock being an experimental one of necessity was subject to a considerable amount of interference, and further was infected with the parasite *Nosema apis*.

With regard to *Nosema*, it is to be noted that in the first year the infection was noticeably heavy, yet during the breeding season the strength of the stock was not affected sufficiently to prevent natural swarming or wintering in normal numbers. While certain of the bees undoubtedly died under heavy infection with the parasite others were found in full working activity, also heavily infected. In the second year, although the parasite survived in the stock over winter, it was never found in very large numbers; eventually its presence could not be demonstrated after the middle of June, and we are forced to conclude that if the *Nosema* infection has not effectually died out it has fallen to a low, and for the time being at least, non-significant, level. As already indicated no signs of disease, *e.g.* dysentery, crawling, etc, have been associated with the stock during the course of the experiment, and it is doubtful whether the presence of *Nosema* has proved an adverse feature of much practical importance in this instance. In June 1919 the stock was of full strength and appeared to be prospering well.

No. 2. **History of a Stock Naturally Infected.**—A small stock

of bees (No. 32) covering less than four frames was obtained in the end of March and placed in a new situation alongside a stock (No. 31) harbouring *Nosema apis*. Sample bees were taken and searched for *Nosema* at the date of deposition and the result was negative.

A month afterwards eleven bees were captured on the frames of this stock and examined individually; one bee was found to have *Nosema apis* in the spore stage. Three days later twelve more bees were taken, five of which were found to be infected with *Nosema apis*.

At the end of May the stock was covering ten frames and had a large amount of brood. *Nosema* was still present, and spores could be found in the dead bees in the front of the hive. Of five living bees taken, one was found to be infected. Unfortunately at this date the queen appears to have been injured. She was found dead outside the hive On examination she was proved free from *Nosema* infection. Queen cells were formed, but no queen was seen on frames up till end of June. On 5th July a frame with brood and queen cells was introduced from No. 31 (Dutch bees). A queen was hatched and was seen laying on 22nd July.

At the end of June a few bees were taken for examination and *Nosema* was not found.

On 6th July five bees were taken and these were also found to be free from *Nosema*. Meantime the stock swarmed.

During July and August the parent colony, which it may be noted was now headed by a queen bred in the adjacent *Nosema* infected stock, increased satisfactorily, and in the beginning of August covered nearly ten frames with abundance of stores Examinations for *Nosema* were made in August—two bees were tested separately and yielded a negative result, ten were pulped and six smears examined, again the result was negative.

On 18th September the strength of the stock consisted of about six frames of bees with brood upon one and a half, there were sufficient stores for wintering. Throughout the whole period of observation and experiment no signs of disease have ever been noted, and the infection with *Nosema* appears to have disappeared about the time of swarming.

Summary.—Infection with *Nosema* appears to have occurred naturally from an adjacent stock (No. 31, p. 513) within the period of one month, and to have been maintained for two months, subsequent to this date parasites were not found, and it should be noted that in the adjacent stock at this time the same feature occurred. The infection while present was not accompanied by dysentery or any other disease symptoms, and during its presence increase of the stock was maintained. The infection while it lasted could not be regarded as materially affecting the prosperity of the colony. The success of the stock was not absolute, since only a limited amount of surplus stores was obtained, but we cannot believe that the presence of *Nosema* was more than a minor cause of this; even in relatively unfavourable circumstances the parasite failed to spread within the stock.

No. 3. **Natural Infection of a Nucleus.**—In February 1918 a small one frame nucleus of bees was established with a view to

experiment. They were tested for the presence of *Nosema*, five bees being examined individually by microscopic search and eighteen by having their chyle stomachs pulped and searched. No trace of the parasite was observed.

Prior to any experimental use of this nucleus, the bees, during a short period in the middle of the day upon 22nd March, obtained access to a hive containing *Nosema* infected frames, left open temporarily by an attendant. The source of the infection was forthwith removed.

On 22nd April eight bees of the nucleus were examined, and all were found to be infected with *Nosema*. Again on 16th May five young bees were tested and three found infected. Again on 11th June seven dead bees from this stock were examined and *Nosema* was found in two. On 5th July three live bees were examined and no *Nosema* found.

Towards the end of May the queen was lost through the introduction of a small lot of bees intended to strengthen the nucleus. She was replaced by a queen surviving from an Isle-of-Wight diseased stock. Notwithstanding the presence of the parasite the nucleus continued to build up, so that in the beginning of August the bees were covering nine frames with brood upon seven. During the season, from March till August, whilst *Nosema* was being demonstrated in the stock, there never were any signs of dysentery nor of Isle-of-Wight disease. This small colony became the subject of another experiment in which there was no further history of *Nosema*.

No. 4. **Failure to infect by Means of Bees from Colonies previously harbouring Nosema Apis.**—On the 18th June a nucleus (No. 14) consisting of four frames of bees, including the queen, was taken from stock No. 31 and a frame of brood and stores from No. 32. These were placed in a newly disinfected and painted hive situated two miles distant. As already described, both parent stocks had a recent history of contamination with *Nosema apis*.

On 2nd July it was ascertained that there were three frames of fully sealed brood and bees covering six frames, but the queen was missing. A frame of brood with one sealed queen cell was introduced from No. 11, a colony with a disease-free history. On the 12th a queen was seen upon the frames, and on the 19th she had begun to lay. At this date fifteen bees were taken and examined for *Nosema*. No parasites were found.

On 2nd August two bees were examined and scattered spores of *Nosema* found in one. No developmental stages were seen.

In the beginning of September there were five frames of brood, mostly sealed. The bees were covering eight frames and there was a good supply of stores. When examined in December they were found clustered on 4½ frames.

It is to be noted that this stock, which originated in two others known immediately prior to its institution to harbour *Nosema apis*, has so far not developed recognisable infection with this parasite. This is in keeping with the concurrent history of the parent stocks, in which the parasite could not be found during the same period.

In this experiment an opportunity was afforded the parasite for development in bees of Dutch race and in ordinary British bees from two separate sources.

No. 5. **Nosema infected Bees with Queen having Isle-of-Wight Disease History.**—On 3rd July 1918 a nucleus (No. 13) consisting of about three frames of Italian bees from a stock known to be heavily infected with *Nosema apis* was given a 1917 queen, transferred from a stock definitely affected with Isle-of-Wight disease. The nucleus during the succeeding two months maintained itself only fairly. The strength attained at the beginning of August was about six frames of bees; during August this did not increase. It was kept under close observation until the beginning of September, during which period there were no signs of disease nor of any undue mortality in the neighbourhood of the hive. The queen was young, and her production was not equal to reasonable expectation. It is to be remembered that she survived from an Isle-of-Wight diseased stock.

Nosema apis was looked for on a number of occasions, and was found only upon one of these. So scarce did the parasite appear to be that it would not be safe to attribute the weakness of the stock to this cause alone.

Summary.—Although the original bees forming this nucleus were abstracted from a stock harbouring *Nosema*, this parasite was never found in significant numbers of the bees. There were two kinds of bees present, viz.—Italian and Blacks, during the period of observation, and neither appeared to be materially affected. Infection never spread beyond the casual stage during the three months of the experiment (to 1st October).

The stock was alive in January 1919. A large sample of bees was examined at this date and *Nosema* was not found.

No. 6. **Appearance of Nosema in an Isolated Stock.**—The following is a continuation of the history of the stock, whose initiation as an experiment is recorded in a previous paper. (*Proc. Roy. Phys. Soc*, 1916, p. 57.)

On the 20th February 1916 this stock was found reduced in numbers and short of food. There were signs of dysentery about the frames. Bees examined were found to be infected with *Nosema*. Instructions were given for close observations to be made on the stock.

During March the weather was cold, but the stock seemed to be doing fairly well and dysentery was not so marked.

On the 3rd April three boxes of bees from it were sent to Aberdeen. Nine bees were alive on arrival and were kept under a bell jar in a sunny position till the last bee died on the 11th. All the dead bees were examined and found to contain spores in great numbers. The living bees also were found to be infected, and one of those which flew upon release showed a complete infection of the chyle stomach, not a single healthy cell being visible. At the end of the month the stock was reduced to four frames of bees.

On the 7th of May the queen was found dead on the floor of

the hive. She was found heavily infected with *Nosema* spores. The stock was very weak in numbers, and samples examined showed an extremely heavy *Nosema* spore infection.

The chief points of note regarding this stock are these. The colony was isolated from all other hive bees; it was presumed to be free from *Nosema* when this took place, although we cannot be certain that this was the case. As already reported (*Op. cit.*, p. 52), it was fed with stores contaminated with Isle-of-Wight diseased bees, and there is no record at any period of its history of Isle-of-Wight disease symptoms. The colony died out three months after the infection with *Nosema* was detected, the bees at the end showing typical appearances in the intestine of heavy *Nosema* infection. Dysentery was also a feature in this case.

In view of the fact that loss of the queen, as we record later, is an occurrence liable to ensue on *Nosema* infection, it is worth recalling that twice during the history of this stock, viz., in the winter 1914-15 and in the summer of 1915, this stock became queenless. Examinations for *Nosema* were not being made during the period within which these queens were lost.

Further Experiences of Nosema.—In addition to the foregoing, we have on frequent occasions discovered the presence of *Nosema* in stocks of bees under circumstances which prevented us from making continuous studies of the stocks themselves. We have found, *e.g.*, that this parasite is probably more common amongst Italian bees, and further, our observations lead us to the view that such bees are largely tolerant of the parasite under ordinary conditions. In this connection there must be borne in mind the significance of such infected bees in Great Britain as nurseries and disseminators of *Nosema*.

The foregoing account of the course of *Nosema* infection in the main presents a picture of *Nosema apis* as a comparatively harmless associate of bees. This is not, however, invariably the case, as is shown in subsequent records, and our experience has suggested that much depends upon other factors of the environment. In a number of cases in which we kept bees in unfavourable conditions or in which the natural circumstances were adverse, *e.g.* as regards weather, we found that dysentery and a significantly high mortality were associated with the presence of *Nosema apis* in the bees. In particular we have over a series of years kept bees in single frame observation hives, and invariably during winter, when these bees were kept at a living room temperature by day and allowed to feed freely—the temperature falling naturally during the night,—dysentery developed, accompanied by a high mortality. In a number of such cases *Nosema* has been found in a high proportion of the bees. We have no experimental evidence in these cases as to how far the presence of *Nosema* in the unfavourable circumstances here recorded is responsible for the dysentery and rapid mortality, but on the other hand it has been clear to us that once dysentery was present in a *Nosema* infected stock, the numbers of actually infected bees were much greater than in those cases where *Nosema* was present, but dysentery was not observable.

Isle-of-Wight Disease and Nosema Disease.

Records of Concurrent History of Isle-of-Wight Disease and Nosema Disease.—We have now to record cases of *Nosema* disease with which there were associated the symptoms ordinarily regarded as diagnostic of Isle-of-Wight disease, or in which *Nosema* appeared to be affecting the stock in an adverse manner.

No. 7. In the summer of 1916 a frame of black bees removed from an experimental stock suffering from Isle-of-Wight disease was placed in a one frame observation hive, supplied with an Italian queen, and removed to another area over 20 miles away. The parent experimental stock had no history of *Nosema* infection, and was believed to be free of this parasite. At the time of the institution of the experiment now being recorded the weather was unfavourable, and the bees both in the parent stock and in the observation hive were exhibiting dysenteric symptoms and crawling when opportunity offered. The result was that the queen ceased laying. With an improvement in the weather both crawling and dysentery diminished, but the number of bees was now very small. A fresh frame of bees from the same source was introduced to the experimental hive, and after temporary confinement of the queen in a cage, she was released, accepted, and began to lay The dysentery at this period had almost disappeared.

On the 30th July there was sealed brood on both sides of the frame.

On this date a flying bee taken on the alighting board about to enter the hive was found to be infected with *Nosema* The chyle stomach was heavily parasitised, and free spore clusters were abundant in the colon. Further examinations were repeatedly made of both live and dead bees at this date, but in only one instance—that of a dead bee, which was very full of spores—was the parasite found.

During this period right up to the middle of September there was no further dysentery, but crawling was intermittent to a limited extent. The record continues as under:—

20th September.—This nucleus has sealed stores on top of both sides of frame. It has been fed with syrup. Bees appear quite healthy

21st September.—Do do

29th September.—All well. A good proportion of sealed stores

October.—The behaviour of this nucleus has been normal all this month. Welsh bees were added and the nucleus maintained until December, when the bees were returned to the parent stock.

There are two features in the foregoing record which appear to us noteworthy. The dysentery which was present was clearly associated with the bees before the appearance of *Nosema*, and occurred at the time when Isle-of-Wight disease was the prominent feature.

The second point is the failure of *Nosema* to become well established, even while the nucleus was in otherwise unfavourable conditions.

No. 8. As recorded in the previous experiment, a frame of bees having a history of *Nosema* infection was added to a stock suffering from Isle-of-Wight disease. This took place in December.

On the 12th of March following, a sample of bees—30 in number—was taken and examined. The result gave no evidence of the presence of *Nosema apis*, nor were there any signs of Isle-of-Wight disease. Up till May no signs of any disease were apparent in the stock. The following account gives the subsequent history.

On the 26th of May bees were carrying out dead and sick. One sick bee, able to crawl but not to fly, was found to be heavily infected with *Nosema apis* in both intracellular stages and free spore clusters.

On account of this discovery examinations were made as under:—

Two dead bees picked up from the ground in front of the hive were both found to contain spores and intracellular stages. The hive was opened and one live bee taken from the top of the frames. *Nosema* was not found in it. Three other dead bees taken from the grass contained spores, a fourth did not.

On the 27th the weather was favourable and the stock was working extremely well. Two bees were captured on arrival at the hive. One, which had the honey sac full, contained an enormous number of spores; the other, which was carrying pollen, showed a large number of infected cells, but spores were not seen.

A dead bee taken from the grass in front was full of spores.

A live worker arriving on the alighting board was captured. We found the honey sac full, chyle stomach chalky and completely parasitized with spores everywhere. The colon was practically empty. Another bee taken on arrival had the honey sac full, the chyle stomach chalky with some dark contents,—completely parasitized, all the cells seemed full of spores, the colon was practically empty.

On the 28th five live bees were taken leaving the hive, the chyle stomach was whitish in all Spores were found in four; one showed early stages of the parasite. The stock was working well all day. There were no "crawlers" and no signs of Isle-of-Wight disease.

During June the weather was mostly favourable and the stock increased to nine frames of bees, but stores were not very plentiful. Microsporidiosis appeared to be on the decrease, but foul brood was suspected on the 8th.

In the beginning of July the stock had increased to ten frames and a super was put on.

Microsporidiosis was not marked, although very numerous spores were found in one bee examined. Experiments with this bee yielded results rich in *Nosema* infection. No difficulty was experienced in maintaining bees alive until the spore stage was reached.

The stock, although as noted was not showing any very marked signs of trouble, did not increase, but probably diminished in numbers in succeeding weeks, although the queen continued to lay. On the older frames the presence of sac brood, which was suspected

on the 8th, was definitely confirmed and found to have increased in amount.

Throughout the period that *Nosema* was being readily found in a very high proportion of the bees, there were none of the characteristic signs of Isle-of-Wight disease, and no observer of the stock familiar with this condition could possibly have diagnosed it as present. Nothing to suggest it had been seen since the previous October. It was, however, obvious that the combined presence of *Nosema* and sac brood disease was adversely affecting the stock. About the middle of July the first signs of Isle-of-Wight disease made their appearance. There was an inclination in bright sunshine to crowd in fair numbers on the alighting board, and especially to crowd in large numbers on top of the frames rather than to fly when the hive was opened. Also a limited number of bees when opened were found to have the colons congested and the chyle stomach contents purplish in colour. Further, the number of bees leaving and entering the hive in working hours and in suitable weather was relatively small in proportion to the size of the stock, and to those working from adjacent hives even where these stocks were smaller. At this date, 20th July, the stock was markedly short of stores.

In order to combat the sac brood two of the worst frames with bees upon them were removed to a small hive, and two frames of foundation were placed in the middle of the brood nest. Syrup was fed. Eighteen loiterers were picked off the alighting board, and of these only three showed "Isle-of-Wight" disease, intestinal symptoms; the others appeared normal. Two bees examined in detail showed no trace of *Nosema*, and it may be added here that *Nosema*, although repeatedly looked for, was not again found in this stock.

In the beginning of August sac brood was still present and the stock distinctly reduced in numbers During August in fine weather crawling symptoms were observed, and samples taken for examination showed the usual symptoms in the intestine in this disease. No traces of *Nosema* were found in either the dead bees examined in pulp or in fresh bees taken individually.

Early in September the strength was reduced to five frames and the stores were very low. The lesser wax moth was present in fair numbers. The queen continued to lay, and eggs and brood in all stages were present upon three frames. The hive floor was cleared of debris and dead bees, Betanaphthol candy was supplied, and the frames with bees were sprayed with Bacterol. During the next week the bees diminished in numbers, and latterly there were few crawling symptoms. Two frames of stores from a healthy stock were supplied. With reference to the dead bees cleared from the floor, it may be stated that these were pulped and tested for *Nosema*. Only a very few spores were observed, and indications were that it could not have been present in a widespread form in this stock during these latter weeks.

The stock dwindled during the next six weeks, although the bees were not showing any signs of disease and the queen laid to the last The bees were feeding well, being supplied with Bacterol treated candy. Towards the end of October the stock became

extinct. One hundred bees were pulped and yielded a negative result for *Nosema*. The queen also was examined for *Nosema* and no trace of this parasite was found.

Notes upon the foregoing history.—Although the *Nosema* infection was accompanied by sac brood disease, it seems clear that this parasite was an essential cause of the failure of the stock to build up in a normal manner.

The disappearance of *Nosema* from a stock, such as occurred here, we have noted on other occasions. From a consideration of all the circumstances the re-appearance of Isle-of-Wight disease must be regarded as an entirely new outbreak. Factors of significance are the weakened condition of the stock from the recent presence of *Nosema* and of sac brood diseases, and also the situation in which the stock was placed. It stood in an apiary set apart for the experimental study of Isle-of-Wight disease in immediate proximity to other stocks suffering from this disease.

Altogether the facts indicate that *Nosema* infection may be quite definitely established in the absence of all symptoms we are familiar with in Isle-of-Wight disease. The fact that when such symptoms eventually appeared in the stock *Nosema* was either in a latent condition or absent suggests that these two conditions are not causally related.

No. 9. **Failure of Nosema Infection with subsequent development of Isle-of-Wight Disease.**—On the 10th, and again upon the 15th May 1918, candy infected with *Nosema apis* spores was fed to a healthy stock of Punic bees (No. 12), previously tested for *Nosema*, with negative results. Examinations of bees for *Nosema* infection were made upon various dates with the results recorded below. Upon the 18th May ingested spores were found in one bee out of five examined. Again, upon the 24th May, spores were found in one bee out of five examined, but no developmental stages were observed. On 11th June the parasite in the spore stage only was again found in a single bee. On 13th July, 25th July, 2nd August and 3rd September examinations were made, all of which yielded negative results.

On the 11th June a few crawling bees were observed in front of this stock (No. 12), and from this date onward this continued until September. The numbers were always small, and the increase of the stock was not markedly impaired. At the same time the indications undoubtedly suggested Isle-of-Wight disease. Most of those which crawled were opened and examined, and in no case were the distinctive appearances of advanced *Nosema* infection ever seen. The stock increased from five frames to nine, with brood upon six, at the beginning of September. At the end of this month the hive was fully crowded with bees on ten frames. Syrup was fed to the bees and the stock put up for winter.

On the 17th December 65 bees were subjected to search, a few individually, and others by pulping their chyle stomachs. In no instance was *Nosema apis* observed.

(10 teased collectively, 3 individually—3 smears.
13 „ 3 „
39 „ 3 „ All negative.)

By the 10th of January the stock had died out, confirming the suspicion that Isle-of-Wight disease was present.

This record illustrates the failure of *Nosema* to establish itself upon a stock of Punic bees after the stock had been fed with infected material in summer, while meantime Isle-of-Wight disease developed. It is noteworthy that even in these unfavourable circumstances *Nosema* did not spread in the stock.

Experiments showing that Isle-of-Wight Disease is Different from Nosema Disease.—With a view to further establishing the separate nature of the condition known as Isle-of-Wight disease and *Nosema* disease, we carried out the following experiments :—

No. 10. A small lot of bees covering less than one frame was taken from a stock showing the symptoms associated with Isle-of-Wight disease and placed on 31st January 1918 in an observation hive which had recently been occupied by a *Nosema* infected lot of bees. The hive was not disinfected nor cleaned. The Isle-of-Wight diseased stock had been carefully examined for *Nosema* infection previously. No stage of the parasite was ever seen, and the stock was therefore held to be free from this parasite. On the 5th February these bees were fed with candy contaminated with *Nosema* spores from the former occupants of the hive, and on the 8th a queen surviving from a stock which had died out with Isle-of-Wight disease was introduced. The bees at introduction were very dull, most of them showing weakness and falling readily off the frame. Dysentery was present also. During the early days of the experiment they became livelier and improved in appearance, and dysentery was much reduced.

On 22nd February seven live bees were taken for examination and six of them were found heavily infected with spores of *Nosema*. Two dead bees from the alighting board were examined . one was found infected, the other yielded a negative result.

On the 26th February the bees, which were now much reduced in numbers, were placed along with the queen in a small cage. These survived till the 27th. The queen was found to contain *Nosema* spores in very large numbers, and had thus reached this stage of infection within the period or 22 days, assuming that she was not previously infected. The dysentery which was present, and which we believe was due to secondary causes, such as overheating in confinement with resulting excitement, had practically disappeared in the later stages of the experiment.

The foregoing experiment was designed along with another following to show the distinct character of *Nosema* disease and of Isle-of-Wight disease. The Board of Agriculture investigators in their report concluded that Isle-of-Wight disease is caused by *Nosema apis*, and have explained the failure of observers to find *Nosema* in many cases of the disease as due to the extreme virulence of the parasite in killing off the bees while it is still in the trophic stage. This experiment shows that by definitely introducing *Nosema* into an Isle-of-Wight diseased stock in which we had previously failed to find *Nosema*, we without difficulty obtained it within the period of 17 days from the majority of bees present and from the queen in three weeks.

No. 11. Another frame of bees taken from the same stock as that utilised in the previous experiment was placed on the same day in an adjacent observation hive. The two had a common alighting board. The bees were showing marked Isle-of-Wight disease symptoms. They were feeble, many were frequently falling off the frame and very few could fly. During the first ten days the bees under the new conditions improved in appearance and became more active. The mortality was not excessive. The weather on the whole was rather cold.

On the 12th February a queen which had already been the subject of an experiment with Isle-of-Wight diseased bees was introduced to these bees.

On the 22nd February bees from this lot were taken and examined—the first six were all found infected with *Nosema* in the spore stage, notwithstanding, as explained in the previous experiment, the fact that *Nosema* could not be found in bees of this stock prior to the initiation of this experiment. This result is of special interest and the infection is readily understood. The common alighting board, which is really a full sized window sill, in which the two observation stocks were placed had been previously used by a stock suffering from *Nosema* infection, and was further at this time in use by the bees in the previous experiment. As both lots of bees belonged to the same stock originally it is highly probable that mixing occurred, and that bees from the infection experiment entered the adjacent hive. At all events the infection with *Nosema* in both lots was very complete, and subsequent examination showed the majority of the bees to contain *Nosema* spores in large numbers.

In this experiment we have thus been able not only to adduce evidence of the separate nature of these two diseases, but also to superimpose in the same stock a *Nosema* infection upon Isle-of-Wight disease.

On the 25th the number of bees was reduced greatly and the survivors were put up in a small cage temporarily, and subsequently given a frame of Italian bees to institute another experiment.

Means of Dissemination of Nosema Apis.

With a view to ascertaining the degree of readiness with which infected worker bees and queens may communicate *Nosema* to others, the following experiments were carried out:—

Infection by Contact with other Bees.—*Infection of Workers.*—A small number of bees was given *Nosema* infected candy on 13th September 1918. Infection was confirmed by serial examinations day by day until on the 24th there were only seven survivors. At this date these were caged afresh with a number of Italian bees believed by control examination of samples to be free from infection, and the whole lot supplied with fresh uncontaminated candy.

On the 27th the seven black bees still survived; one of these was released and flew. It was captured later and returned to the cage. The black bees died on 30th September, 17 days after infection. On examination this was found to have been of a gross character.

On 9th October four of the Italian bees were dead. Only in one were stray spores found; the others appeared free. One remaining live bee was killed, examined, and found to be definitely infected, both spores and intra-cellular stages being present.

It would thus appear that the Italian bees underwent infection by contact with the black bees, and that this was definitely established within a period of fifteen days.

Infection of Queens.—Case 1. A frame with a moderate number of Dutch bees was placed in an observation hive on 14th September 1917, and two days later a queen from a defunct Isle-of-Wight stock was introduced.

On the 25th, and again on 27th, candy heavily contaminated with spores freshly taken from an Italian bee was supplied. The bees were seen feeding upon this. At this time the bees appeared quiet, but there were no signs of dysentery or other trouble, and it was observed that on fine days the bees were more active and flew. They were supplied with ordinary candy and also with syrup, the latter of which was taken only in part.

On 11th October four bees were taken alive and examined, three contained developmental stages of *Nosema*, and the fourth was heavily infected with spores. On the following day a bee found alive in the doorway lying on its back was taken, and it also was found to contain enormous numbers of *Nosema* spores

As it appeared from these examinations that this small lot was extensively infected, it was decided to sacrifice the queen with a view to determining whether infection in her case had taken place, and at this date, *i.e.*, seventeen days after the first supply of *Nosema* to this lot of bees, she was taken, killed and examined A thorough search failed to reveal the presence of any stage of this parasite. It is not without interest to recall the fact that this queen was a survivor of a stock which died out from Isle-of-Wight disease.

On the following day nine dead bees were found at the entrance. These were examined, and two were found containing a very large number of spores; the others appeared to be free.

Case 2. On this date a fresh queen (Italian) was introduced. With a view to strengthening this small lot some Punic bees were introduced ten days afterwards. They attacked the queen and balled her. She was removed and caged, but died on the following day Fluid expressed from her abdomen was found to contain spores of *Nosema*. This queen had been in contact with the *Nosema* infected bees during a period of eleven days only. There is of course the possibility that she contained *Nosema* prior to this period, but it may be mentioned that the bees which accompanied her from Italy in a small cage were all examined and found free from this parasite.

This small lot of bees was subsequently maintained without a queen, and Italian bees were added on the 9th of November. By the 24th almost all the Dutch bees were dead, and those examined from time to time were in every case found infected with *Nosema* in the spore stage. Although never more than a small lot of bees they survived until the first week in January. *Nosema* infected bees were found to the last.

Case 3. On 31st October a queen from a stock previously tested and found negative for *Nosema* was introduced to a nucleus heavily infected with this parasite.

On 3rd December the queen was isolated with a few of the bees for further experiment. She, however, died two days later, and examination revealed the presence of a limited infection of the chyle stomach.

Further Observations.—The following further results have been obtained in the case of queens heading stocks infected with *Nosema apis*. Of twelve queens examined after death, spores of *Nosema* were found in four. Of four queens taken alive and sacrificed, three showed meronts in the chyle stomach epithelium but no spores. No trace of *Nosema* was found in the fourth.

Infection by means of the Queen.—*Case* 1. *History of a Stock.* On 16th May 1917 an Italian queen was given to a frame of Dutch bees in a nucleus hive situated on a roof 45 feet above street level. The nucleus maintained itself well, and the bees were always active, although, as explained below, the numbers did not increase up to expectations. The food was supplemented during July and August with syrup and with candy medicated with Bacterol, as supplied by Messrs. Pascall, yet on 13th September, when twelve bees were taken for examination, eleven were found infected with *Nosema apis*. No other indications of disease were evident. The bees were active and taking in pollen.

Since these bees occupied an isolated position in a thickly populated part of a large town, and as the parent stock from which the Dutch bees initiating the experiment were taken have never shown signs of the presence of *Nosema*, it is highly probable that the Italian queen was the source of infection. Subsequent discoveries as narrated below tend to confirm this view.

Frequent examinations showed that a very high proportion of the bees of this stock were infected with the parasite. Foragers arriving at the hive bearing pollen were found with cells from end to end of the chyle stomach to all appearances completely filled with *Nosema* spores. In other cases the infection was very heavy but partial, some parts of the chyle stomach being comparatively free from spores, but showing other stages. There were no signs of dysentery. The weather during August was extremely wet, but became finer in September, although very windy. Towards the end of September the nucleus covering about two frames was spirited and busy. The queen was laying and pollen being carried in. Owing to the high situation of the hive, the bees had difficulties in reaching it in a high wind, and eventually it became clear that the stock, which all along had been active, was suffering considerable loss from this cause. There had always been a good proportion of brood and young bees, yet the stock did not increase up to expectations. On the 27th, after several days of boisterous, although dry and sunny weather, a search was made in the neighbourhood of the hive for stray bees which might have been presumed to have been blown away and which were unable to return. The hive was situated at the end of a large concreted roof with a southern exposure. The space in the immediate

vicinity of the hive has always been found free from bees except immediately below the alighting board, and this was so on the day named. About 14 to 20 yards distant along the west side of the roof in the shelter of a low parapet a considerable number of bees were found; most were alive and crawling slowly on the ground, and on being collected and warmed in a small cage, they nearly all recovered and flew. To our surprise the queen was found dead about 18 yards distant from the hive. Fortunately no question can arise as to the identity of these bees, including the queen, since, as already noted, this was a solitary stock of Italian bees on an exceptionally high elevation in the heart of the city. Further, no bees are known to be within a very considerable radius of the site. Since it was found on the 1st October that there were two queen cells and also two drone cells on the frame, and further, since eggs had been seen on the 25th, the loss of the queen must have been recent.

On examination the queen proved to be extremely heavily infected with *Nosema*. The chyle stomach cells where not ruptured, were seen to be nothing but sacs packed with spores. It is probable that she left the hive voluntarily or was driven from it by the bees on account of her condition. As already stated, there were present in the hive at this time queen cells showing that she had been laying up to practically the time she left the hive. If the conclusion that the queen introduced *Nosema* to this small lot of bees is correct, then it would appear that she herself lived for a period of at least four months in an infected condition.

On the date on which the queen was found twenty-six dead workers were recovered. These were pulped and examined, but no *Nosema* spores were found On the floor of the hive a number of dead was collected, six gave a negative result as regards *Nosema*, while three were positive, yielding spores in very large numbers.

The remaining bees survived queenless to the middle of December, and repeated examinations were made for *Nosema*. Infection was found in a high percentage of cases right up till the end.

Case 2. *History of a Queen.* At the beginning of October two frames of bees taken from a healthy stock were given a young Carniolan queen. Within a limited period in the course of a routine examination the bees of this nucleus were discovered to be generally infected with the parasite *Nosema apis*. Control examination of the parent stock gave negative results for *Nosema*, and the previous history of the experimental hive has no record of *Nosema* contamination Suspicion thus rested on the queen as the source of this infection. With a view to testing this, the queen was introduced at the beginning of November to a stock of Irish bees in another apiary with a clean history as regards disease. The queen of the stock was removed previously.

Five bees from the Irish stock were examined in the middle of December and one was found infected with *Nosema*.

On the 10th of January nine live bees were taken; these on examination yielded a negative result. Eighteen dead bees were taken from the floor of the hive. Their chyle stomachs were

pulped and samples taken for examination. Spores of *Nosema* were numerous. The stock was found to be queenless at this date. The dead queen was not found in the hive nor in its vicinity. The stock died out early in February. Practically every bee had *Nosema* in the spore stage.

Possible Infection of Workers with Nosema apis *from cleaning the Queen's body.*—On the 8th October five bees were confined in a cage sterilised by fire with a queen immediately after she had been isolated and fed on contaminated candy. She had been observed to crawl upon it and her wings were seen to touch it. After the bees had been with her for 24 hours she was removed. A control examination was made of companion bees from the same stock and no *Nosema* was found.

The bees were not examined until on the 17th one was found dead. A search was made, but no trace of *Nosema* was observed.

On the 21st another bee had died, and it also yielded a negative result in a *Nosema* search.

On the 25th the three remaining bees were killed and examined. Two were found to contain *Nosema*, one showing spores in fair numbers and the other with meronts and spores in great abundance. The third bee was found to be free.

Conveyance of Nosema through the alimentary canal of the Queen.—Experiment I On the 18th October, a queen after being isolated for an hour, was fed with candy which we liberally contaminated with spores of *Nosema apis*. She was observed in the course of a period of four hours to repeatedly feed upon this material. At the end of this time she was removed and placed in a small cage along with a small number of bees. She was left with those over night (24 hours). The queen was next transferred to a cage freshly sterilised with fire containing healthy bees from stock No. 6 (tested *Nosema* free) on 19th October.

25th October. At this date all the bees were alive and active.

30th October. On this date all the bees were still alive. One was taken and examined microscopically. *Nosema apis* was found in the chyle stomach in significant numbers—the stages observed were unopened spores and recently developed planonts. Meronts could not be detected.

31st October. One dead bee was found in the cage at this date. Examination showed it to be free of *Nosema*. As a control we took a live bee and examined it. No parasites in any stage could be found in the contents of the stomach, the cells of which were normal in appearance.

5th November. Two bees which died over night were examined, but no trace of *Nosema* infection could be made out. The queen died on the evening of this date, having survived eighteen days after receiving infection. On the following morning she was examined and found to be extensively infected. Her chyle stomach was whitish in appearance from the presence of myriads of spores, which appeared to be present in practically every cell.

The three remaining bees were now examined, one contained spores, but no cellular infection could be traced, and the other two were negative.

Experiment II. On 10th October a queen which had been fed fifteen days previously with *Nosema* infected candy was again caged and supplied with similar material. She was kept under observation until we satisfied ourselves that she fed upon the contaminated material. As she was seen to tread upon it and to rub her wings and body also against it, she was removed and confined with a number of bees for a period of twenty hours with the object of insuring that all infection adhering to the surface of her body would have a chance of being removed.

At the end of the twenty hours the queen was again transferred to a fresh cage sterilized by fire, and into which there had been introduced a small lot of bees; these were taken from a hive regarded, from the result of extended examinations, as *Nosema* free.

On 12th one bee was removed from the cage and its chyle stomach examined. No *Nosema* spores or other stages were observed.

Later in the day the queen was found dead along with seven other bees, leaving only two alive. One of the newly dead bees was examined and was found to be heavily infected with the parasites in the meront stage. The dead queen on examination was found to be heavily infected with parasites in the spore stage. Infection was thus completed within twenty-two days, and possibly within only seven days.

The remaining bees yielded the following result as regards *Nosema*:—

Dead bees:—2 negative.
3 slightly infected.
1 heavily infected.
1 live bee negative.

From the foregoing it would appear that *Nosema* is readily communicable to the bees by an infected queen. It cannot be said with certainty that the death of the queen under the conditions of this experiment was due to infection with the parasite.

Experiment III. On the 9th October a queen was isolated and observed to feed upon candy contaminated with fresh *Nosema* spores. She was then caged with a number of her own bees with a view to their removing any contamination which may have taken place from the surface of her body.

After twenty hours she was again isolated and transferred to a freshly sterilised cage containing clean candy along with a small number of bees taken from a tested *Nosema* free stock.

On the 12th one bee was removed from the cage and the chyle stomach examined. Only one or two free spores were observed. These we assume were ingested forms.

On the 17th a newly dead bee was examined and a few large meronts were seen.

On the 22nd one live bee was taken and on examination found negative as regards *Nosema.*

On the 25th two bees were killed and examined; in one stray spores were seen but no developing stages. In the other the spores were more numerous, but again infected cells were not observed.

On the evening of this date the queen died. She was examined on the morning of the 26th, and a very heavy infection with *Nosema* was found to have been established. Four attendant bees remained, and these were examined with the following results—two contained scattered spores and intracellular stages, and in the other two meronts only were observed.

The infection in these four bees was of a comparatively slight character and in marked contrast to the condition in the queen.

From the result of the foregoing experiments there seems little doubt that an infected queen under normal conditions will probably be as certain an agent of infection as can exist. Further, the mortality amongst *Nosema* infected queens in our experiments has been significantly high.

Altogether, we feel justified in concluding that in any stock harbouring *Nosema*, there is oonsiderable probability that the queen will sooner or later become infected with this parasite. When this happens, in view of the personal hygienic relations existing between queen and attendant workers, she becomes a centre of infection, and we may expect the disease to make rapid progress. In this connection it may, therefore, be pointed out that an obvious remedial measure, where the presence of *Nosema* is known or even suspected, is to effect a change of queen.

Probably, where the circumstances admit of it, the stock might be left queenless for a time. The significance of a queenless period is that it permits of the dying out of infected bees, and thus increases the possibility of final elimination of the parasite from the stock.

General Conclusions.—In a stock infected with *Nosema apis* the behaviour of the bees has in our experience been in striking contrast to that of the members of a colony afflicted with the condition known as "Isle-of-Wight" disease. It is a common experience to find that bees of an infected colony captured entering the hive carrying pollen or nectar are while doing so harbouring very large numbers of the parasite in the spore stage. Loss of flight power has not been found to be a characteristic of *Nosema* infection until the insect is actually dying. In Isle-of-Wight disease it is usual for this symptom to appear a considerable time before death, if the bees are prevented from sacrificing themselves by crawling and subsequent death from exposure. We have not observed *Nosema* infected bees to loiter in large numbers about the doorway nor to gather in clusters on the ground, as Isle-of-Wight crawlers do. We have seen them come out, when *in extremis*, and falling over on the ground, lie upon their backs with feebly moving or trembling legs. Our observations suggest that the course of *Nosema* disease in a stock may be, first, the initial stage in which workers only are infected At this stage the disease is not recognisable except on microscopic analysis The rate of progress appears to depend greatly upon concomitant factors and is not infrequently quite slow. *The loss to the stock is to be measured by a shortening of the life of the individual bee and not by a premature cessation of its activities.* In the summer the

natural increase resulting from the normal egg laying of a healthy queen may greatly outstrip the loss from disease and its presence may be overlooked. At other seasons reduction of the stock from the presence of this parasite is to be expected. Sometimes the parasite appears to die out or to persist in a low proportion of the bees. Survival of the stock in this manner does not imply immunity against Isle-of-Wight disease, and such stocks have been known to succumb later to this disease. A factor of great importance in determining the course of the malady is the infection of the queen. When this occurs, the infection may be expected to spread steadily within the colony as long as she survives. We have shown how potent a disseminator of *Nosema* an infected queen becomes. *The frequency with which loss or death of the queen occurs in Nosema disease, is in striking contrast to her survival in Isle-of-Wight disease.*

As regards the occurrence of dysentery in *Nosema* infection, we have been unable to obtain evidence that this is a primary symptom. Our infected stocks have usually maintained themselves for prolonged periods during which dysentery was not present. We have explained the conditions under which we have been able experimentally to introduce it, with a resultingly increased mortality.

Our main conclusion from a study of the presence of *Nosema apis* in bee colonies in this country is that this parasite is always a weakening factor, and in the presence of other adverse conditions favourable to the development of dysentery it may become seriously pathogenic to bee stocks. In ordinary circumstances we have not found it to destroy bee colonies in the rapid and virulent manner common in Isle-of-Wight disease, although at the same time we are satisfied that *Nosema* affected stocks do not yield the same amount of stores as healthy colonies.

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THE Preliminary Statement of the Agricultural Returns for Scotland, 1919, was issued in September, and an abstract giving particulars of the acreage of the principal crops and the numbers of live stock in each county and district, as well as the figures for Scotland as a whole, appears on pp. 582-591 of this issue of the JOURNAL. It should be noted that these are the preliminary figures, and are liable to modification.

Agricultural Returns for Scotland, 1919.

The total area under all crops and grass amounts to 4,751,500 acres, a decrease of 9500 acres, the arable land having decreased by over 47,000 acres, while the area under permanent grass is greater by nearly 38,000 acres. The land under rye-grass and other rotation grasses and clover exceeds that of last year by over 45,000 acres; the decrease in the area under other crops is thus 92,500 acres. The area under wheat, extending to 79,500 acres, is practically unchanged; barley, with 174,000 acres, shows an increase of 21,000 acres, or 13·8 per cent.; while the area under oats, 1,109,500 acres, is less by 134,000 acres, or 10·8 per cent. The total area under the cereal crops is less than that of last year by 114,000 acres. The area under potatoes, 154,500 acres, shows a decrease of 15,000 acres, or 8·8 per cent., while turnips and swedes have increased by 29,500 acres, the area now under the crop being over 426,000 acres. Of the area under rotation grasses and clover, that for hay has increased by 3500 acres and that for pasture by 41,500 acres; of the area under permanent grass, that for hay has increased by 5000 acres and that for pasture by 32,500 acres. The total area cut for hay is 547,000 acres, or 8500 acres more than last year.

The area under wheat, barley, oats and potatoes this year is 1,518,000 acres; this is 127,000 acres less than last year, but 164,000 acres more than in 1916, which was the basal year for the food production campaign.

The live stock returns show that the numbers of horses and cattle have slightly increased, the number of pigs has considerably increased, and the number of sheep has considerably decreased. Dairy cattle are more numerous by nearly 3000, and feeding cattle over two years old by 29,500, while those of one year and under two and those under one year have decreased by 10,000 and 3000 respectively. All these movements are in the opposite direction to those which took place in 1917-18. Sheep have decreased by 480,000, the total being the lowest on record. Pigs are more numerous by 9500.

Separate returns have been obtained this year for the first time of bulls, rams and boars. These number 91,000, 81,000 and 1700 respectively. For the purpose of comparison with last year, these new classes are included in the classes "other cattle two years and above," "other sheep one year and above," and "other pigs" respectively.

The following notes on this hardy breed are extracted from an article in *Modern Farming*, Sept. 1919:—

Shetland Cattle.

The Shetland cow is probably the smallest in the world, and it has mastered the whole art of living where all other cattle would starve, and of converting scrub and weeds into rich milk.

It is eight years since the Shetland Herd Book Society was formed by a few men and women interested in the welfare of the Shetland Islands and their products. Here and there Shorthorn and other blood had been introduced to "improve" this ancient and unique breed, and these founders of the society realised that the only way to stop this needless and regrettable crossing was to give the Shetland cattle a status of their own by means of a properly kept herd book.

The Shetlanders responded to the idea at once, and the first herd book, issued early in 1912, contains the names of about 140 members, nearly all of them local farmers and crofters. Since then the herd book has been issued year by year, and the influence of properly recorded pedigrees, combined with show competition, is already to be seen in the general grading up of the breed. This has been encouraged by the use of premium bulls under the Live Stock Improvement Scheme administered by the Board of Agriculture for Scotland.

It is fortunate for the best interests of the breed, perhaps, that so far the outside world knows little or nothing of the breed. If there was a craze for these diminutive yet very profitable cattle, much of the best stock would be quickly bought up and dispersed. far and wide.

The outstanding quality of the breed is its amazing hardiness For long centuries it has had to live out in all weathers on its bleak island home, and find nutritive value in food on which less hardy animals would quickly starve. None but the most vigorous calves have been able to survive this harsh process of selection, and the weaklings have died out. The breed is not only free from tuberculosis and other hereditary taints; it may be said to be resistant to them. And an enthusiastic breeder will tell you that, so far from the Shetland cattle needing any other blood to improve them, it might be well for certain breeds if they would borrow from these dwarfs some of their hardihood and deep milking powers.

So far, Shetland breeders have settled on no definite colour for their cattle. A glance through the herd book shows that black and black and white are the colours most frequently mentioned, but there are also white, grey, blue, brindled, red, roan, and mixed colours.

Perhaps it might be wise on the part of breeders to decide whether they should aim to produce one particular colour so as to give the breed every possible distinctiveness of appearance. And the fact that so uncommon a colour as dun appears to be dominant in breeding certainly gives it a strong claim as the best to select. Indeed, it seems somehow to become these little beasts peculiarly well.

The head of the Shetland is very striking, and is typically a milker's head. Though the whole is nicely formed and pleasing to the eye, the muzzle is proportionately very broad, enabling big mouthfuls of food to be taken at a time. A slightly dished face, with full placid eyes and small ears, is favoured, and the type of horns preferred are small ones incurving with a slight upward tendency.

In the body a deep and broad chest is sought after, with a nicely developed brisket, straight back, and well sprung ribs. Broad and strong hindquarters that can easily support an udder when it is holding 30 or more lbs. of milk are also desired.

Though the legs should be short to preserve the miniature appearance of the breed, importance is attached to them being fine and clean in bone, and any crossing or sweeping action of the legs is barred as indicating weakness of constitution.

In the bull great importance is attached to the chest being deep and broad so as to indicate a large lung capacity; the back must, of course, be straight from the withers to the setting of the tail, and the hindquarters have to be broad and strong and furnished with a thin, long tail.

One distinctly defined colour is preferred in bulls, though for cows any colour is admissible.

Bull calves which are not thought worth keeping on for breeding are allowed as bullocks to grow into beef, and as there is usually but little food to spare for them beyond what they can pick up for themselves, they do not make very heavy weights or large joints.

Nevertheless the meat is very tender and delicately flavoured, and sells readily enough among those who are aware of its excellence. With suitable feeding, of course, the bullocks grow and put on weight rapidly, and there is no need to look on bull calves as unfavourably as they sometimes are in other dairy breeds.

Indeed, the striving towards the ideal type drawn up by the society, combined with the natural vigour of a breed that has survived a thousand years of harsh selection, is calculated to produce a very fair beef animal within the limits of the small size of the Shetland.

But primarily it is a dairy breed, and it is to be hoped that the day will come when a class for Shetlands will be included at the London Dairy Show. Goats are admitted to the show in considerable numbers, but the Shetland can bear comparison with the choicest goats from any point of view, and especially as commercial animals. It is a notable achievement for a goat to give a gallon of milk in a day, whereas the Shetland cow will yield three and even four gallons a day.

Leaf-Stripe of Barley.

IT is no exaggeration to say that scarcely any field of barley is free from the attacks of the leaf-stripe fungus (*Pleospora graminea*). This is easily recognised in mid-season by yellow or brown stripes along the length of the leaf. Later in the season few of the leaf-stripe plants will be found with ears, because the plant withers before earing. If ears are formed they are generally caught in the upper sheath, or they emerge distorted, and rarely are ears and grains perfectly formed. The effect of leaf-stripe is not evident in the grain sample, although sometimes there are grains with a brownish end resembling heated grain. But it is by the grain that the disease is carried from the old crop to the new. The disease is

therefore reduced by treatment of the grain by methods somewhat similar to those used for smut and bunt. The importance of clean seed is recognised in Denmark, and for a number of years experiments on treatment have been carried on. These have not been altogether effective in eradicating leaf-stripe, but have brought improvement, and in a recent summary valuable information is given.

The results show that barley sown early in cold soil produces more leaf-stripe plants than seed sown later when the soil is warmer. In some cases early sown plots carried as much as 30 per cent. of diseased plants. Leaf-stripe is also stated to be more prevalent in four-row or six-row barley than in two-rowed varieties. Amongst the latter there is more leaf-stripe in the short, broad, erect eared varieties (Standwell, Maltster, etc.) than in the narrow eared "Chevalier" types.

The treatment of seed consists in steeping the grain, that is submerging it in suitable solutions for some hours, and it has been found that merely watering the solutions over the seed, as is often done for smut, does not give the same satisfactory results. The solutions of most value are formalin, copper sulphate, and corrosive sublimate. Formalin solution is made by mixing one part of formalin (40 per cent. solution) with 19 parts of water, and the seed is steeped in this for 6 hours if known to be badly infected with leaf-stripe, or for 3 hours if the leaf-stripe was not so abundant in the preceding crop. Copper sulphate solution is made by dissolving 1 lb. of bluestone in every 2 gallons of water; this is done in one or more wooden barrels, and the seed-grain is completely covered by the solution from 2 to 4 hours Corrosive sublimate, 1 lb. in every 10 gallons of water, gave good results, but the solution is too poisonous for general use. Hot water kept at a temperature of 135° F, a continental method for treating grain, is beneficial, but not to be relied on in every case. The choice of solutions for steeping ordinary farm grain lies between formalin and copper sulphate, and the cost will depend on the prices of these two substances. Formalin has an advantage in that any grain left over from sowing is non-poisonous for poultry if left exposed to the air for several days, whereas copper sulphate treated grain is poisonous for poultry even after some time. Both solutions have some effect in spoiling the germination of the grain, but the strength of the solutions and the length of steeping recommended have been selected as having the least injurious effect; on this account care should be taken to follow the directions carefully.

Village Industries.

In connection with the article on "Rural Industries" which appeared in the last number of this Journal, the views on this subject put forward in the *Economist* of Aug. 30th are of interest. The substance of the article, which is well thought out and practical, is as follows:—

"Rural life hitherto has been weak not only socially, but also economically. Its rejuvenation and revival must be sought first

and foremost by economic methods, that is by the restoration and development of country arts, handicrafts and industries. It is likely enough that reorganised and improved agriculture—more intensive, more scientific, more enterprising—will, after all, constitute the most powerful lever in rural revival; but since in any such improved and better organised agriculture village industries must take a prominent position, it still remains true that the restoration and growth of such industry is a vital element in rural reconstruction.

"Village industries may be roughly classified as (*a*) those directly connected with agriculture, and (*b*) those more or less independent of agriculture. The former would include such pursuits as cheese and butter making, bacon curing, manufacture of jams and preserves, whilst the latter would include the manufacture of toys, metal wares, textiles, furniture and wood carvings, lace and carpets. Another division is, on the one hand, industries which are carried on as a spare time occupation by agricultural workers, and, on the other hand, as a full time occupation by an entirely separate class of workers. There would, of course, be several intermediate grades between the two divisions: in other words, a certain industry could be carried on in a village as a full time occupation for some and as a part time occupation for others. In any case, the social and economic life of the village would be greatly stimulated, resulting in increased prosperity all round. In those countries like Denmark, Switzerland and Norway, for example, where these industries are well established, they furnish an appreciable addition to the income of the agricultural worker and his family. It is obvious that the agricultural worker has a great deal of spare time, especially in winter. This fact has been well realised in certain parts of Canada, where village industries have been organised to give employment in the long dark winter evenings. Developments in this direction could be closely associated with the renaissance of industrial art and handicraft. The movement to infuse more art into industry, and strengthen the connection between art and industry which took definite shape recently in the organisation of an Industrial Arts Exhibition—under the auspices of the Royal Society of Arts and the Board of Trade—would find powerful support in the restoration of rural industry, for it is here that it would find its most congenial soil and environment. The two great revivals—artistic industry and rural industry—are very intimately bound up together.

"One or two objections may be briefly dealt with, for they have been emphatically raised in the past, even if they have now partly or wholly lost their force. These rural industries have generally been confused with home or cottage industries carried on both in town and country, frequently in the suburbs of large towns, where they have often partaken of the nature of sweated industries. Such industries, called petty trades by Kropotkin, and referred to in the Factory Inspectors' Reports as 'home work,' have been stigmatised as 'small scale,' and liable to all the evils of sweating and lack of proper organisation and State control. These evils will be entirely absent under the new order of things.

"In this new order co-operation and organisation will be pre-

dominant features, effectively preventing any possibility of sweating, and also removing the objection based on the supposition that these trades are necessarily and inherently 'petty,' economically unsound, and doomed to ultimate extinction in the march of so-called economic progress. Whatever may be the respective merits or demerits of small-scale as compared with large-scale production it is not necessary to enter here into this great question, for the simple reason that village industries of to-day can be organised on as large a scale as may be desired. This needs to be strongly emphasised, for it is the kernel of the whole business The whole of the village industries in the country could be controlled, if need be, by one central authority; but probably it would be better to organise them by county, or district, or class, like the Buckinghamshire lace industry, or the Bedfordshire straw-plaiting. The toy-making industry or the small metal-ware industry could be grouped in their respective classes and controlled by one central body, which would buy the raw material and sell the product. Indeed, large-scale industry of the towns, as we know it to-day, is not without examples of great conglomerations of individual units or branches.

"In addition to suitable organisation, there is another powerful agent which should greatly facilitate the development of rural industries and tend to nullify any possible objections, and that agent is electricity. A further objection, for instance, in addition to those already noted is the sentimental one that the English countryside will be 'desecrated' by the introduction of manufacturing industry in any shape or form. But it is not proposed to dump factories down indiscriminately on the countryside; our Village Industrial Hall or Palace of Industry need not be an ugly blot on the landscape, but should be a lofty, well-ventilated, well-lighted and spotlessly clean structure, with trees, greensward and flowers around it If the villages can be supplied with electric light as well as power and traction from large central stations, one of the worst evils of country life—at least, to the townsmen—namely, its darkness in winter, would be removed Village life would be brightened up in every sense of the word. Another possible field for the application of electricity in the rural revival is the electro-culture of plants and electrification of seeds, for if all the great possibilities indicated by the experiments so far carried out are ultimately realised, electro-culture should prove of the greatest benefit in that intensive farming which must be a prominent feature in rural organisation, and constitute the basis of other important auxiliary industries.

"The revival of village industries will, of course, depend largely on other cognate branches of reconstruction and social activity, such as education, housing, transport and electrical plant. Scientific research will also be needed in many of the industries. In fact, Lord Selborne's Committee on Agricultural Policy has already recommended that grants should be made through the Agricultural Organisation Societies in England, Scotland and Ireland, or through the County Councils. Grants for experimental work have been made in the past to the British Flax and Hemp Growers' Society and to the British Tobacco Growers' Society, and similar grants could be made to other like bodies Ultimately rural industry will

have to stand on its own legs, be economically self-supporting, able to face world-wide competition, and not be artificially bolstered up in any way. Much good work has already been done by voluntary organisations and private individuals; and if a considerable measure of success has been achieved in the past in the face of inertia and neglect, there seems no limit to the possibilities when this great social reform movement is powerfully backed up by better housing, better transport, and all the blessings of electricity, rural education and scientific research, and public sympathy based on knowledge."

Agricultural Labour in Other Countries.

GERMANY.—On 30th January the Government issued a new code intended to regulate conditions of labour on the land, to check the exodus from rural districts, and to attract urban wage-earners to agriculture. In particular it deals with the question of dwelling accommodation for agricultural labourers. Hitherto agricultural labourers have been at a disadvantage under the Civil Codes of the various federal States. Thus in Prussia under a law of 1854 agricultural labourers have been liable to a year's imprisonment if they "take concerted action for causing persons in the service of a certain employer or number of employers to go out on strike, or if, with a view to obstructing the work of such persons, they endeavour to compel either the employers or the authorities to do certain things or to grant certain concessions." In future the provisions of the Civil Code with regard to contracts of service are to apply to persons engaged on agriculture, forestry and kindred occupations.

The main provisions of the new Agricultural Labourers' Code are as follows:—

Hours of Labour.—The number of daily hours of labour is not to exceed, on an average, eight for four months of the year, ten for other four months, and eleven for the remaining four months. Payment for overtime is at a special rate. The time spent in going and coming between the farm and the place of work is included in working hours, but not the interval for rest nor the time spent in feeding horses or cattle. In the summer half of the year, at least two hours' rest a day must be allowed.

Wages.—As a rule wages in cash must be paid by the week. Where payment is partly in kind the produce paid must be of the average quality of the year's crop and must be measured by the metric system. Payments in kind must be made quarterly in so far as the nature and use of the produce allow. Where the produce due as wages in kind cannot be delivered its value must be paid in cash, reckoned according to the official maximum producers' prices, or, failing such, according to the maximum prices obtaining in the nearest market.

Since dwelling accommodation, allotments and other allowances often form part of labourers' pay, they must, if they have been guaranteed by the employer as part of such pay and if they have no market value, have their monetary value determined and recorded in writing.

When contracts of service have been concluded for the period of a year the pay must be distributed evenly over the various seasons. Should there be a breach of a contract of service the deduction from wages by way of penalty must not exceed one-fourth of the cash wage due, and in the aggregate such deductions must not exceed fifteen times the local standard daily wage for common labour, as laid down in the National Insurance Code.

At least one-tenth of the local standard daily wage, as laid down in the National Insurance Code, plus a 50 per cent. bonus, must be taken as the hourly rate of payment for overtime. In estimating payment for overtime the time occupied in feeding and looking after cattle must be reckoned as overtime unless it be the local custom to include this work in the contract of service. Other urgent kinds of work done on Sundays and holidays must be paid for at the rate of double the daily wage locally current under the National Insurance Code.

Workers' Committees.—The new code provides that a workers' committee shall be formed for each farm or other agricultural unit, and shall draw up working rules to be conspicuously posted within the farm

Protection of Women Workers.—Women agricultural workers who have charge of a household must be released from work in time to allow them to return home an hour before the principal mealtime. They must be released from work on Christmas Eve, Easter Eve, and the day before Whitsunday. If they have to look after a large household or if they board workers not belonging to their own family they must not be obliged to work, except in cases of necessity, to an extent which seriously interferes with the performance of their domestic duties.

Dwelling Accommodation.—Housing accommodation must be unexceptionable from a moral and a sanitary point of view. In the case of a married couple it must be adequate, allowing for the number and sex of children. The dwellings of unmarried labourers must be durable, must admit of being locked up, and must be furnished at least with a table, bed, chair, lock-up cupboard and washing accommodation.

Cancelling of Contracts of Service.—Violence, coarse insults, immoral incitements in the course of employment, obstinate refusal or neglect to fulfil duties, repeated irregularity in paying wages, bad food, insanitary housing, constitute sufficient grounds for the cancelling of a contract of service, but not political activity or agitation in connection with trade unions

The code also provides for safeguarding the interests of pensioners, especially disabled soldiers, for the prevention and settlement of labour disputes, and for joint consultation between the employers' association and the agricultural labourers' delegates

The code had force from the day it was promulgated.

ITALY.—In Italy a shorter working day has been introduced by agreement between employers and work-people, thus anticipating or supplementing legislation on this point. The 8 hour day or 48 hour week has been agreed upon in agriculture. In lower

Milanese the actual number of hours worked will vary in length according to the season, being 6 per day from November to January, 7 in February and March, 8 in April and October, 9 in August and September, and 10 from May to July.

In the *Tribunal* of 4th April it was reported that at a meeting of representatives of agriculturists and agricultural workmen the unanimous decision was reached that the working time for agricultural labourers of either sex hired by the day should be 8 hours per day. To meet special needs due to the season of the year and to weather, overtime will be allowed, under certain conditions, if no other labour is available, to be paid for at a higher rate.

The time of beginning work and the intervals may be regulated according to circumstances in order that labour may be used to the best possible advantage, always within the limit of 8 hours.

PORTUGAL.—A new decree, coming into force on 17th May, relating to hours of labour has been issued, according to which the maximum working day is fixed at 8 hours or 48 per week, but agricultural workers do not come within the scope of the decree.

DENMARK.—The negotiations between the Danish Employers' Federation and the Federation of Danish Trade Unions have resulted in an agreement for the introduction of an 8 hour working day or 48 hour week as from 1st January 1920, but agriculture, does not fall within the scope of the agreement.

Farm Bookkeeping and Cost Accounting.

COST accounting necessitates a more elaborate system of book-keeping than most farmers have cared to contemplate. Many farmers, however, who have not hitherto been in the habit of keeping accounts at all have recently begun this practice since the assessment for income tax was altered, and once they have got their books in order and found the benefits of a clear and simple form of accounting, they may well ask themselves if it would not be worth their while to extend their system and find out how the different branches of their farm compare as to financial results. The subject, however, is by no means a simple one, and to the average farmer, who must in general be his own book-keeper, the keeping of ordinary accounts is an irksome and at times sufficiently puzzling task. Partly for the purpose of assisting him in this work an Agricultural Costings Committee, as is generally known, has recently been formed, which aims at the dissemination among farmers of information as to the best methods of keeping books and records of costs and as to the advantages of doing so. In view of the present importance—for the fixing of prices, etc.—of obtaining data as to costs of production, the Committee hope that farmers who have been in the habit of keeping accounts will be willing to supply them with particulars on which to calculate costs in general, and also to compare different systems of farming.

Somewhat similar work has been done in other countries especially Germany and Austria, and the following notes on the

methods adopted in the latter country and in Sweden and in Switzerland, where also book-keeping bureaux have been established in recent years, may be of interest. The articles from which the information has been extracted appeared in bulletins published by the International Institute of Agriculture.

AUSTRIA.—In Austria the work of these bureaux consists in the keeping of the books of over 1200 estates of all sizes. The central bureau in Vienna, which at first was occupied only in establishing new bureaux and working out uniform regulations for the intercourse between these offices and the farms connected with them, had, in the years immediately before the war, turned its attention to working up the data which had been collected regarding the different estates as to total profitableness and costs of production, the economic position of the farm and its relation to factories, the intensity of the farming and chief source of income, and other important points. The principal aim of the book-keeping bureaux in Austria is not only to keep accurate accounts of every event taking place on the farm, but rather to draw correct conclusions from the books to enable it to give good advice to the farmers, so that they may avoid failure and obtain the largest possible return from the property under the circumstances.

An example of the working of one of these bureaux having 119 members is given. Each member sends to the bureau every week a detailed report of all the events of the farm. Three persons are employed in registering and entering these reports. One is entrusted with the whole correspondence, two close the accounts and balance the ledgers, while one works up the statistics of all the farms from a commercial standpoint After the accounts have been made up and the balances struck, the head of the bureau reckons the cost of production and draws up the final reports, in which economic advice is given. He also visits the farms and thus keeps in touch with the members. The greater part of the expenses of the bureau are covered by State and local grants.

In the opinion of the writer of the article quoted it would be a mistake to offer farmers compensation for the expenses incurred in making the weekly returns; the slight trouble entailed by these weekly reports should be fully compensated by the benefit of accurate book-keeping and the knowledge of the cost of production.

SWEDEN.—In Sweden various factors have contributed to the spread of the practice of book-keeping. The introduction, about twenty-six years ago, of prizes for the best-managed small holdings gave the first real impetus to the movement, particularly after it was decreed by statute in 1902 that "the farmer who for his farm has received a prize in money cannot be awarded a second prize for the same farm unless he submits to the Commission of Prizes his notes drawn up according to the forms fixed upon by the Direction of Agriculture, and collected by him since the time at which the first prizes were distributed" Other factors instrumental in increasing the interest in book-keeping have been the ever-growing intensity of farming in Sweden, which has caused the need of control to be more sensibly felt; the spread of Control Associations (at the beginning of 1912 Sweden possessed over 700

associations for the control of dairies and pig-rearing concerns), which has contributed greatly to a better understanding of the economic importance of agricultural book-keeping; and finally the establishment, by the law of 1910, of taxation on capital and on income, which has rendered compulsory, to a certain extent, the practice of account-keeping.

Among the measures lately adopted in order to extend the movement among practical farmers the following may be mentioned:—

(1) *The Creation of Agricultural Book-keeping Bureaux.*—In 1911 and 1912 bureaux of agricultural book-keeping were established in several provinces by associations of rural economy and by other associations formed specially for the purpose. In order to explain the organisation of these bureaux the following extracts are given from the statutes of the agricultural book-keeping association of the province of Malmohus, which has its seat at Malmo:—

> "The Association is organized as an economic association without personal liability, and a representative of the Society of rural economy of the province has a seat on its committee.
>
> "The book-keeping bureau established by the Association has the following objects in view: keeping and closing complete farming accounts based on the annual reports sent by farmers; auditing accounts; making inventories; drawing up individual declarations; distributing forms for book-keeping; and compiling, from the material which it receives, reports of some value for elucidating economic questions of general interest."

There are three methods of book-keeping adopted by the Swedish bureaux. A, simple agricultural book-keeping; B, more extended book-keeping, with special accounts for the various branches of the farm, to which is added for C, a detailed control of the returns of the various crops.

The subscription to be paid for the keeping of books is based on the time spent for each member, and the minimum fee for closing accounts is, for the three types of book-keeping above mentioned, 20, 40 and 60 crowns (£1, 1s. 8d., £2, 3s. 4d., and £3, 5s.) respectively. The sum to be paid for keeping the books has varied up to the present from 0·50 to 2 crowns per hectare of field (2½d. to 10½d. per acre), according to the size of the farm and the more or less complete system of book-keeping.

This association works also in connection with the control associations; the assistants of the latter help the farmers in keeping their current accounts, after which the control and closing operations are done at the bureaux.

(2) *The Appropriations granted by the State and the Associations of Rural Economy for the Spread of the Practice of Book-keeping among Small Farmers.*—According to a resolution voted by Parliament in 1911 a sum of 15,000 crowns (£900) is granted every year for distribution among the small farmers who apply to the book-keeping bureaux approved by the State and by the Association

of Rural Economy. This subsidy is paid to the bureaux to which the farmers have entrusted the closing of their accounts, and it amounts to 15 crowns (16s. 3½d.) during four years for each account closed in the course of the year, for farms not exceeding 185 acres of arable land; it is given on condition that the Association of Rural Economy pays an equal sum.

(3) *Special Courses of Book-keeping for Farmers.*—Eight years ago, on the initiative of the Associations of Rural Economy and of some private persons, a great number of courses of book-keeping were organised throughout the country for the benefit of farmers. These courses, which last only a few days, have generally been well attended. Further, instruction in simple agricultural book-keeping is frequently a part of the programme of the supplementary schools attached to the primary schools in the country, and courses in book-keeping are also given in the higher and lower schools of agriculture.

SWITZERLAND.—In Switzerland, where the practice of book-keeping has made very satisfactory progress of recent years, the success of the movement may be attributed to the adoption of the following principles :—

(1) The selection of a system of book-keeping which spares the farmer unnecessary writing, but which enables him to balance his accounts correctly.
(2) Uniform instruction for the farmers, who must engage themselves by an agreement to keep their books.
(3) The balancing of the books by a Central Bureau.
(4) Comparative examination of the figures and use of the results in the study of questions connected with political economy and with the science of farming.

A simple form of book-keeping determining only the net returns of the property as a whole has been adopted in Switzerland. It does not entail upon the farmer the work of following the exchange of values in the interior of the farm It simply sets forth what the farm disposes of to third parties and what it gets from them, and shows at the end of the year in what manner the amount of its capital has changed from what it was at the beginning of the same period. Nevertheless, under the term "third parties" the farmer and his family are included, in connection both with eventual accessory undertakings and with consumption As this latter is often connected with that of the salaried hands, the common household is also considered as a third party. This system of book-keeping is therefore based on four accounts: Farm, Household, Accessory Undertakings, Consumption. The Household Account plays only the part of intermediary, and the expenses which it bears at the end of the year are distributed among the other three accounts in proportion to the number of persons maintained.

Instruction in Accounting. — Courses of book-keeping are announced by the agricultural press and by some of the political papers. The candidates must engage themselves by agreement to keep the accounts of their farm for at least one year, and to submit

their books to be audited by the Secretariat, which examines them also as to the profitableness of the farm. The candidates then take part in a three days' course, for which all their travelling and living expenses are reimbursed, and the necessary material, such as forms, etc., supplied free of charge. When the accounts are given up for audit, a diploma and a prize of 30 francs (about 24s.) are granted. Any candidates who, after having taken part in the course, fail to keep their engagement, are required to reimburse the Secretariat all expenses incurred on their behalf.

In order to encourage farmers to continue in the practice of keeping their books, the Secretariat supplies them with the requisite material and undertakes to balance their accounts for them. During the course of the first year each book-keeper is visited by an employee of the Secretariat, who checks the books, especially the inventory, draws up, on a uniform plan, a brief description of the farm, discusses and settles all questions likely to present difficulties, such as deciding on the amount of remuneration to be assigned to the farmer and to his family, or distributing the rent of the buildings, etc. The expenses of these researches, including the work done by the Secretariat, amount on an average to about £4 per annum per farm.

Closing the Accounts.—Owing to the somewhat complicated nature of this branch of farm-accounting, the work is in every case entrusted to a central office, which follows two methods in its procedure :

(1) The simple closing, which shows only the net returns and the income of the farms and of the accessory enterprises; and
(2) The amplified closing of accounts, which examines separately the various items of the gross revenue and of the expenses, without, however, doing the same for the net returns.

The two methods are a control on each other. The farmer receives only the simple closing of accounts.

Examination of Results.—The results of these books are submitted to methodical examination. The researches bear on the amount of capital employed, on the outlay for labour and the other working expenses, as well as on the gross and net returns and on the income. The consumption is also examined. By means of these investigations knowledge is gained as to the influence which the extent of the farms, the manner of utilising the soil, and the kind of farming, have upon the produce destined for the market, upon the intensity of the farm, etc.

Land Settlement in Switzerland.

In dealing with the problem of land settlement in Switzerland Dr. Bernhard[1] points out that the question has two aspects, viz., the intensification of cultivation and enlargement of the cultivated area and the increase of housing accommodation for the workers, both urban and rural. The following summary of his article should be of interest at the present time :—

Owing to the extensive industrialization of Switzerland and its

[1] "Die Innenkolonisation der Schweiz," by Dr. Hans Bernhard, *Zeitschrift für schweizerische Statistik Volkswirtschaft.*

mountainous character the proportion of territory planted with foodstuffs is almost the smallest among European countries. This unfavourable position with regard to the essentials of life has urged Swiss farmers to attempt land settlement. Another motive is supplied by the fact that the cultivated land has not yet been made fully productive. Vast areas of Switzerland, tens of thousands of hectares, are, from the point of view of the food-supply, no better than uncultivated although they are used for rearing stock. And these very lands are largely flat and fertile, and would lend themselves well to being broken up and cultivated, without any prejudice to the stock farming.

Among the uncultivated and depopulated lands the woods, which in Switzerland cover 900,000 hectares, can be numbered. From the point of view of land settlement they represent a very extensive area which might bear foodstuffs. But there is certainly a difference between tillable pasturelands and woodlands; the latter constitute a very precious element in the general economy of the country.

It is, however, a fact that in many places in Switzerland there are wooded areas where, for evident reasons of economy, there ought to be intensively cultivated land, while elsewhere, as, for instance, on the slopes of the mountain chains, where woods would be entirely in place, that system of small holdings prevails which is typified by farms of low economic value and difficult to cultivate.

If, on the other hand, we examine the conditions of land settlement in those parts of the cultivable territory which are already productive, we notice the inconveniences of an excessive division of the lands due to the lack of housing accommodation for the rural population, who are obliged to live in groupings which transgress every law of hygiene and economy. This state of affairs excludes much utilization of agricultural machinery, as well as the possibility of solving the problem of housing accommodation and the scientific extraction of a yield from the soil without loss of time and wealth The same is true, with due distinctions, of a realization of the value of mountain lands. Finally, due account must be taken of the reaction which large hydraulic works developing electric power have had on agriculture. Where they have been constructed on cultivated lands they have given rise to a far from negligible series of inconveniences and often to notable damage.

Other defects arise out of the problem of housing accommodation Within a comparatively brief space of time Switzerland has been transformed from an agricultural to an industrial State. Unlike the early domestic industries, which maintained the decentralization of the population, the industry of factories, which developed rapidly, united large masses of people in a few centres.

It is certain that the grouping of dwellings in the industrial centres arose without the important problem of provisioning and land settlement being taken into account. If a contemporaneous solution of this problem had been attempted, the industrial quarters of the large towns would have been differently planned, and important allotments of uncultivated land at a short distance from many industrial centres could have been handed over to the industrial

population to be cultivated or made more intensively productive. For this it would have been necessary to build on these lands workmen's dwellings connected with the town by modern means of communication. An excellent opportunity was thus lost of obtaining an important contribution to the food-supply from a class of the population unconnected with rural economy and from more or less uncultivated lands; and the urgent problem of providing dwelling accommodation for the industrial population remained meanwhile unsolved, and found itself faced by perpetually increasing difficulties in inconvenient, unhygienic and overcrowded districts.

Having dealt with the defective utilization of the soil of Switzerland, considering the matter from the point of view of the cultivation of foodstuffs and of housing accommodation, we will pass to a description of the land settlement programme drawn up by Dr. Bernhard in view of the conditions we have examined.

The question is above all one of settling uncultivated lands. With this object works of land improvement were undertaken with the State's aid, but no works of this kind were ever undertaken on the scale required.

Only the deficiency of foodstuffs which became apparent during the war and the very high prices of provisions awakened in landowners a desire to improve their lands. The State also, when faced with the increasing difficulties, showed itself more interested in the matter. In the canton of Zurich some improvements were undertaken, but works on a really large scale have not yet been begun.

The other problems of land settlement are connected with the effort to promote works of land improvement. Among these problems is that of forming new settlements of peasants. There is no lack of land, especially in the districts far from towns, which should be improved. Dr. Bernhard gives the exact situation of land adapted to this purpose.

Such undertakings would be useful from every point of view. Not only would there be a new acquisition of cultivated land, but these new agricultural units would, at small expense, give a larger yield than the old over-divided farms The plain of the Rhone in Valais would be particularly adapted to the scheme. On it many independent farms, to be cultivated by machinery, and measuring from 10 to 20 hectares each, could be formed, to the evident advantage of the class of small farming landowners.

Another necessary part of land settlement is the transference of agriculturists from lands adapted to hydraulic or other works entailing the suppression of agriculture. Dr. Bernhard instances the Sihl Lake scheme. He states that in this and other like cases a forced expropriation of peasants, who will be indemnified in accordance with established custom, is contemplated. This proceeding is costly, and it does not solve the problem, because the peasant cannot, with the sum he receives, re-establish his farm elsewhere, and is in most cases obliged to emigrate, which obviously involves a loss to the national economy. The best solution would be to provide for peasants of this kind the means to find in the neighbourhood a field for their activity corresponding to that they

gave up, as regards both its political and its economic conditions. In other words, the case is practically one for breaking up the uncultivated land in the neighbouring districts.

The most conspicuous and valuable task which Swiss land settlement is called upon to accomplish is, however, connected with the victualling and housing of the industrial and urban population. We must not forget that it was industrialisation which in Switzerland gave birth to the movement for land settlement. The question is one of decentralizing the non-agricultural population and bringing it into contact with the soil. How can this be done?

Above all, by giving a new impulse to the movement to form within the circumference of towns gardens, of which a quite inadequate number exist to-day.

The increased cultivation, as gardens, of lands within the circumference of industrial towns does not, however, suffice to meet the needs of the industrial populations. The lack can be supplied only by using larger areas of uncultivated land, situated at some distance from inhabited centres, for this purpose. When this is done the scientific realization of the value of the land by industrial firms or communal administrations is to be preferred to individual cultivation on the part of families of towndwellers or small farmers.

We have still to notice an important part of land settlement, the system, namely, of organising permanent dwellings for the urban and rural populations. If the consequences of the urban agglomerations of population, and of the difficulties of victualling the large towns which arose during the war, be considered, the urgency is understood of the problem of decentralising industrial towns, and the fact also that this should be considered one of the chief problems of land settlement. It is so all the more because, owing to the introduction into industry of the new working hours, the workman is not obliged to live in the immediate neighbourhood of his factory or other place of employment. The electrifying of railways will do away also with many of the inconveniences of travelling.

The area of towns which is built upon must not be expanded except in accordance with regulating plans.

It is necessary that in the policy of housing and of planning urban centres the principle prevail that every family not following the trade of agriculture have the use of a house of its own, and that this house, in accordance with the size, trade and means of the family inhabiting it, either have attached to it a few ares of land to be cultivated or have dependent on it a regular agricultural holding. It will not be difficult to attain to this solution in Switzerland, for most of the industrial centres have in their neighbourhood much uncultivated land which would lend itself well to being rendered productive by settlement of this kind.

In these settlements it is essential that agricultural work be done by mechanical means, and the planning and grouping of the houses must be such that the land to be cultivated can be worked in common, and time and expense thus economised.

Dr. Bernhard states that in Switzerland an important work in

the field of land settlement lies before the State. In the first place a Swiss land settlement law is necessary.

It should comprise the following main points :—

(1) It should ensure the greatest possible support in all cantons to every work of agriculture, especially the important works of land improvement ;

(2) It should similarly promote all measures referring to the population of rural districts, and should with such object improve the condition of mortgages ;

(3) It should facilitate the acquisition of lands, and in the first place of lands now uncultivated which lend themselves to being settled ;

(4) It should provide measures of gradual compulsion by which those concerned would have to collaborate in the works of public utility connected with land settlement.

Agricultural Reconstruction in France.

The following notes based on extracts from an interesting article which recently appeared in the *Times* on agricultural reconstruction in France, may serve a useful purpose if they bring more clearly before us the magnitude of the problem with which that country is faced.

When the enemy struck his blow in August 1914, its force was immediately felt in agriculture, for the mobilisation of every man of military age left the burden of labour to be borne by the women and children and the aged Matters were rendered still worse by the requisitioning of most of the farm-horses and cattle, and by the great scarcity of artificial manures, which rapidly became abnormally dear, superphosphates rising from about 6½ francs to 30 francs per 100 kilogrammes (*i.e.* 11s. 6d. per cwt.), while tools and implements cost three times as much as before. Despite the almost superhuman efforts made by the women of France, and the admirable results obtained, it ultimately became necessary to reduce the acreage under cultivation. The following summarised statistics throw some light on the extent to which this diminution took place.

In 1918 the acreage under wheat, one of the main crops of France, was 4,800,000 hectares,[1] as compared with 6,500,000 before the war, and it is estimated that this year's crop will yield only 50,000,000 quintals,[2] or about half that of a good pre-war year. The oat crop is in an even worse case, the present total yield being only about 30 per cent. of what it was before the war. Live stock of every description has suffered equally badly, but the most noticeable and important feature has been the diminution in the supplies of cattle, amounting to two-and-a-half millions, involving great loss to the dairying industry through the decreased production of milk and the consequent scarcity of butter and cheese. Sheep and pigs have both decreased during the war by

[1] 1 hectare = 2·47 acres
[2] 1 quintal = 220·46 lbs.

over 40 per cent., the former falling from 16,000,000 in 1913 to 9,500,000 in 1918, and the latter from 7,000,000 to 4,000,000 over the same period.

It will be seen, therefore, that the reconstitution of French agriculture must in any case be a most difficult problem, even were it not further complicated by the existing systems of land tenure. "Owing to the extensive subdivision of estates in France, the soil is often broken up into holdings so small that individually they cannot come under machine cultivation to the extent which to-day is so necessary. Recently a law was passed to facilitate the re-aggregation of these very small holdings through the formation of local associations of landowners. Under the operation of this law it should be easier to educate the farmer regarding the essential advantages of modern agricultural machinery. The spirit of co-operation has indeed made considerable strides for a long time past through the medium of agricultural syndicates, but it will have to develop still farther in order to take fuller advantage of the system of agricultural credit, of which at present too little use is made, considerable financial resources which should be at the disposal of the agricultural interest remaining at present untouched."

Mention may be made at this point of the departmental and district agricultural bureaux which have recently been established for the purpose of popularising a more extended knowledge of modern agricultural methods; these bodies work in co-operation with the local associations. An annual grant in aid, amounting to twenty million francs, is voted by the French Government for the development of the scheme. The policy underlying the methods adopted by these bureaux is to influence the farmer by example and persuasion, and not by compulsion, to any form of which the Frenchman is temperamentally antagonistic.

The foregoing remarks deal with the general economics of French agriculture. But when one comes to consider conditions in the devastated areas, the obstacles offered to reconstruction in its most literal sense appear well-nigh insuperable. The war zone had an area of 4,844,000 hectares, three-quarters of which were devoted to agriculture, and it is stated that it would require an expenditure of no less a sum than 40,500,000,000 francs to re-establish the ruined provinces.

The area of the actual fighting ground was about 1,225,000 hectares, of which 919,000 had been under cultivation. More than a tenth of this area is completely destroyed, its soil useless, and many of its villages obliterated.

Some 800,000 hectares, not so completely devastated, have suffered very serious damage from the churning up of the subsoil with the crop-bearing earth, and the destruction of survey marks, pastures and plantations.

A third zone is that behind the immediate front line, which was occupied by the enemy throughout the war. The approximate area of this zone is 2,560,000 hectares, of which 1,920,000 were under cultivation before the war. While the soil in this area has not been so seriously affected as in the other zones mentioned, it has suffered from the consequences of neglect and vicious methods of cultivation practised by the enemy.

The plight of the refugee peasants returning to such land is too often very pitiable. If the house and outbuildings have not disappeared, furniture, tools and implements of every description have been smashed or pillaged, and the stock scattered far and wide. The farmer who returns to this desolation is more often than not destitute, and dependent on the State or public philanthropy. "A law is now in force which solemnly assures to these people the right of a complete restitution in respect of the damage they have suffered, but the operation of this law obviously involves expert enquiry and a series of formalities before the first instalments of the indemnities can be paid, and months of delay and waiting would be necessary if credit were not obtainable. Such credit can be obtained from the Ministry of Agriculture, but before it is given guarantees are required which the isolated farmer is quite incapable of giving.

"In the circumstances the obvious course for these people is to group themselves into co-operative societies embracing one or more communes. By consolidating their holdings in this way they will be able to furnish the guarantees required to obtain credit.

"Agricultural co-operation has thus become the direct agent of agricultural reconstruction. The first associations of this sort were constituted during 1917, after the enemy retreat to the Hindenburg line. From that year onward a thousand or more tractors with ploughs have worked up considerable areas of soil, especially in Picardy and in Ile de France. At the same time, both on the British and on the French fronts, the Army Commands organized agricultural labour, and lent assistance, both in men and horses, to those farmers who persisted in carrying on their industry under the very fire of the enemy batteries.

"The number of agricultural co-operative societies[1] has increased considerably of late, and they work very smoothly. The various holdings are worked together as one farm under the general management of a chairman elected by the members of the society. All the various processes of agricultural work are carried on in common, and the profits are divided in proportion to the area held by each member. The society purchases the implements and machinery and also the stock required, taking advantage of the system of agricultural credit.

"However successful this system may be, it does not meet every requirement. It does not appear, for instance, to meet requirements in the way of rebuilding farmhouses and villages, and this, of course, is one of the most essential works incidental to the rebirth of the liberated districts of the country For some time past temporary shelters have been provided by the Government, but the larger number of those required are still to seek, and this is one of the principal obstacles in the way of bringing back the rural population to the country side. No obstacle, however, is large enough to keep the French peasant alienated from his land for long, and if some parts of the devastated provinces are lost for all time, others, thanks to passionately devoted labour, will in time recover their ancient place in the scale of national agricultural production in France."

[1] See JOURNAL for July 1919, p. 422.

Scottish Women's Rural Institutes.

THE annual conference in Edinburgh and the first exhibition of produce and handiwork at the Highland and Agricultural Society's Show may be characterised as outstanding events in the Scottish Women's Institute movement. The conference was well attended by delegates and institute office-bearers, many of whom stayed on in Edinburgh for a short course of lectures and demonstrations on the conservation of fruit and vegetables. The demonstrations were given at the East of Scotland College of Agriculture by Mrs. Candy, Lecturer to the Board of Agriculture and Fisheries.

A full account of the conference will be published in the "Women's Institute Handbook." Discussion on "Programme making for Institutes," "What Institutes can do to widen interests," and "The Possibilities of Recreation in Village Life," Local Exhibitions and Competitions," and "Co-operative Effort," evoked valuable information and suggestions, as many of the delegates are now able to speak from considerable experience. The following recommendations were made by the delegates :—

1. That the present constitution be maintained as a basis for future administration, to be developed as new needs arise.
2. That the Board be asked to continue to co-operate with the Institutes on the lines already adopted
3. That a practical woman be appointed to all Committees dealing with housing schemes in rural districts, and that where there is a Women's Institute in the district it should be asked to send a representative.

At the Highland and Agricultural Show each area was allotted a space in the stand provided, and the exhibits proved to be of a very high order,—needlework in all branches was well represented; there were interesting exhibits of tweed, baskets, rugs, lace, netting, and of specimens to illustrate the use of scraps. On the produce and food conservation side, there was great variety, and some excellent specimens were shown. The several areas awarded prizes to the Institutes sending in the best exhibits as a whole, and also to individuals showing especial excellence in different classes of work.

Women's Institutes have recently been formed in Dumfriesshire, Stirlingshire, Lanarkshire, Forfarshire and Aberdeenshire.

Agricultural Conditions.

THROUGHOUT Scotland the weather during July was abormally dry. The conditions were ideal for hay-making, but other crops suffered more or less seriously, and pastures became very bare. During the first three weeks of August the weather was fine throughout the greater part of Scotland, while during the last week or ten days heavy rain fell in most districts, which was beneficial especially to the potato and turnip crops September opened with fine breezy weather, but during the last fortnight there was a good deal of rain, with a spell of wintry weather at the end of the third week.

The harvesting of wheat began in the earlier districts about

the middle of August, and by the end of September it had been completed except in a few localities. The yield per acre is expected to be from 5 to 10 per cent. below the average. The cutting of barley was well advanced by the end of August, and by the end of September was finished except in the northern and some of the north-eastern districts. The estimated deficiency is about the same as tnat of wheat. Oats are the poorest of the cereals; the yield will probably be 10 per cent. under the normal, and straw is short in many districts. By the end of September the harvest was finished in the midland counties and on the lower ground in the southern counties, while in the northern counties there is still much to do, the harvest being notably backward in Skye and Shetland. The prospects of the potato crop have been much improved by the recent rain, but some damage has been caused by frost. The crop is, however, free from disease. The yield will be considerably under the average, especially in the important counties of Forfar and Perth. Turnips and swedes are generally healthy and vigorous, but much damage has been caused by green fly in Forfar, Perth and the Lothians, and mildew is prevalent in some parts of Forfar and Perth. The crop will be under the average. The prospects of mangolds are varied, but on the whole better than those of turnips.

Tree fruit is yielding fairly well in Perth and other districts, but in Lanark it has proved almost a failure; raspberries and strawberries suffered from drought, and the yields were considerably below the average.

Grazing cattle and dairy cows suffered from the drought, and pastures have as yet scarcely recovered. The milk yield has fallen off considerably. Sheep on arable farms have done fairly well, but are rather lean; hill sheep are, however, in normal condition in most districts.

Practically all the "pivotal" men whose release was applied for by the Board have now been demobilised, and the supply of regular men is now fairly adequate. Casual labour is almost everywhere deficient, and while, generally speaking, harvest work was carried through without much difficulty, there was in some districts a shortage of hands.

RECENT PERIODICAL LITERATURE.

A number of the following extracts and summaries are taken from recent bulletins of the International Institute of Agriculture. Full references to the bulletins, and to the original publications quoted therein, may be obtained on application to the Secretary, Board of Agriculture for Scotland, 29 St. Andrew Square, Edinburgh

Selection of Oats Resistant to Rust in the United States. *J. H. Parker, U.S. Dept. of Agric., Bull. No.* 629, *Washington.*—In the United States two kinds of rust, *Puccinia lolii avenae* M'Alpine (crown rust) and *Puccinia graminis avenae* Erikss. and Henn. (stem rust) cause considerable damage in the oat fields every year.

The article gives the results of inoculations on different varieties of oats in

greenhouses in order to offer a basis for making selections and crosses to produce improved oat varieties resistant to crown rust and suitable for culture in oat growing regions.

The greenhouse tests were made because in ordinary field trials no proper judgment can be made of the degree of immunity of a variety. For example the Sixty-Day and Kherson varieties, recommended as rust-escaping, were proved by the experts not to be so, their apparent immunity being due to their early-ripening habit. The employment of these two varieties in crossing might therefore cause disappointment.

In the experiment 3286 inoculations were made on seedlings or on headed plants. Unquestionable resistance to stem rust was present in two varieties, White Tartarian and Ruakura Rustproof. Several varieties of the red-oat (*avena sterilis*), including certain strains of Burt, Cook, Appler, Italian Rustproof, Red Rustproof and Turkish Rustproof, are very resistant to the crown rust. The variety Ruakura Rustproof alone was resistant to both kinds of rust.

Rust resistance is shown to be specific, for many of the varieties which are resistant to crown rust are susceptible to stem rust under identical conditions.

The results obtained by these experiments furnish the plant breeder with precise data for the selection of material for field experiment.

Stem-Eelworm and Crop Rotation. *J. K. Ramsbottom, Journ. Roy., Hortic. Soc., London*, 1919.—The appearance of Stem-Eelworm (*Tylenchus devastatrix*) in a crop of narcissus bulbs and the impossibility of continuing narcissus cultivation, afforded a chance of testing the value of succession of crops on a badly infested plot of land. Experiments in manuring with fertilizers, and in treating the soil with sterilizing chemicals such as naphthaline, carbon-bisulphide, gas lime, toluol, calcium carbide, formaldehyde and ammonia, gave no dependable results in freeing the soil from the eelworm. Crop succession was then tried with decided results. Onions planted on the infested soil germinated well, but the young plants were completely destroyed. Yet other crops which had been recorded as harbouring stem-eelworm escaped injury. Such was the case with rye, oats, clover, lucerne, peas, broad-beans, rye-grass, wheat, chives, buckwheat and potatoes. The susceptibility of onions was also indicated in another experiment where of many crops grown in sterilized soil, but watered with water infested with eelworms, onions only were harmed. The invulnerability of susceptible species of plants to the eelworms of the narcissus bulbs confirms the idea that races of stem-eelworms become so adapted to one particular kind of plant that they will not attack another kind, even though that other kind is known to have been subject to the attacks of other races of the stem-eelworm.

Cropping as a check to Wireworms and Leather-jackets in Britain.—In the *Gardeners' Chronicle* (1919) Mr. J. C. F. Fryer says that by preference wireworms will not attack a mustard crop, and that even when forced by necessity to do so they do not thrive, and without other food will gradually die out. Moreover the decomposition of a mustard crop when ploughed into the soil seems to be actively harmful to the wireworms. The author therefore recommends that mustard be sown in either April or May as a seed crop to last all summer, or in late summer after fallow or early harvested crop, when it may be ploughed in green or eaten off by sheep. As a preventive treatment against wireworms and leather-jackets he thinks that probably the best method is to sow mustard as a first crop, preferably for seed.

New Measure against Cabbage Maggot. *E. B. Stookey, Jour. Ec. Entom. Concord.*, 1919—In view of the very considerable damage done by this pest to cabbages in fields, gardens, and especially allotments, during the present season, the following American recipé may prove of some value. Many experiments were carried out with a view to controlling the destructive maggots of this fly (*Phorbia brassicæ*), and of these the most successful turned out to be treatment with green tar oil, as follows:—One part Anthracene oil was mixed with 80 parts soil, and the mixture was sprinkled round each plant as it was transplanted. This effectively prevented the egg-laying of the flies near the cabbage plant. Strong mixtures of oil and soil (1 to 20) proved harmful to the plants, but probably a mixture weaker than that recommended would be effective. One U.S. gallon of the mixture sufficed for 200 plants.

A Study of Two Types of Commercial Milk. *Freear, Buckley and Stenhouse Williams (Research Institute in Dairying, Reading. Camb. Univ. Press,* 1919).—The investigations described in this paper form part of a general inquiry as to what steps can be taken to improve the general level of market milk in the country.

A preliminary enquiry had shown that the milk which is supplied to our large towns is subject to a loss of 1 to 2 per cent. due to "souring," and that, of the remainder, a very considerable proportion arrives in such a condition that it is necessary to pasteurize it before it can be delivered to the consumer. Since about 70 per cent. of the milk produced is consumed as milk, these losses represent a grave wastage of foodstuff, money and labour. Estimates of the extent of these losses were published in the Journal of the Royal Agricultural Society of England for 1918.

It was decided, therefore, to make a comparative study of the relative keeping qualities of "clean" and "average" milk, both produced for commercial purposes, and at the same time to investigate the bacteriological content of the samples in each case.

The work was carried on for a year, and full details of the methods of investigation employed are given.

Methods of Production and Distribution of the Clean Milk.—The cows were milked in a special milking barn, which was kept scrupulously clean. After each milking, the floors, gutters, walls and mangers were washed and cleansed thoroughly, and in the mornings the walls, which were finished with smooth cement, were scrubbed with a brush. The cows were brought in night and morning, and were so arranged that they faced inwards. By this arrangement the light from the windows or from the electric light on the walls fell upon their hind quarters, and the workers were able to see exactly what they were doing. At each milking the cows were carefully groomed and cleaned. The udders and teats were washed with cold water and afterwards wiped with a clean damp rag. The hair on the udder was always kept short by means of a horse clipper, and the brush of the tail was cut so that it did not reach beyond the hock. The most scrupulous cleanliness was insisted upon as regards the workers' hands, overalls and caps. The milking stools were also kept clean so that the hands of the milkers might not be soiled. The milking was done by hand, and the milking pails were of such a shape as to prevent, as much as possible, hair and dirt from the cow falling into the milk. The milk from each cow was immediately removed to the weighing room, which adjoined the milking barn, and was then carried to the dairy, which was situated at a distance of 20 yards from the milking barn.

The milker did not enter the dairy, but poured the milk into a small receiving tank which was placed on a bracket outside the wall of the dairy immediately before each milking. A tube from the tank passed through the wall and conducted the milk to a "Max" filter. From this the milk passed over a cooler and then into carefully cleaned churns or bottles. The cooler was cooled with water from a deep well, no refrigerating plant being available owing to war conditions. The milk was not therefore cooled as low as was desirable, the temperature varying from 45° to 62° F., but being generally from about 50° to 56° F.

The churns and milking vessels and bottles were all carefully cleaned first with cold water, next with soap or caustic soda and hot water, and then rinsed with cold water. They were finally sterilised with live steam for 20 minutes.

In the case of the milk produced under "average" conditions, the cows were groomed once a day. After the morning milking the cows were turned out and the shed washed out. The teats were given a superficial wipe with a cloth which had been dipped in a bucket of cold water, but beyond this no further attempts were made to ensure their cleanliness at the time of milking.

The cleanliness of the hands and clothes of the milkers was uncertain. The milk was weighed and then strained through a flannelette strainer in the byre, and stood there until two large cans were full. It was cooled in the summer months. After the morning milking the cans and utensils were all washed with soda in a tank of warm water, the water being unchanged during the washing. The utensils were not rinsed in clean water after being taken from the tank, but were immediately set up to dry. After the afternoon milking the utensils were merely rinsed with cold water and set up to dry ready for the morning milking.

Periods of sweetness of Clean Milk when stored at different temperatures.—The notable feature of the samples of clean milk was their uniform character;

the length of time which they kept sweet depended on the temperature to which they were cooled, the temperature at which they travelled, and the temperature at which they were subsequently kept in the laboratory. By the time it reached the laboratory the clean milk was already 22 to 26 hours old. Notwithstanding this, and although its temperature on arrival was sometimes as high as 76° F., it remained sweet when kept in an ice chest for periods which varied from 7·75 days to 32 75 days In a cool cellar it kept from 1·75 days to 18·75 days, and at the ordinary temperature of the laboratory from 1·75 to 6 75 days On no occasion did it arrive sour in spite of the unsatisfactory conditions of transit.

The "Average Milk," on the other hand, reached the laboratory about 3 hours after milking In the ice chest the longest period of sweetness was 19 days and shortest 4 days, the great majority of the samples (36 out of 40) remained sweet for 6 days or more In the cellar no sample remained sweet for more than 6 days, and 10 per cent of the samples were sour in 1 day. In the laboratory one-third of the total number of samples were sour in less than 24 hours, and only one sample remained sweet for 5 days The variations in time of keeping are accounted for by the seasonal variations of temperature at different times of the year

Comparison of the Bacterial Content of "Clean" Milk and "Average" Milk.—An examination of the bacterial content of the various samples showed that in spite of the fact that the average milk reached the laboratory only 3 hours after milking, its bacterial content was very much higher than that of the clean milk, and that it regularly contained large numbers of gas-producing organisms In the case of the clean milk, on only two occasions were more than 10,000 organisms found per c c, while the numbers generally present were only a few hundred The "average" milk, on the other hand, frequently contained over 200,000, and on several occasions from 1 to 14 millions in the same quantity

A considerable capital outlay was involved in the production of the clean milk, but the extra cost above the market price was not more than 3d per gallon It is pointed out that the production of clean milk requires a sufficient supply of the proper apparatus, and workers who possess not only intelligence and enthusiasm, but also that kind of vision which is not dependent on the eye alone for its conception of "dirt" The provision of modern apparatus alone is not sufficient, as was evident from the results obtained from another farm On this farm considerable sums of money had been expended in providing a milking shed of the most approved type and all the necessary apparatus for the production of clean milk, yet the samples which were sent to the laboratory were rarely up to the standard At no time was the work under the supervision of a person with the necessary knowledge, and when visits were paid to the farm at milking time, grave errors in the methods of production could always be demonstrated If clean milk production is to become at all general in this country, provision will require to be made for the proper technical training of those engaged in the dairy trade

The Production of Veal *versus* **that of Milk** *A Goutn* and *L Andouard, Comptes rendus des Seances de l'Academie d'Agriculture de France*—The authors are of the opinion that during the present food shortage it is in the general interest that less veal be produced, and that the milk used in producing veal be used as human food A pound of veal contains about 190 grains of nutritive constituent, while there are about 77 grains in a pound of milk of average richness

The authors give in a table the amount of milk and grain consumed by a calf during ten-day periods up to the age of sixty days It is shown that at first the calf consumes milk three times the nutritive value of the veal produced, and later, from the fortieth to the sixtieth day, of six times the value

If the calf is kept until it reaches 220 lbs, the 132 lbs gained since birth represent a nutritive value of 55 lbs., and it has consumed 154 gallons of milk of a nutritive value of 262 lbs; that is, it has consumed five times as much as it has produced

The authors state that the veal from very young calves is not unsuitable for human consumption.

The Irish Dressed Meat Trade. *S. A. O'Leary, Better Business*—The author is the manager of the Wexford Meat Supply and Bacon Factory, Limited, and outlines a policy for the establishment and development of an ex-

port trade in dressed meat. It is pointed out that, to be of any advantage to the farmer or to the country, the dead meat trade must be handled on co-operative principles. Unless action is taken on these lines at an early date, before the export of fat live stock ceases, the writer predicts the domination of the trade by a meat combine, and gives some interesting notes on the unscrupulous methods employed by the five big firms of meat packers in America as revealed by the investigations of the Federal Commission appointed by President Wilson.

He goes on to indicate the many advantages of a co-operative dead meat trade for Ireland. The present loss of carcase weight in transit to Scotland and England is estimated at from 20 to 25 lbs. per animal of 5 cwt. dead-weight, or the value of £1 to £1, 10s. per head. With 400,000 fat cattle exported from Ireland annually, there is therefore a yearly loss, through wastage alone, of over half a million sterling, which would be saved under the other system advocated. Moreover, as a consequence of bad treatment in handling, the carcases are frequently badly bruised, which causes deterioration in value and has the effect of lowering the reputation of Irish meat.

The main advantage of a dead meat trade, however, is that it would raise the price of cattle to the farmer by a figure which would make the fattening of cattle one of the best paying parts of his business, instead of, as in recent years, a more or less unprofitable side-line carried on as a necessary adjunct to tillage. During last winter and spring the cost of fattening a two-and-a-half year old bullock was not less than from £1 to 23s. per week, and on an average the amount of carcase weight put on would fall short of this figure in value. A co-operative dead meat trade would render cattle-fattening much more profitable, owing to the utilisation of the by-products, which, in a factory handling from 100 to 150 cattle weekly, would represent an increase of from 10 to 15 per cent. in the value of a beast. The profitable utilisation of such products as horns, hair, fats, casings, blood and offals, however, would necessitate fairly large supplies coming forward, and the development of a good business organisation to deal with them.

Another immediate advantage to the country would arise from the amount of employment which the slaughter of cattle and handling of the by-products would give. The slaughter and treatment of say 400,000 cattle in Ireland and the carrying on of industries arising therefrom would provide employment for a considerable number of men and women and involve the expenditure of about £600,000 per annum in wages, the circulation of which would greatly benefit the community generally.

The establishment of a co-operative meat trade would, futhermore, have far-reaching effects on the live stock industry, in that it would give the farmer complete control of the disposal of his produce to the consumer in other countries. The writer expresses the view that the present position of subservience of the farmer to dictates of manufacturing and distributing capitalist combinations renders progress in Irish agriculture impossible, and reacts in every sphere of the national economic situation.

Finally, the increase in the cattle-fattening industry which would follow the development of the trade would increase the fertility of the land, and make the farmer less dependent on artificial manures.

Some interesting notes are then given on the development of the dead meat trade in Wexford, where a co-operative factory was opened in 1912. In that year there was a turnover of about £34,000, and its subsequent development has now brought the annual trade to about £400,000. Arrangements are being made to deal with increased supplies, and it is hoped in another year to double the present output.

It is suggested that six or eight factories on the Wexford model could be established at centres where the supply of fat stock would be sufficient to provide about 5000 head annually. The capital required for such factories would be from £10,000 to £12,000, which sum would include the instalment of plant for dealing with by-products. For economic purposes, however, the writer proposes the establishment of a central tannery and fat refinery to handle the output of all the factories, under the management of a registered federation, which would also take in hand the selling of the goods exported. A very necessary adjunct to each factory would be a system of technical education in matters connected with the trade, *e.g.* refrigeration, steam, electricity, tanning, meat inspection, etc. The promotion of the scientific breeding and fattening of stock would also be

dealt with by the central body. Such a federation would be in a very strong position to protect its domestic interests in every way, and its linking up with consumers' co-operative societies in England and elsewhere should go a long way towards solving the food price question.

Digestion Experiments with Pigs in Illinois. *H. S. Grindley, W. J. Carmichael* and *C. I. Newlin, University of Illinois Agric. Exper. Stn., Bull. No.* 200.—The objects of the experiments were as follows:—(*a*) To determine the influence of one feed upon the digestibility of the nutrients of another feed; (*b*) to study the individuality of pigs as to the thoroughness with which they digest their feed; and (*c*) to determine the coefficients of apparent digestibility of the nutrients of the following six rations:—wheat flour middlings, ground corn, ground barley, wheat flour middlings and ground corn in the ratio of 1 to 1; ground barley and corn in the ratio of 1 to 1, and tankage and ground corn in the ratio of 1 to 7·5.

The authors conclude that: (1) the coefficients of digestibility of the nutrients of feeds, calculated indirectly by subtracting the weights of the digestible nutrients of one feed as directly determined in other tests from the corresponding values for the two feeds combined, may be, and probably often are, decidedly inaccurate, and (2) the weights of the digestible nutrients of a mixed ration, calculated by the use of the coefficients of digestibility of the nutrients obtained directly for the individual feeds when fed alone, may be decidedly inaccurate.

It therefore follows that, in order to obtain strictly accurate results for the coefficients of digestibility of mixed rations, digestion experiments should be made directly upon the mixed rations as fed.

The authors conclude that, under conditions that are practically identical throughout the same experiment, the coefficients of digestibility of the nutrients of a number of different rations show significantly higher values for some pigs than for others. However, the differences in the coefficients of digestibility of the nutrients of the same feeds by the different pigs are probably too small to be considered of much, if any, practical or economic importance.

Effect of Heat on Trichinæ. *B. H. Ransom and Benjamin Schwartz, Jour of Agr. Research, Washington.*—It is a well-known fact that the larvæ of *Trichinella spiralis*, which are of rather common occurrence in pork, may be killed by thorough cooking, and the meat thereby rendered safe for food so far as concerns the danger of Trichinosis. As to the actual temperature required to kill the parasites, however, various writers give very different figures, so that the question of the thermal death point has been rather uncertain.

From the results of recent investigations made by the writers into this question, the following conclusions are drawn :—

The vitality of the larvæ of the *Trichinella spiralis* is quickly destroyed by exposure of the parasites to a temperature of 55° C., gradually attained, the result apparently of irreversible coagulation changes in the protoplasm. This temperature may be considered the thermal death point.

Trichina larvæ exposed to temperatures slightly below 55° C. for short periods of time may recover from this exposure; but they die if exposed for longer periods, recovery or death depending apparently upon whether or not coagulation of the protoplasm has proceeded beyond a stage from which a return to normal may occur.

Exposed to temperatures in the neighbourhood of 50° C., trichina larvæ die if the application of heat is sufficiently long continued, apparently as a result of exhaustion following excessive activity to which they are stimulated by the heat.

The longevity of trichina larvæ freed from their cysts by artificial digestion, and kept at temperatures ranging between limits at which they become quiescent from the effects of heat and cold respectively, varies inversely with the temperature.

Methods of destroying trichinæ by heating at temperatures below the thermal death point, which may be utilised in connection with the preparation of certain kinds of cured pork products, appear not to be applicable in the case of fresh pork.

Upon the basis of the results of experiments recorded in this paper, the Bureau of Animal Industry has selected a temperature of 137° F. (58·33° C.) as the minimum temperature to which pork and products containing pork are

required to be heated when cooked in establishments operating under federal meat inspection. This requirement has reference to the temperature actually reached in the interior of the meat, and not merely to that of the water or oven in which it is cooked. This temperature is several degrees above the thermal death point of trichina larvæ, thus providing a certain margin of safety.

Crossing Qualities of the Rouen Duck. *X. Faucillon, Paris.*—The Rouen duck is a useful breed, productive, easily raised, and everywhere favourably regarded. It has a striking resemblance to its wild ancestor, although it is considerably larger and heavier. The weight of a Rouen drake, improved by selection, is as much as 10 lbs., while that of the wild drake is seldom more than 3½ lbs.; in the case of females the difference is still more striking. The raising of Rouen ducks has long constituted a very successful branch of the poultry industry, the principal markets being Duclair, Gournayet and Dieppe.

The Duclair duck is a local variety of the Rouen breed. It is large, with a wing-spread of 40 inches, dark plumage and flesh, matures early, and is prolific. Its excellent flesh has a more pronounced flavour than that of the ordinary Rouen duck.

The Rouen duck exercises a very favourable influence on other races from the point of view of increased productivity. Its qualities as an improving factor in cross-breeding have been extensively made use of in other regions. For instance, crossing between the Barberry drake and Rouen duck produces a duck called "mullard," a large unfertile half-breed, of delicate flesh and a large liver, valuable as a delicacy. Cross-breeding of the Rouen with other ducks, such as the Pekin and Aylesbury, also gives excellent results.

The author recommends a large increase in the production of the Rouen duck as a valuable help in these times of food shortage.

Mange in Horses; Treatment in Belgium. *M. A. van den Eeckhout, Ann. Méd. Vét.*, Brussels, vol. lxiv., 1914.—Articles which may carry mange, and which can be so treated, should be washed with milk of lime; while harness may be disinfected with a concentrated creoline solution. Infected animals themselves should have an ointment brushed in with a hard brush, so that the burrows of the mange mite may be filled. The ointment consists of a mixture of equal volumes of carbonate of soda, brown soap, creoline and water, the soda being first dissolved in the water and the soap and then the creoline added to form a paste. For use, the mixture should be diluted with five parts by volume of water. The treatment, which should last for about half an hour, should be repeated four times in about a fortnight, and after each brushing the horse should be washed down with clean water. The method is said to be simple and efficacious.

The Life-history of the Red-currant Green-Fly. *M. D. Haviland, Proc. Roy. Soc., Edinburgh*, vol. 39, 1919.—Miss Haviland has made a serious endeavour to settle the disputed question of the fate of this aphis, *Myzus ribis*, in the summer. The aphis is a well-known pest of fruit bushes, where it is often associated with the presence of large red blisters on the leaves. The total damage caused by the pest is sometimes considerable owing to the immature ripening of fruit due to damage caused to the foliage. Various detailed measurements carried out by the authoress show that there are two races of the aphis, and that these depend to some extent on the nature of the food. The Red-currant Aphis may be migratory, and although it can pass through its various yearly stages successfully on a currant bush alone, it prefers in the summer state to migrate to weeds, most often of the Labiate family. As the summer passes there is a steady decline in the rate of reproduction of individuals on currant bushes, and as a result of the attacks of enemies and infestation by parasites the Currant Aphis often disappears altogether from currant bushes in August or September.

Life-History of the Gooseberry Green-Fly. *M. D. Haviland, Proc. Camb. Phil. Soc.*, vol. 19, 1919.—The spring attack of the Currant Green-Fly (*Aphis grossulariæ*) on currant and gooseberry bushes is well known, for young shoots rapidly become destroyed owing to the bunching of leaves and general distortion of growth. The resemblance between this species and one which frequents the Guelder Rose led Miss Haviland to try to what extent the food plants were interchangeable. Colonies of the currant aphis were transferred

Guelder Rose (but none survived more than six days), and other colonies were transferred from G. Rose to currant, and only two survived for more than ten days. Supposing that the two so-called species may be different stages of the same creature, the authoress offers many further suggestions as to the possible relationship between those stages, one of her contentions being that the Guelder Rose is the natural host of the species, and that the spread and abundance of a new and suitable food in gooseberry and currant bushes has enticed it to leave its old for a new love, to the regret of all fruit growers. In any case infected Guelder Rose bushes should not be tolerated near currant or gooseberry bushes, but should be destroyed.

Fruit Tree Pests in Britain in 1919.—A writer in the *Gardeners' Chronicle* (June 7) states that for the third year in succession there is in Britain a plague of caterpillars on fruit trees of all kinds. The caterpillars vary with the species of tree, but they are "chiefly of the Winter Moth group, supplemented by a good many larvæ of the Lackey, common Tortrix and Figure-of-Eight Moths." The writer used a soft soap and nicotine spray before the trees blossomed, and after blossoming a lead arsenate spray, both with good effect. Suckers are said to be numerous amongst apple bloom, and though there is a mild attack of plum aphis, apples are more free from aphides than the writer has ever seen before.

Condemnation of the Bullfinch.—In a note in *Country Life* (May 3, 1919) Dr. W. E. Collinge gives in summary the result of an investigation of the food of the Bullfinch. He finds that the majority of gardeners and fruit-growers are unanimous that Bullfinches have increased greatly in number in recent years, that for at least half the year they are most destructive in fruit orchards, and that fruit-growers would welcome repressive measures against this species. Dr. Collinge's examination of the food contents of 484 birds and thirty-four nestlings confirms the opinions of gardeners as to the havoc done by the birds. Practically the whole of the food is vegetable matter, and "of the total bulk found in these birds, 41 per cent. consisted of cultivated fruits, 15 per cent. of wild fruits, and 44 per cent. of weed seeds." It is strange that the examination revealed no trace of blossom buds, for to many a gardener the Bullfinch's destruction of buds in spring is the main factor in its condemnation. Dr. Collinge also discovered, from growing seeds found in droppings, that the bullfinch is a serious distributor of weed seeds.

Birds Beneficial to Agriculture.—A pamphlet with the foregoing title has been issued by the Trustees of the British Museum at a price of 2s. While the pamphlet is meant primarily to form a guide to a special exhibit of birds beneficial to agriculture, it nevertheless possesses much general interest. Of the entire list of those British birds which reside sufficiently long in the country to be worth reckoning in this connection, the author, Mr. F. W. Frohawk, states that "about 120 species may be regarded as decidedly beneficial to agriculture generally." A *résumé* is given of the connection between birds and injurious insects, and descriptions of the habits, appearance and food of forty-four typical useful birds, accompanied by many excellent illustrations, give a fair sample of the beneficial birds of the British Isles.

Protection of Wild Birds in the British Isles.—The Report of the Departmental Committee on the Protection of Wild Birds, 1919, is of considerable interest to farmers in that it suggests, with a view to future legislation, a more thorough and uniform system for the protection of birds, including some whose activities are of great service. While it is suggested that all birds should be protected during the breeding season, subject to the right of the owner or occupier, a detailed list of birds is given which are to be absolutely protected throughout the year, and this includes birds so useful as the Long- and Short-eared, the Tawny and Barn Owls. Another list mentions birds which should be absolutely protected during the breeding season, and here are to be found, amongst others, the Kestrel, Nightjar, Nightingale, Woodlark and all species of Woodpeckers. It is possible, however, that farmers, especially sheep-farmers, may not so readily appreciate the suggestion that the Raven should be absolutely protected during the breeding season, and that the Golden Eagle should be protected all the year round; but it is provided that a central authority should have power to exempt certain destructive birds from all protection. To the Lapwing a special clause is given suggesting the absolute

protection of eggs and nests, except that owners, or persons authorised by them in writing, should be allowed to take the eggs on their own land up to the 15th April. It is also recommended that there should be general protection of all birds, eggs and nests throughout the country on Sundays.

Treatment for Furniture-Beetle in New Zealand. *A. H. Cockayne, Jour. Agr.*, New Zealand, 1919, p. 198.—White and Kauri pine and many other varieties of timber suffer in New Zealand from the attacks of the timber-beetle, *Anobium domesticum*, which traces the same life-history in that as in this country. The only radical method of getting rid of the pest is rigorous removal and destruction of infested timber; but where timbers are immovable, a spray of lead arsenate (1 lb. to 28 gallons of water) is effective. Where such a remedy might be too dangerous on account of its poisonous properties, mixtures composed of 5 parts benzine to 1 part creosote or a solution of naphthaline in benzine (2 balls to a ½ pint) may be used. Into each of the borings in furniture should be injected benzine and creosote, and the entrance thereafter stopped with a pellet of soap.

Recent Canadian Legislation.—The Fertiliser Act. *Agr. Gazette of Canada.*—The amendment to the Fertiliser Act of 1909 stipulates that each package of fertiliser sold must be labelled with brand name, registration number, and guaranteed analysis, stating separately in minimum percentages only (*a*) the percentage of nitrogen, (*b*) the percentage of available phosphoric acid and total phosphoric acid, (*c*) the percentage of potash soluble in water, and also the name and address of the manufacturer or agent.

In the case of bone meal, tankage or other organic products, and basic slag, the phosphoric acid shall be stated as total phosphoric acid unless it be desired to state available phosphoric acid also. When leather in any form, wool waste, hair, or any inert organic nitrogenous material, forms part of any fertiliser, the percentage of such ingredient must be mentioned in the guaranteed analysis, unless, by processing, the nitrogen has been made available in such materials. When potash is derived from sulphate of potash or carbonate of potash, it may be so stated in the guaranteed analysis.

The Act further provides that every brand of fertiliser offered for sale in Canada shall bear a registration number secured from the Minister of Trade and Commerce, and also provides for the licensing of dealers in fertiliser products. The penalty for violation of the Act shall not exceed $100.

Co-operation in the Egg Industry in Canada. *Agric. Gazette of Canada.*—Co-operation has made immense strides in agricultural Canada during the last three or four years, and probably in no particular more thoroughly than in the handling and marketing of eggs, to which both the federal and provincial governments have given attention and in which they have accomplished much.

The co-operative egg circle, which is at the basis of the organization, is an association organized among farmers for the purpose of marketing eggs frequently and regularly through a common medium. The object is to maintain the quality of the eggs as they leave the farm, and to place them in the hands of the consumers with the least possible delay and in good condition. It has been estimated that Canadian farmers, before they adopted co-operation, annually lost between five and six million dollars as a result of carelessness in handling and marketing eggs. The co-operative marketing of eggs and poultry has lifted poultry farming to a higher level, has made the market for eggs and poultry more stable, and has improved hen-houses, the feeding of poultry and conditions generally.

The co-operative system of selling is as follows:—

(1) The eggs, stamped by the producer as stated, are delivered on a certain day of each week to the local secretary, or to a person designated by the local association. Each egg bears its producer's number. If the producer live at some distance from the local consigning office he may send his eggs directly to the headquarters of the central association. His eggs are numbered in any case.

(2) All boxes of eggs received are sent to the city by the local secretary, who receives a small remuneration for his work.

(3) The eggs are graded on arrival. The proceeds of sales, less consignment charges and 2 per cent., are returned to the local secretary, and distributed among the producers according to the quantity supplied by each of them.

LEGAL DECISIONS AFFECTING AGRICULTURE.

Compensation for Damage to Tenant's Crops by Game. *Thomson* v. *Earl of Galloway.*—This case, which has decided an interesting point in regard to a tenant's right to claim compensation for damage to crops by game, arose on an Appeal from the decision of the Sheriff-Substitute of Dumfries and Galloway at Wigtown upon a question of law submitted to him by way of special case stated by an arbiter in an arbitration under the Agricultural Holdings (Scotland) Act, 1908, between William Thomson, tenant of the holding known as Polwhilly and Inks, and the Right Honourable the Earl of Galloway, proprietor of the holding. The question related to the construction of Section 9 of the Agricultural Holdings Act, 1908, the main provision of which is that, where the tenant of a holding has sustained damage to his crops from game, he shall be entitled to compensation from his landlord for such damage (if it exceeds 1s. per acre), provided neither he nor anyone claiming under him had right, or written permission, to kill such game. In 1918 a claim under this section was lodged against the proprietor for compensation in respect of damage sustained by the tenant to his crops from game, and on 8th November 1918 the arbiter issued proposed findings under which he estimated the damage to the tenant's crop at £84 and proposed to find the proprietor liable therefor. The arbiter found, *inter alia*, (1) that substantial damage was done by winged game, the right to kill and take which was not vested in the tenant and which he had not permission in writing to kill; (2) that the game came upon the farm principally from a neighbouring proprietor's land; and (3) that the damage was done almost entirely during the spring months, and during the close season for killing such game, when the crop was brairding. The tenant was prepared to accept the arbiter's proposed findings, but the landlord maintained in law that the proprietor could not be held liable under the Act, and the following question of law was submitted for the opinion of the Court:—"Is a proprietor liable to his tenant under Section 9 of the said Act for damage done to the tenant's crops by game coming from a neighbouring proprietor's land, and during the close season for killing such game?" It was argued on behalf of the landlord that if the damage done to the crops was caused (1) by game coming not from land belonging to the tenant's landlord but from a neighbouring proprietor's land, or (2) by game coming during close time, no compensation should be due by the landlord. The tenant maintained that the whole question turned on the wording of the Statute, and that there was no room for arguments based on equitable considerations. The Sheriff-Substitute answered the question of law submitted to him in the affirmative, and on an Appeal to the Second Division of the Court of Session (the Lord Justice-Clerk, Lords Dundas, Salvesen and Guthrie) the Court (Lord Salvesen dissenting) held that the landlord was liable under the Act to compensate the tenant for the damage. It was pointed out by the Lord Justice-Clerk that it might be that the determination of the arbiter in this case imported a hardship upon the proprietor, although he was not quite clear that that necessarily was so; but the question to be considered was whether, on a proper construction of the Act, the arbiter did right in awarding the compensation.

OFFICIAL ORDERS AND CIRCULARS.

In view of the continuation of the control of the supply and distribution of certain articles of food, a considerable number of Orders dealing with agricultural produce or supplies have recently been issued or re-imposed. The following notes taken from the "Ministry of Food Journal" give the chief points in these Orders of interest to agriculturists.

Cereals.

The Cereals (Restriction) Order, 1919, incorporates, with certain amendments and additions, the provisions of three Orders which are thereupon revoked, viz.:—The Wheat, Rye and Rice (Restriction) Order, 1917; the Damaged Grain, Seeds and Pulse (Prices) Order, 1917, and the Grain (Prices) Order, 1918. The new Order maintains the prohibition on the use of wheat for any purpose except the manufacture of flour or for use as seed, and the pro-

hibition on the use of wheaten flour, rice or rice flour, or any article containing the same, except as human food or for the purposes of human food.

As regards wheat, exemption is only permitted in the case of "tailings or screenings or damaged wheat which are unfit for use in the manufacture of flour for human food," and which have been so certified by any two members of a panel to be appointed by the Food Controller.

A maximum selling price for damaged wheat, both imported and home grown, and for tailings or screenings of wheat which are unfit for use in the manufacture of flour for human food, is fixed at 72s. per quarter of 504 lb., additions being allowed to persons other than the producer, similar to those permitted under the Grain (Prices) Order, 1918. Prohibition on the sale of wheat, barley or oats otherwise than by weight is continued.

The full text of the Order is given below :—

THE CEREALS (RESTRICTION) ORDER, 1919, DATED THE 14TH AUGUST 1919 (NO. 1013).

Part I.—Restriction on Use and Sale by Weight.

1. (*a*) A person shall not use any wheat except for the purpose of seed, or except in the process of manufacturing flour.

(*b*) This clause shall not apply :—

(i) to tailings or screenings of wheat which are unfit for use in the manufacture of flour for human food, and which have been certified as such under a certificate in Great Britain of any two members of a panel to be appointed by or under the authority of the Food Controller for the purposes of this clause, and in Ireland of any person or persons to be appointed for the purpose by or under the authority of the Food Controller; or

(ii) wheat which has been so damaged as to be unfit for use in the manufacture of flour for human food and which has been certified as such in accordance with the provisions of the preceding sub-clause.

2. A person shall not use any wheaten flour, rice or rice flour except in the manufacture of articles suitable for human food, or use any article containing any wheaten flour, rice or rice flour except as human food.

3. A person shall not damage or permit to be damaged or treat or permit to be treated, any wheat, wheaten flour, rice or rice flour or any article containing wheat, wheaten flour, rice or rice flour so as to render the same less fit for the purposes of seed or the manufactnre of flour or articles suitable for human food, or waste or permit to be wasted any such grain flour or article.

4. Any person authorised by the Food Controller may take samples of any wheat, wheaten flour, rice or rice flour or other article which he has reason to suspect is being used, damaged or treated or is intended to be used, damaged or treated in contravention of this Order.

5. A person shall not sell or offer to sell any wheat or any tailings or screenings of wheat (other than wheat, tailings or screenings certified under the provisions of Clause 1 of this Order as unfit for use in the manufacture of flour for human food) to any person other than—

(i) a miller buying for the purposes of the manufacture of flour; or

(ii) a person who in the ordinary way of business deals in wheat for the purpose of his livelihood; or

(iii) a person requiring and holding a licence granted by or under the authority of the Food Controller for the purpose of entitling him to use wheat or tailings or screenings of wheat for a manufacturing business carried on by him; or

(iv) in the case of wheat which is suitable for seed, a person buying wheat specifically for the purpose of seed;

and a person not being a person to whom wheat or tailings or screenings of wheat may lawfully be sold under the foregoing provisions of this clause shall not buy or offer to buy wheat or tailings or screenings of wheat accordingly.

6. A person shall not sell or offer to sell any wheat, barley or oats whether imported or home grown and whether mechanically treated or not, otherwise than by weight.

Part II.—Maximum Price for Damaged Wheat.

7. Subject as hereinafter provided, no wheat which has been so damaged as to be unfit for use in the manufacture of flour for human food and no tailings or screenings of wheat which are unfit for use in the manufacture of flour for human food, may be sold by or on behalf of the producer in the case of wheat harvested in the United Kingdom or by or on behalf of the importer in the case of imported wheat, at a price exceeding a price at the rate of 72s. per quarter of 504 lb.

8. On the occasion of the purchase of any wheat or tailings or screenings of wheat to which Clause 7 applies from any person other than the producer or importer of the grain sold, the maximum price shall be ascertained by adding 1s. per quarter to the price otherwise applicable according to the foregoing provisions of this Order, provided that where the total quantity purchased by one buyer from one seller does not in any period of 7 consecutive days including the day of sale exceed 7½ quarters, the maximum price in respect of each quarter so purchased shall be ascertained by adding 5s. per quarter to the price otherwise applicable according to the foregoing provisions of this Order, and where such total quantity does not in that period amount to half a quarter the maximum price in respect of such sales shall be ascertained by adding 9s. per quarter to the price otherwise applicable according to the foregoing provisions of this Order, and where such total quantity does not in that period exceed 28 lb., the maximum price in respect of such sales shall be the actual cost to the seller with the addition of a sum at a rate of ½d. per lb.

9. (*a*) The maximum price under this Order for wheat harvested in the United Kingdom or tailings or screenings of such wheat, to which Clause 7 applies, are fixed on the basis of the following terms and conditions being applicable to the transaction :—

(i) Payment to be net cash within seven days of completion of delivery, and moneys then unpaid thereafter to carry interest not exceeding the rate of 5 per cent. per annum or Bank Rate, whichever shall be the higher.

(ii) The grain to be delivered by the producer free on rail or barge, or to mill or store in accordance with the usual custom of the district.

(iii) Any freight, haulage, porterage and cartage incurred after delivery in accordance with sub-clause (ii) of this clause, to be for buyer's account.

(iv) All sack hire up to and including the time of delivery to rail, barge, mill or store by the producer, to be for the producer's account, and all charges for sack subsequent thereto to be for the buyer's account.

(*b*) Where the grain is sold on terms and conditions other than the terms and conditions stated in the foregoing part of this clause, a corresponding adjustment shall be made in the maximum price.

In particular :—

(i) Where grain is delivered by the producer to a distance greater than the distance corresponding with the usual custom of the district a sum at the rate of 1s. per ton per mile for the extra distance shall be added to the maximum price.

(ii) Where the grain is delivered by the producer at his premises a sum at the rate of 9d. per ton per mile for the distance corresponding with the usual custom of the district shall be deducted from the maximum price.

10. (*a*) The maximum prices applicable under this Order for imported wheat or tailings or screenings of such wheat, to which Clause 7 applies are fixed on the basis of the following terms and conditions being applicable to the transaction :—

(i) Sales by importers to be *ex* quay, store or granary and grain shipped in bags to be sold gross weight, including bags, no charge being made for bags. Other terms of sale (except as hereinafter specifically provided) to be in accordance with the usual custom of the trade. All storage, transport and other charges incurred after sale by the importer to be for account of the ultimate buyer.

(ii) On sales by importers, payments to be net cash against Bill of Lading Warrant or approved Delivery Order. On all other sales, payment

to be net cash within seven days of completion of delivery, and moneys then unpaid thereafter to carry interest not exceeding the rate of 5 per cent. per annum, or Bank Rate, whichever shall be the higher.

(*b*) Where the grain is sold on terms and conditions other than the terms and conditions stated in the foregoing part of this clause, a corresponding adjustment shall be made in the maximum price.

11. The amount added to the maximum price in respect of charges permitted under Clause 9 and Clause 10 of this Order shall be accurately shown as separate items on the invoice relating to the sale and shall not in any case exceed reasonable expenses actually paid or incurred.

12. Where the maximum price at which grain may be sold by any person depends upon the amount of any sums paid or charged for transport or storage or any other matter by any former seller, such person shall be entitled to rely upon any written statement as to the amount of such sums which may have been given to him by the person from whom he bought the grain in question unless he has reason to suspect the truth of such statement.

13. On the occasion of a sale of any wheat to which Clause 7 applies which has been mechanically treated, or tailings or screenings of wheat to which Clause 7 applies which have been mechanically treated by torrefying, bleaching, gristing, crushing, bruising, kibbling, splitting or other kindred process, or kiln dried or dried by other mechanical method, the maximum price shall be ascertained by adding to the price otherwise applicable according to the foregoing provisions of this Order the cost of such treatment not exceeding a usual and reasonable charge.

14. A person shall not sell or buy or offer to sell or buy any wheat or tailings or screenings of wheat to which Clause 7 applies at a price exceeding the maximum price applicable under this Order or, in connection with the sale or disposition, or proposed sale or disposition thereof, enter or offer to enter into a fictitious or artificial transaction or make or demand any unreasonable charge.

15. Any person dealing in any grain to which Clause 7 applies shall keep accurate records containing such particulars as are necessary to show whether or not he is complying with the provisions of this Order so far as they relate to him or to his trade, and shall make such returns as shall from time to time be required by or under the authority of the Food Controller. All such records and documents shall at all times be open to the inspection of any person authorised by the Food Controller.

Part III.

16. For the purpose of this Order the expression "wheaten flour" shall include any flour of which flour obtained from wheat forms part.

The expression "quarter" shall mean a weight of 504 lb.

The expression "unfit for use in the manufacture of flour for human food" shall mean grain which is so damaged or so inferior in quality that any flour or meal which could be milled therefrom would be unfit for use in human food.

The expression "importer" shall mean the person signing the shipper's draft, but this shall not be construed so as to limit the general interpretation of that expression.

17. The Wheat, Rye and Rice (Restriction) Order, 1917, the Dredge Corn Order, 1917, the Damaged Grain, Seeds and Pulse (Prices) Order, 1917, and the Grain (Prices) Order, 1918, are hereby revoked, but without prejudice to any proceedings in respect of any contravention thereof, provided that licences granted by or under the authority of the Food Controller under the Wheat, Rye and Rice (Restriction) Order, 1917, and in force immediately before the coming into operation of this Order shall be deemed to have been granted under this Order.

Potatoes.

Potatoes in the ground are being sold by auction at excessive prices, according to information which has been received by the Food Controller. It is necessary therefore to warn speculators that, should a maximum price be fixed for potatoes during the coming winter, no account will be taken of excessive prices which may have been paid for potatoes by speculators.

Feeding Stuffs.

The Food Controller has, in consultation with the Crushers' and Refiners' Advisory Committee, agreed to a schedule of maximum prices of home manufactured cakes and meal, these prices remaining current until further notice. The main points of this schedule are that linseed cake will be £25 per ton; cotton seed cake (black), £20 per ton; cotton seed cake (white), £19, 10s. per ton, in each case these figures being the price per ton *ex* mill to the farmer. Compound cakes will be £23 per ton. Scottish manufacturers may, however, add any sum up to 10s. per ton to these prices to recompense them for the extra cost of the carriage of raw materials from England.

Live Stock.

Prices.—The continuance of the control of meat and live stock during the coming winter has made it necessary to fix the prices to be paid for live stock until the end of June next.

The Food Controller has had the benefit of the advice of the Central Advisory Committee of Meat and Live Stock and of the Central Agricultural Advisory Council, and after consultation with the Boards of Agriculture has fixed prices as follows:—

CATTLE.

These schedules give the prices in shillings per cwt. in each month for cattle of each grade payable on live-weight sales.

Bulls, Bullocks and Heifers.

1919.	1st Grade. *Shillings.*	2nd Grade. *Shillings.*	3rd Grade. *Shillings.*
September	79	74	69
October	79	74	69
Nov. 1 to Nov. 15	79	74	69
Nov. 17 to Nov. 29	80	75	70
Dec. 1 to Dec. 13	82	77	72
Dec. 15 to Dec. 27	83	78	73
Dec. 29 to Jan. 10	84	79	74
1920.			
Jan. 12 to Jan. 24	85	80	75
Jan. 26 to Feb. 7	86	81	76
Feb. 9 to Feb. 21	87	82	77
Feb. 23 to March 6	88	83	78
March 8 to March 20	89	84	79
March 22 to April 3	90	85	80
April 5 to April 17	91	86	81
April 19 to May 1	92	87	82
May 3 to May 15	93/6	88/6	83/6
May 17 to May 31	95	90	85
June 1 to July 3	95	90	85

Cows.

1919.	1st Grade. *Shillings.*	2nd Grade. *Shillings.*	3rd Grade. *Shillings.*
September	74	66	57
October...	74	66	57
Nov. 1 to Nov. 15	74	66	57
Nov 17 to Nov. 29	75	67	58
Dec. 1 to Dec. 13	77	69	60
Dec. 15 to Dec. 27	78	70	61
Dec. 29 to Jan. 10	79	71	62
1920.			
Jan. 12 to Jan. 24	80	72	63
Jan. 26 to Feb. 7	81	73	64
Feb. 9 to Feb. 21	82	74	65
Feb. 23 to March 6	83	75	66
March 8 to March 20	84	76	67
March 22 to April 3	85	77	68
April 5 to April 17	86	78	69
April 19 to May 1	87	79	70

1920.	1st Grade. *Shillings.*	2nd Grade. *Shillings.*	3rd Grade. *Shillings.*
May 3 to May 15	88/6	80/6	71/6
May 17 to May 31	90	82	73
June 1 to July 3	90	82	73

Any beast sold in Scotland that does not come up to the standard of a 3rd grade animal must be sold on the dead-weight basis.

If, in the opinion of the person grading a beast, it is likely to yield an unusually small or large proportion of bone the above prices may be varied by 1s., 2s. or 3s. more or less, but in no case shall the price for the first grade be exceeded by more than 1s. per cwt. for bulls, bullocks, heifers and cows in excess of the maximum price in force for the time being.

As hitherto, per head charges will continue to be levied in order to create an equalisation fund, out of which the Ministry of Food will defray the following charges, among others, which in uncontrolled times fall on the farmer or butcher, namely, railage from farm to market, auctioneers' commission, market tolls, lairage, feeding, insurance for tuberculosis (for cattle other than fourth grade), railage from market to slaughter-house, droving, slaughtering charges, etc.

The per head charge has been allowed for in determining the prices payable to the farmer and the figures given in the above schedule are actual prices which the farmer will receive. In the case of live cattle, the farmer's share of the per head charge will be 1s. per cwt., and this amount will be collected from the buyer. In the case of cattle sold on the dead weight a corresponding charge of ½d. per lb. payable by the vendor, as in the case of sheep, will be reimposed as from October 1.

SHEEP.

The prices per lb. (according to estimated dead weight) of sheep of good marketable quality are as follows :—

1919.	Per lb. *s.*	*d.*
September	1	2½
October...	1	2¾
Nov. 1 to Nov. 15 .	1	2¾
Nov. 17 to Nov. 29 ...	1	2½
Dec. 1 to Dec. 13 ...	1	3
Dec. 15 to Dec. 27 . .	1	3¼
Dec. 29 to Jan. 10 ...	1	3¾
1920.		
Jan. 12 to Jan. 24 ..	1	4
Jan. 26 to Feb. 7... ...	1	4¼

1920.	Per lb. *s.*	*d.*
Feb. 9 to Feb. 21 . .	1	4½
Feb. 23 to March 6 ..	1	4¾
March 8 to March 20 ...	1	5
March 22 to April 3 ...	1	5¼
April 5 to April 17 . .	1	5½
April 19 to May 1 ...	1	5⅝
May 3 to May 15 ...	1	5⅝
May 17 to May 31 ..	1	5¼
June 1 to July 3 ...	1	5

The prices in respect of sales of cattle and sheep on the dead-weight will be fixed on a corresponding basis.

The continuance of the present prices until the middle of November will, it is hoped, ensure an even flow of cattle to the markets so that the Ministry of Food will not be compelled to require farmers to hold over stock in the same way as became necessary last year.

At the same time it is desirable to point out that only full mature stock will be accepted at the various grading centres and Government slaughterhouses, and that in order to prevent difficulties at the markets farmers must send all immature stock to store markets and not to grading centres or slaughterhouses.

The prices are intended to encourage the winter feeder to take immature stock from the summer grazing districts and to reduce the number of cattle being offered for slaughter.

Milk.

The Milk (Winter Prices) Order, 1919, *S.R.O. No.* 1208 :—By this Order maximum wholesale and retail prices are fixed for milk sold during the period 1st October 1919 to 30th April 1920. Provision is, however, made in the Order for the modification of these prices to suit local conditions, and accordingly the Food Commissioner for Scotland has issued an Order fixing maximum retail prices for Scotland on the following scale :—

TABLE I.

In the counties of Nairn, Dumbarton, Haddington, Lanark, Renfrew, and

the burghs of Aberdeen, Airdrie, Barrhead, Clydebank, Coatbridge, Dumbarton, Dunoon, Elgin, Gourock, Greenock, Hamilton, Helensburgh, Inverness, Johnstone, Kirkintilloch, Lanark, Motherwell, Oban, Paisley, Perth, Port-Glasgow, Renfrew, Rutherglen, Wishaw and the Cumbraes,

AT THE RATE of :—

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.
3/4	3/4	3/8	3/8	3/8	3/8	3/4 per gallon.

In Shetland, the Lewis district of Ross and Cromarty, the burghs of Carnoustie, Dalkeith, Dundee, Edinburgh, Glasgow, Leith, Monifieth and Musselburgh ; the parishes of Barry, Liff and Benvie, Mains and Strathmartine and Panbride, in the county of Forfar; and the parishes of Cramond, Corstorphine, Colinton (with the village of Currie), Liberton, Newton ; those parts of the parishes of Lasswade and Cockpen lying north of the Edinburgh-Penicuik railway (with the village of Rosewell), and the landward portions of the parishes of Dalkeith and Inveresk, in the county of Midlothian,

AT THE RATE OF :—

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.
3/8	3/8	4/-	4/-	4/-	3/8	3/8 per gallon.

In all other counties and burghs in Scotland not specially mentioned above,

AT THE RATE OF :—

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.
3/-	3/4	3'8	3/8	3/8	3/8	2/8 per gallon.

For milk sold wholesale by producers the scale is as follows :—

TABLE II.

Month in which delivery takes place.	*Rate per Imperial Gallon.*
1919.	*s. d.*
October	2 2
November	2 8
December	3 3
1920.	
January	3 3
February	3 3
March	3 0
April	2 2

Any charges actually incurred by the seller for transport may be added to the above prices.

In the case of milk delivered by the producer on behalf of a wholesale dealer other than the producer the price per gallon is ascertained by adding the sum of half to the prices in the above table.

When milk is sold wholesale by a person other than the producer and is not delivered by the producer the rate is in accordance with the following table :—

TABLE III.

Month in which delivery takes place.	**Rate per Imperial Gallon where delivery is made to Buyer's Railway Station or at Seller's Premises.*	*Rate per Imperial Gallon where delivery is made to Buyer's Premises.*
1919.	*s. d.*	*s. d.*
October	2 5	2 11
November	2 11	3 3
December	3 4	3 5
1920.		
January	3 4	3 5
February ...	3 4 ...	3 5
March	3 2	3 4
April	2 5	2 11

* In addition to the net railway charges (if any) paid by the wholesaler for transportation from the wholesaler's station to the buyer's station.

The following is the text of the Order :—

In exercise of the powers conferred upon him by the Defence of the Realm Regulations and of all other powers enabling him in that behalf, the Food Controller hereby orders that except under the authority of the Food Controller the following regulations shall be observed by all persons concerned :—

1. A person shall not directly or indirectly sell or offer for sale or buy or offer to buy any milk at prices exceeding the maximum prices provided by or in pursuance of this Order.

2. Until otherwise determined pursuant to this Order the maximum price applicable on the occasion of a retail sale of milk shall be :—

(*a*) (*See Table I. above.*)

(*b*) The foregoing prices shall include all charges for delivery, but the Food Controller or any person authorised by him may from time to time fix for all or any of the milk sold within any area and not delivered to the buyer's premises, a rate different from the rate for the time being applicable to milk which is so delivered.

(*c*) Where at the request of the buyer the milk is sold in bottles at the seller's premises, a charge at the rate of ¾d. per quart, or a charge of ½d. where any less quantity is sold, may be made for bottling, and where at the request of the buyer the milk is delivered in bottles at the buyer's premises a charge may be made for bottling at the rate of 1d. per quart, provided that in either case the milk is bottled under proper and sanitary conditions at or before reaching the seller's premises.

3.—(*a*) Where milk is sold wholesale by or on behalf of the producer, the maximum prices chargeable for milk delivered during the months mentioned in the first column of the following Table shall be at the rate per imperial gallon set opposite the same in the second column thereof. (*See Table II. above.*)

(*b*) The rates applicable under sub-clause (*a*) of this clause are fixed on the basis that the milk is delivered at the seller's expense to the buyer's premises or (at the option of the seller) to the buyer's railway station and that in the latter case all charges for transport beyond the buyer's railway station are borne by the buyer.

Where milk is not sold on this basis the rate shall be ascertained by deducting one penny per imperial gallon from the rate applicable under sub-clause (*a*).

(*c*) No additional charges may be made for the provision of churns or other vessels.

4. Where milk is sold wholesale by or on behalf of any person other than the producer, the maximum prices chargeable shall until otherwise determined pursuant to this Order be as follows : –

(*a*) In the case of milk delivered by the producer to or for the account of the buyer in accordance with the directions of the seller, the rate shall be ½d. per imperial gallon higher than the price chargeable to the seller by the producer. (*Table II.*)

(*b*) In the case of milk not so delivered, the rate shall be in accordance with the following table. (*See Table III. above.*)

(*c*) The rates mentioned in sub-clauses (*a*) and (*b*) are fixed upon the basis that the cost of providing churns or other vessels is borne by the seller; and where milk is not sold on this basis, then the rate shall be ascertained by deducting from the rate applicable under such sub-clauses the sum of ¼d. per imperial gallon.

(*d*) Where at the request of the buyer milk is required to be delivered in bottles and is so delivered, an addition not exceeding 3d. per imperial gallon may be made to the prices specified in sub-clause (*b*) provided that the milk is bottled by or on behalf of the seller under sanitary and proper conditions at or before reaching the seller's premises.

5. The Food Controller or a person authorised by him may, with respect to any area, vary the maximum price applicable to sales by wholesale, or by retail in the area.

6.—(*a*) The Food Controller or a person authorised by him may, in any case where he is satisfied that the milk produced is of exceptionally high hygienic quality, increase the maximum price chargeable for milk on a sale by or on behalf of the producer or on any re-sale of the same.

(*b*) Licences issued under the provisions of Clause 5 (*a*) of the Milk (Summer Prices) Order, 1918, and in force at the date of this Order, for the sale of milk of exceptionally high hygienic quality at prices in excess of the prices otherwise applicable thereto under the provisions of this Order shall continue in force as if they had been issued under the provisions of this Order.

7.—(*a*) Where milk is sold to an establishment as herein defined by any person (whether he be the producer of the milk sold or not) in a quantity of not less than 17 imperial gallons to be delivered in any one day the maximum price (including charges for delivery to the buyer's premises) shall be, whichever shall be the lower of the following prices, namely :—

(i) 2d. per imperial gallon higher than the maximum price chargeable in the district in which the establishment is situate for milk delivered to the buyer's premises on a sale by wholesale by a person other than a producer; or

(ii) the maximum retail price for the time being in force in such district.

(*b*) Any other sale to an establishment shall, for the purposes of this Order, be deemed to be a retail sale, and the maximum price shall be determined accordingly.

(*c*) "An establishment" for the purposes of this Order shall mean a public or private hospital, sanatorium, convalescent or nursing home, workhouse, infirmary, asylum, corporation or company not established for the purposes of trading or profit, a religious or charitable community, a residential school or college, and a canteen.

(*d*) The Food Controller or a person authorised by him may—

(i) apply the provisions of this clause, whether with or without modification, to a sale of milk to any body of persons which in his opinion should be treated as an establishment;

(ii) vary the provisions of this clause in its application to any establishment.

8. Where a person registered under the provisions of the Milk (Registration of Dealers) Order, 1918, as amended, as a retail dealer in milk, sells milk to a person buying for re-sale, the maximum price shall, as to the milk sold on any day be 2d. per gallon less than the maximum price applicable to sales of milk by retail in the area in which the sales are made, if the quantity sold in that day to such person does not exceed 8 imperial gallons.

9. No milk shall be sold or offered for sale by retail otherwise than by imperial measure, except that nothing in this clause shall prevent—

(*a*) sales of milk by the pennyworth or two pennyworth; or

(*b*) sales of any fraction of a gill, pint, quart or gallon of milk.

provided that the maximum price is not exceeded.

10. No colouring matter or water shall be added to milk or cream intended for sale, and no milk or cream to which any colouring matter or water has been added shall knowingly be sold, or offered or exposed for sale. Until the contrary be proved, it shall be presumed that colouring matter or water added to milk or cream is added with the knowledge of the seller.

11. Except under and in accordance with the terms of licence granted by or under the authority of the Food Controller, a person shall not sell or offer or expose for sale as milk or under any description of which the word "milk" forms part, any liquid in the making of which dried milk or condensed milk has been used.

12. A person shall not use any milk can, milk churn, or milk bottle, which bears the name or trade name or the trade mark or trade device of some person other than himself or his employer, except with the consent of such person.

13. A person shall not in connection with the sale or disposition or proposed sale or disposition of any milk, enter or offer to enter into any fictitious or artificial transaction or make or demand any unreasonable charge.

14. A Food Committee may, subject to the consent of the Food Controller :—

(*a*) buy milk from any person and sell milk so bought at a price estimated to cover at least the cost of purchasing and distributing such milk; and

(*b*) make arrangements as to the distribution of milk in their area;

(*c*) give directions in their district for securing the purity, cleanliness, and wholesomeness of milk, provided that any directions so given shall not relieve Local Authorities of their powers and duties under existing statutory provisions in regard to milk, or relieve cowkeepers, dairymen, purveyors of milk or occupiers of milk shops from their obligations under any such provisions, and every person to whom any direction is given under the powers conferred by this sub clause shall comply with such directions.

15. A Food Committee shall not, without the consent of the Local Authority or Authorities by whom they were appointed, exercise the powers conferred upon them by the immediately preceding clause in such manner as may involve an expense which is ultimately to be borne by such Authority or Authorities; provided that the validity of any direction given by a Food Committee under any such powers shall not be questionable on the ground that such consent has not been obtained

16 Where any contract subsisting on the 1st October 1919 for the sale of milk provides for the payment during any period to which this Order applies, of a price in excess of the maximum price fixed by this Order applicable on the occasion of such a sale, the contract unless otherwise determined by the Food Controller shall be avoided so far as concerns milk which is to be delivered during such period

17. The provisions of this Order relating to prices shall not apply to milk sold for consumption on the premises of the seller

18 For the purposes of this Order —

"Milk" shall include any milk which has been submitted to any one or more of the following processes, viz —sterilization, pasteurization, homogenization, or any other like process, but shall not include dried, condensed, separated, skimmed or butter milk

"Food Committee" shall mean a Food Control Committee or a Joint Food Control Committee appointed under any Order of the Food Controller

"Buyer's premises" shall not include any roadside collecting place for milk or any other premises which the Food Controller shall in any particular case determine not to be buyer's premises for the purposes of this Order

"Buyer's Railway Station" shall mean the railway station to which in the ordinary course of business the milk would be consigned by the seller to the buyer, or in cases to which Clause 1 (*a*) applies, to the purchaser from the buyer

19 The Milk (Summer Prices) Order, 1916, as amended is hereby revoked as on the date when this Order comes into force, but without prejudice to any proceedings in respect of any previous contravention thereof

20 Infringements of this Order are summary offences against the Defence of the Realm Regulations

Cream.

The Cream Order, 1918, the operation of which was suspended on April 12 last, again became operative on September 1 The sale of cream is prohibited except for making butter or for such purposes as the Food Controller may authorise Children under five and invalids certified by a doctor to need cream should apply to their local Food Committee for a special permit

Fertilisers.

Sulphate of Ammonia —An agreement has been made with the makers of Sulphate of Ammonia with regard to the maximum prices to be charged for this fertiliser for home agricultural use for delivery in the eight months October 1919 to May 1920

These prices are appreciably higher than those during last season, owing to the fact that the assistance which was afforded to makers during the war has now been withdrawn The agreed maximum prices are fixed on a commercial basis which has to cover the substantial increases which have occurred since last year in the cost of coal, wages and raw materials. The Board consider that these prices are not more than are necessary to secure to the manufacturers a reasonable trade profit

AGREED MAXIMUM PRICES.

For sale in lots of not less than two tons for delivery by rail or water to purchaser's nearest railway station or wharf in Great Britain, less a trade discount to Agricultural Merchants, Dealers and Co-operative Societies.

Month of delivery.	*Price per ton in bags, net cash.*
1919.	£ s. d.
October...	20 10 0
November	20 15 0
December	21 0 0
1920.	
January	21 7 6
February	21 15 0
March, April and May	22 0 0

In the case of deliveries to Ireland, Isle of Man or Channel Islands, the above prices include delivery f.o.b. port in Great Britain.

Farmers should place their orders with their usual Dealer or Co-operative Society.

Manure Mixers, Merchants, Dealers and Co-operative Societies should send their orders to the Sulphate of Ammonia Association, 84 Horseferry Road, London, S.W. 1, where they will be allocated among individual makers.

CONDITIONS OF SALE.

(1) The agreed maximum prices are net cash prices for deliveries in lots of two tons and over in maker's bags, net weight excluding weight of bags. Where credit is given to the purchaser, a reasonable extra charge may be made, provided that the discount for net cash is quoted on the invoice, and is such as to bring the net cash price within the agreed maximum price. If purchaser's bags or other packages are used, reasonable allowance shall be made to the purchaser. Where one ton or upwards is sold for delivery in bags containing less than two cwt. each, a reasonable extra charge may be made beyond the agreed maximum prices which would otherwise have been charged.

(2) For Sulphate of Ammonia containing more than 24½ per cent. by weight of Ammonia, the agreed maximum prices shall be increased by 4s. per ton for each complete one-fourth of 1 per cent. (calculated on the total weight of the Sulphate of Ammonia) by which the Ammonia contents are more than 24½ per cent., whilst for Sulphate of Ammonia containing less than 24½ per cent. by weight of Ammonia, the above agreed maximum prices shall be reduced by 4s. per ton for each one-fourth of 1 per cent. or fraction of one-fourth of 1 per cent. (calculated as aforesaid) by which the Ammonia contents are less than 24½ per cent.

(3) For Sulphate of Ammonia containing less than 0·025 per cent. of free acid, an additional charge at the rate of 5s. per ton may be made by the vendor, provided that the invoice given by the vendor to the purchaser states such additional charge separately, and contains a guarantee by the vendor that the free acid contained in the Sulphate does not exceed 0·025 per cent.

(4) For Sulphate of Ammonia which is specially ground or pulverised at the request of the purchaser, an extra charge (not exceeding 5s. per ton) may be made for special grinding, provided that such extra charge is separately stated on the invoice given to the purchaser as aforesaid.

(5) The above increases or reductions in the agreed maximum prices chargeable shall not apply to any delivery of less than two cwt. of Sulphate of Ammonia.

(6) For deliveries of less than two tons or of small quantities made *ex* merchant's store, the Board would regard as reasonable the following additions to the price charged for two ton lots :—

Quantity delivered	*Additional price.*
1 ton and over	10s. per ton.
2 cwt. and over but less than 1 ton	1s. per cwt.
1 cwt. „ „ 2 cwt.	2s. „
28 lbs. „ „ 1 cwt.	3s. „
14 lbs. „ „ 28 lbs.	4s. „

In the case of sales for delivery to consumer's premises *ex* merchant's shop or store, the cost of conveyance, charged at local rates, may be added.

Ground Basic Slag.—The following prices are the agreed maximum net cash prices for Ground Basic Slag in maker's 2-cwt. bags, delivered in *minimum lots of 4 tons* in railway truck, or free *ex* barge or ship at purchaser's or consumer's railway station or wharf in Great Britain, or, in the case of shipments to Ireland, the Channel Islands or the Isle of Man, free on board at port of shipment in Great Britain :—

Percentage (calculated in terms of tri-basic Phosphate of Lime) of total Phosphates.	*Price per ton.*
12 per cent. and over, but less than 14 per cent.	62s.
14 " " " 16 "	64s.
16 " " " 18 "	66s.
18 " " " 20 "	68s
20 " " " 22 "	70s.
22 " " " 24 "	72s.
24 " " " 26 "	75s.
26 " " " 28 "	78s.
28 " " " 30 "	81s.
30 " " " 32 "	84s.
32 " " " 34 "	87s.
34 " " " 36 "	90s.
36 " " " 38 "	93s.
38 " " " 40 "	96s.
40 " " " 42 "	99s.
42 " " " 44 "	102s.

The above prices for all qualities are the agreed maximum cash prices for sales of Ground Basic Slag for delivery between 1st September 1919 and the 28th February 1920. In the case of sales of Ground Basic Slag for delivery during other periods, the maximum prices for all qualities will be less than the prices set out above, in accordance with the following table, namely :—

Period of delivery	*Reduction in the agreed maximum prices set out above.*
During March 1920	2s per ton.
" April 1920	3s. "
" May 1920	4s "

Orders for delivery at these prices should be placed with the Basic Slag Makers as soon as possible.

GENERAL CONDITIONS.

(1) The maximum prices are net cash prices for Ground Basic Slag in maker's bags, net weight excluding weight of bags Where credit is given to the purchaser, a reasonable extra charge may be made, provided that the discount allowed for net cash is quoted on the invoice, and is such as to bring the net cash price within the agreed maximum price If purchaser's bags or other packages are used, or the purchaser takes delivery without bags, a reasonable allowance shall be made to the purchaser Where one ton or upwards is sold for delivery in bags containing less than 2 cwt each, a reasonable extra charge may be made beyond the agreed maximum prices which would otherwise have been charged

(2) The above prices for all qualities are for Basic Slag, ground in such a way that at least 80 per cent of the total weight will pass through a sieve containing 10,000 apertures to the square inch. Where Basic Slag is sold less finely ground, an allowance off the above maximum prices shall be made to the purchaser at the rate of 3d. for each 1 per cent (calculated upon the total weight of the Basic Slag) by which the quantity which will pass through such a sieve as aforesaid is less than 80 per cent, but with an additional allowance at the rate of 9d for each 1 per cent (calculated as aforesaid) by which the quantity which will pass through such a sieve is less than 75 per cent. An invoice is to be given to each purchaser, stating in every case the percentage of the total weight of Basic Slag delivered which will pass through a sieve containing 10,000 apertures to the square inch.

(3) For Ground Basic Slag, packed in special bags for carriage by sea, an extra charge at the rate of 2s. 6d. per ton may be made

(4) Discount of 5s per ton is allowed on sales of 2 tons and upwards to Manure Mixers, Merchants, Dealers and Co-operative Societies

Potash Salts—The Government has recently acquired from Germany a quantity of potash salts in exchange for food, and arrangements have now been made by the Board of Trade for the distribution of about 40,000 tons for agricultural purposes The sale of the material will be undertaken by the British Potash Company Limited, 49 Queen Victoria Street, London, E C 4, under the direction of an Official Committee, to be called the Potash Distribution Committee, on which the Board of Trade and the Departments of Agriculture for England, Scotland and Ireland will be represented, together with representatives of trade interests

The following maximum selling prices have been agreed —

FOR SALES TO FARMERS, DELIVERED TO NEAREST RAILWAY STATION IN GREAT BRITAIN OR IRELAND IN LOTS OF NOT LESS THAN 4 TONS.

			Price per ton, nett cash in bags. £ s d
Potash Salts	30 per cent	K_2O	12 10 0
Muriate of Potash	60 „	KCl	20 12 6
Sulphate of Potash	90 „	K_2SO_4	23 2 6

Manure Mixers, Merchants, Dealers and Co operative Societies will be allowed a discount on these prices of 7s 6d per ton on Potash Salts and 10s per ton on the Muriate and Sulphate of Potash

The potash will be sold at the above basis prices, and a proportionate increase or decrease will be made for higher or lower quality as shown by analysis of a representative sample of each consignment

Farmers should place their orders without delay with their usual dealer or co operative society

Manure Mixers, Merchants, Dealers and Co operative Societies should send their orders to the British Potash Company, 49 Queen Victoria Street, London, E C 4 Special terms may arranged for purchases *ex* ship

For sales of small quantities made *ex* merchant's store the Board would regard as reasonable the following maximum additions to the price charged for 4 ton lots —

Quantity delivered	*Additional Price*
1 ton and over	10s per ton
2 cwt and over, but less than 1 ton	1s per cwt
1 cwt „ „ 2 cwt	2s „
28 lbs „ „ 1 cwt	3s „
14 lbs „ „ 28 lbs	4s „

In the case of sales for delivery to consumer's premises *ex* merchant s shop or store the cost of conveyance, charged at local rates, may be added

STATISTICS.

PRICES of AGRICULTURAL PRODUCE and FEEDING STUFFS in July, August, and September 1919.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	JULY.			AUGUST.			SEPTEMBER.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt l.w. s. d.	per cwt. l.w. s. d.	per cwt l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.
Aberdeen-Angus ...	83 6	77 3	71 11	80 2	75 0	69 8	79 9	74 10	70 0
Shorthorn . ..	82 9	77 9	72 9	79 9	74 9	69 9	80 0	75 0	70 0
Galloway	83 9	78 3	71 0	78 8	73 4	66 0	79 3	74 0	68 0
Ayrshire	79 0	73 10	60 7	76 6	69 0	60 0	.	68 8	60 0
Cross-bred	83 0	76 6	70 9	79 8	74 4	68 8	79 5	74 3	68 11
Blue Grey	84 0	78 4	70 8	...			.	.	...
Highland ...	82 0	...	...	78 0	74 0	...	80 0	..	..
	per lb. d.	per lb. d.	per lb d.	per lb d.	per lb. d.	per lb. d	per lb. d.	per lb. d	per lb. d.
VEAL CALVES	15⅝	10⅝	7	13½	9	7¼	14½	9½	7⅝
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot	16¼	16	15¾	16	16	15⅝	16¼	16¼	16
Half-bred .	16¼	16	15½	16¼	16	15½	16¼	16	15⅝
Blackface	15⅝	15	15	15½	15	14⅞	15½	15½	15
Greyface	16¼	16	15¼	16	15¾	15	16¼	16	15¼
Down Crosses ..	16½	16¼	...	16¼	16¼	.	16½	16¼	...
PIGS—	per stone. s. d.	per stone. s. d.	per stone s. d.	per stone. s. d	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs	17 10	17 6	16 0	17 11	17 7	16 0	17 11	17 4	16 0
Porkers	17 11	17 10	16 0	17 10	17 10	16 0	17 11	17 7	16 0

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description	JULY			AUGUST			SEPTEMBER		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
STORE STOCK —									
STORE CATTLE—	Per head	Per head	Per head	Per head	Per head	Per head	Per head	Per head	Per head
Aberdeen Angus	£	£ s	£ s	£ s	£ s	£ s	£ s	£ s	£ s
Yearlings	22 12	17 8	12 6	21 9	16 11	11 1	25 17	18 19	12 4
Two year olds	34 3	27 10	20 18	35 8	25 15	21 5	36 6	26 14	21 17
Shorthorn									
Yearlings	28 0	19 5	13 0						
Two year olds		30 0	27 0						
Galloway									
Yearlings	17 10	15 17	13 5	18 15			20 0	15 15	13 10
Two year olds	26 0	25 0	20 0		26 0	21 0	31 17	27 0	20 0
Ayrshire									
Yearlings	15 15	11 15	11 0					11 10	9 0
Two year olds	25 5	17 15					22 0	16 0	
Cross bred									
Yearlings	19 9	16 13	12 18	15 12	15 4	11 2	20 17	16 15	14 16
Two year olds	34 8	26 15	21 4	33 16	26 5	22 5	34 16	27 15	23 8
Blue Grey									
Yearlings	17 10	15 5	13 0						
Two year olds	31 10	27 0	22 10						
Highland									
Yearlings	13 18	12 3	9 13		15 10	11 0			
Two year olds		19 0	18 0		18 0	16 0			
Three year olds			21 8		21 0				
DAIRY COWS—									
Ayrshire									
In Milk	47 14	36 11	24 13	47 8	36 12	25 5	48 3	35 1	26 4
Calvers	52 1	36 11	25 12	50 9	36 13	26 3	54 0	38 13	26 15
Shorthorn Crosses									
In Milk	55 5	41 19	30 14	56 16	43 13	31 7	58 9	45 5	31 12
Calvers	52 11	38 5	27 11	53 17	37 17	27 13	56 5	41 14	28 14
STORE SHEEP—	s d	s d	s d	s d	s d	s d	s d	s d	s d
Cheviot Hoggs		51 6		63 0			78 9	59 1	
Half bred Hoggs	109 4			89 6	77 0		113 0	88 6	84 6
Blackface Hoggs		40 0			49 6			57 0	45 0
Greyface Hoggs	64 0	54 4	44 0	65 6	61 10	51 0	71 9	66 9	65 0
STORE PIGS—									
(6 to 10 weeks old)	81 2	62 6		76 5	54 1		71 2	52 4	

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	JULY.			AUGUST.			SEPT.		
		Dundee	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF :—										
		per lb.	per lb.	per lb	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.
Home-fed—		d.	d.	d.	d.	d.	d.	d.	d.	d.
Bullock or Heifer ...	1	12¾	12¾	12¾	12¾	12¾	12¾	12¾	12¾	12¾
	2	12¼	12¾	..	12¼	12¼	..	12¾	12¾	12¾
Bull	1	12¾	12¾	12¾	12¼	12¼	12¾	12¾	12¾	12¾
	2	12¾	12¾	...	12¾	12¼	...	12¾	12¾	...
Cow	1	12¾	12¾	12¾	12¼	12¼	12¾	12¾	12¾	12¾
	2	12¼	11	...	12¼	11	...	12¼	11	11½
Irish—										
Bullock or Heifer ...	1	...	...	12¾	..	...	...	...	...	12¾
	2	...	...	...	...	...	...	...	.	...
Bull	1	..	...	12¾	...	...	...	...	...	12¾
	2	...	...	...	...	...	...	...	...	...
Argentine Frozen—										
Hind Quarters ..	1	12⅝	12⅛	11⅝	...	11⅞	11⅞	11⅞	...	11⅞
	2	..	..	11	...	..	11	11⅞	...	...
Fore ,, ...	1	8⅝	7⅞	7⅝	...	7⅝	7⅝	...	...	7⅝
	2	...	...	7⅝	..	...	7⅝	...	...	...
Argentine Chilled—										
Hind Quarters ..	1	...	...	.	..	..	..	...	...	...
Fore ,.	1	.	...	...	..	...	...	...	..	...
MUTTON :—										
Hoggs, Blackface ...	under 60 lb.	13½	13½	13½	13½	13½	13½	13½	13½	13½
	60 lb. and over.	13½	13½	.	13½	13½	...	13½	13½	13½
,, Cross	under 60 lb.	13½	13½	13½	13½	13½	13½	13½	13½	13½
	60 lb. and over.	13½	13½	...	13½	13½	..	13½	13½	...
Ewes, Cheviot	1	13½	13½	13½	13½	13½	13½	13½	13½	13½
	2	13½	...	...	13½	..	. .	13½	...	...
,, Blackface ..	1	13½	..	...	13½	...	...	13½	13½	13½
	2	13½	...	..	13½	...	...	13½	...	...
,, Cross	1	13½	13½	13½	13½	13½	13½	13½	13½	13½
	2	13½	...	...	13½	...	...	13½	...	...
Argentine Frozen ...	1	10½	10½	10½	10½	10½	10½	10½	10½	10½
LAMB :—										
Home-fed	1	...	13½	...	...	13½	...	13½	13½	13½
	2	...	13½	...	...	13½	...	13½	13½	11½
Argentine Frozen ...	1	...	10½	...	...	...	...	..	10½	...
	2	...	...	...	...	...	...	...	...	...

Average Prices of Provisions at Glasgow.

(Compiled from Reports received from the Board's Market Reporter.)

Description.	Quality	July.	August.	Sept.
		s. d.	s. d	s d
Butter:				
Irish Creamery ... per cwt.	1	252 0	252 0	252 0
„ „ (Unsalted) „	1	252 0	252 0	252 0
Canadian ... ... „	1	252 0	252 0	252 0
„ (Unsalted) .. „	1	...	.	..
Australian ... .. „	1	252 0	252 0	252 0
„ (Unsalted) ... „	1	252 0	252 0	252 0
New Zealand ... ... „	1	252 0	252 0	252 0
„ (Unsalted) „	1	252 0	252 0	252 0
Argentine ... .. „	1	252 0	252 0	252 0
„ (Unsalted) .. „	1	252 0	252 0	252 0
Cheese:				
Cheddar ... ... „	1	144 8	144 8	144 8
Cheddar Loaf ... ... „	1	...	...	..
Dunlop .. .. „	1	144 8	144 8	144 8
Canadian ... ... „	1	144 8	144 8	144 8
New Zealand ... ... „	1	144 8	144 8	144 8
Bacon:				
Ayrshire (Rolled) ... „	1	227 6	227 6	227 6
Irish (Green) ... ... „	1	...	...	..
„ (Dried or Smoked) „	1	..	...	...
Wiltshire (Green) ... „	1	...	...	192 0
„ (Dried or Smoked) „	1	...	...	209 0
American, Long Clear Middles (Green) ... „	1	184 0	184 0	207 0
American, Short Clear Backs ... .. „	1	190 0	190 0	196 0

Description.	Quality.	July.	August.	Sept.
		s. d	s. d.	s. d.
Bacon *(continued)*				
American, Bellies... per cwt.	1	...	...	196 0
„ Sides ... „	1	186 0	186 0	193 6
„ Cumberland Cut „	1	184 0	184 0	190 8
Canadian, Sides ... „	1	190 0	190 0	...
„ Cumberland Cut „	1	188 0	188 0	189 6
Danish, Sides ... „	1	...	..	...
Hams				
Irish (Smoked) ... „	1	...	...	...
American, Long Cut (Green) ... ... „	1	192 0	192 0	195 0
American, Short Cut „	1	190 0	190 0	195 0
Canadian, Long Cut „	1	192 0	192 0	192 0
Eggs				
Country .. .. per doz.	1	4 1	4 5	4 7
	2	3 11	4 3	4 5
Irish . ... per 120	1	38 10	37 11	43 0
	2	37 10	36 9	41 9
„ (Duck) .. „	1	33 3	34 0	...
	2	32 6	...	...
American ... ... „	1	28 5	31 6	32 6
	2	...	30 0	31 4
Canadian ... ... „	1	30 7	32 8	35 6
Chinese .. „	1	...	28 0	...
Danish Fresh) ... „	1	...	38 9	42 9
	2	..	...	44 0

THE SCOTTISH JOURNAL OF AGRICULTURE

AVERAGE PRICES OF POTATOES AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

MARKETS.	Quality.	First Earlies.	Late Varieties. Red Soils. Lang-worthy.	Late Varieties. Red Soils. Other.	Late Varieties. Other Soils. Lang worthy.	Late Varieties. Other Soils. Other.
		JULY.				
		per ton. £ s. d.	per ton £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Dundee	First ...	15 10 0	...	...	...	8 0 0
	Second ...	...	...	...	...	7 0 0
Edinburgh.. ...	First .	13 10 0	...	..	...	5 6 8
	Second ...	...	..	...	..	...
Glasgow	First ...	15 6 7		...	...	8 0 0
	Second ...	...	...	...	...	...
		AUGUST.				
Dundee	First ...	13 2 6	...	...	...	...
	Second ...	12 10 0	..	...	...	...
Edinburgh... ...	First ...	12 0 0	...	...	...	...
	Second ...	11 0 0	...	...	...	...
Glasgow	First ...	12 3 4	...	...	...	...
	Second ...	...	..	...	...	...
		SEPTEMBER.				
Dundee	First ...	12 10 0	...	...	...	...
	Second ...	...	...	...	...	...
Edinburgh... ...	First ...	...	11 10 0	...	11 10 0	8 10 0
	Second ...	...	...	...	...	...
Glasgow	First ...	10 15 0	...	...	...	...
	Second ...	...	...	...	...	...

AVERAGE PRICES OF ROOTS, HAY, STRAW AND MOSS LITTER AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Markets.	Quality.	Roots. Carrots.	Roots. Yellow Turnips.	Roots. Swedes.	Hay. Ryegrass and Clover.	Hay. Timothy.	Straw. Wheat.	Straw. Barley.	Straw. Oat.	Moss Litter.
JULY.		per ton s d	per ton s d	per ton s d	per ton s. d.	per ton s d	per ton s d	per ton s d	per ton s d	per ton. s d
Dundee . .	1	. .	...	..	...	...	75 0	. .	90 0	54 0
	2	. .	...	...	...	...	...	...	. .	. .
Edinburgh	1	. .	...	.	204 0	165 0	60 0	...	65 0	.
	2	...	. .	..	152 6	...	...	. .	...	. .
Glasgow ...	1	. .	. .	...	.	...	...	. .	. .	50 0
	2	..	. .	...	. .	. .	. .	...	.	. .
AUGUST.										
Dundee ...	1	...	.	. .	288 2	...	75 0	...	90 0	54 0
	2	...	. .	. .	271 3	...	. .	...	...	
Edinburgh	1	. .	.		241 3	...	68 9	...	75 0	. .
	2		.	. .	...	...	...	...	...	. .
Glasgow ...	1	. .	. .	.	. .	...	...	...	. .	50 0
	2	. .		. .	. .	...	.	...	...	.
SEPTEMBER.										
Dundee ...	1	.	56 6	...	303 2	. .	92 6	.	110 8	54 0
	2	...	...	...	295 0	...	...	...	...	.
Edinburgh	1	.	..	90 0	253 9	...	76 3	64 2	87 6	50 0
	2	.	...	...	...	...	...	...	...	. .
Glasgow ...	1	...	...	...	.	...	...	...	...	50 0
	2	...	.	...	...	...	...	...	...	. .

AVERAGE PRICES OF FEEDING STUFFS AT GLASGOW AND LEITH.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	JULY.				AUGUST.				SEPTEMBER.			
	Glasgow.		Leith.		Glasgow.		Leith.		Glasgow.		Leith.	
	per ton.		per ton		per ton.		per ton.		per ton.		per ton.	
	£ s. d.		£ s. d.		£ s. d.		£ s d		£ s. d.		£ s. d.	
Linseed Cake—												
*Home	22 12 6		23 6 8		25 7 6		25 10 0		25 5 0		25 5 0	
Foreign	27 0 0		...		27 0 0		...		27 0 0		...	
Soya Bean Cake ...	26 10 0		...		25 7 6		...		25 0 0		...	
Semi-decorticated Cotton Cake ...	...		...		25 10 0		...		19 10 0		...	
Undecorticated Cotton Cake—												
Bombay ...	...		...		...		...		...		...	
*Egyptian ...	14 5 0		...		...		...		...		...	
Coconut Cake ...	...		...		24 0 0		...		24 0 0		...	
*Palmnut Kernel Cake	...		...		...		...		...		...	
Groundnut Cake (Decorticated) ...	...		...		...		...		...		...	
Beans (Brazilian)...	20 6 0		...		21 10 0		...		20 15 0		...	
Maize Meal ...	...		..		...		...		...		...	
Rice Meal	...		...		...		...		...		...	
Paisley Meal ...	20 6 0		...		21 0 0		...		21 0 0		...	
Cotton Seed (Meal)	...		...		...		...		..		...	
Distillery Meal ...	...		...		...		...		...		...	
Beans (English) ...	29 19 0		...		31 0 0		...		29 16 3		...	
Peas (English) ...	...		...		...		...		...		...	
Locust Bean Meal	...		...		...		...		...		...	
Maize	...		...		...		...		...		...	
Oats	...		18 0 0		...		18 15 0		...		20 3 9	
†Flour Millers' Offals	12 11 0		...		14 5 0		...		14 7 6		...	
*Malt Culms ...	17 10 0		...		17 10 0		...		17 10 0		...	
Distillery Mixed Grains—												
*Dried	17 14 0		17 0 0		18 0 0		18 0 0		18 0 0		18 0 0	
Wet	...		...		...		...		...		...	
Brewers' Grains—												
*Dried	...		...		...		17 10 0		...		17 10 0	
Wet	...		...		...		...		...		...	
Wheat—												
*Middlings (Fine Thirds or Parings)	...		12 0 0		12 15 0		13 0 0		...		15 0 0	
*Sharps (Common Thirds)... ...	...		...		...		..		...		13 10 0	
*Bran (Medium) ...	...		11 0 0		...		12 5 0		...		13 10 0	
Bran (Broad) ...	...		...		...		...		...		...	
Feeding Treacle ...	12 0 0		10 0 0		12 15 0		12 15 0		13 0 0		13 10 0	
Crushed Linseed ...	...		...		...		...		...		...	
Fish Meal	18 14 0		21 0 0		19 0 0		21 0 0		19 0 0		20 0 0	

* Fixed price excluding price of bags and authorised transport charges.
† Sold in 2-ton lots, sacks included, ex-Mill and ex-Distillery.

ABSTRACT OF AGRICULTURAL RETURNS FOR SCOTLAND, 1919.

Collected 4th June 1919 (and comparison with 1918).

CROPS.

DISTRIBUTION.	1919.	1918.	Increase.		Decrease.	
	Acres.	Acres.	Acres.	Per cent.	Acres.	Per cent.
Total Area (excluding Water), ...	19,069,683	19,069,683	...	...	...	...
Total Acreage under all Crops and Grass (*a*), ...	4,751,569	4,761,101	...	..	9,532	0·20
Arable Land, ...	3,406,148	3,453,495	...	...	47,347	1·37
Permanent Grass (*a*), For Hay, ...	154,008	148,874	5,134	3·45	...	...
Permanent Grass (*a*), Not for Hay, ...	1,191,413	1,158,732	32,681	2·82	...	...
Permanent Grass (*a*), Total, ...	1,345,421	1,307,606	37,815	2·89	...	...
Wheat, ...	79,596	79,062	534	0·68	...	...
Barley (including Bere), ...	173,948	152,835	21,113	13·81	...	...
Oats, ...	1,109,696	1,243,823	. .	...	134,127	10·78
Mixed Grain, ...	2,401	4,072	...	...	1,671	41·04
Rye, ...	5,945	5,650	295	5·22	...	...
Beans (to be harvested as Corn), ...	7,166	7,275	...	...	109	1·50
Peas	516	417	99	23·74	...	...
Potatoes, ...	154,550	169,497	...	...	14,947	8·82
Turnips and Swedes, ...	426,343	396,689	29,654	7·48	...	...
Mangolds, ...	2,635	2,552	83	3·25	...	...
Cabbage, ...	3,680	3,829	..	...	149	3·89
Rape, ...	10,784	2,848	7,936	278·65	...	...
Vetches or Tares, for Seed, ...	327	424	...	...	97	22·88
Vetches, Tares, Beans, Peas, Mashlum, etc., for Fodder, ...	11,645	15,273	...	...	3,628	23·75
Carrots, ...	392	474	...	...	82	17·30
Onions, ...	186	184	2	1·09	...	...
Flax, ...	1,001	1,338	...	...	337	25·19
Small Fruit, ...	6,115	6,381	...	..	266	4·17
Rye-Grass and other Rotation Grasses and Clover, For Hay, ...	393,098	389,472	3,626	0·93	...	...
Rye-Grass and other Rotation Grasses and Clover, Not for Hay,	1,006,521	964,818	41,703	4·32	...	...
Rye-Grass and other Rotation Grasses and Clover, Total, ...	1,399,619	1,354,290	45,329	3·35	...	..
Other Crops, ...	1,920	1,753	167	9·53	...	...
Bare Fallow, ...	7,683	4,829	2,854	59·10	...	...
Orchards (*b*), ...	1,619	1,684	...	...	65	3·86

LIVE STOCK

	No	No	No	Per cent	No	Per cent
Horses used for Agricultural purposes (including Mares for Breeding,	140,510	137 369	3,141	2 29		
Unbroken Horses (ncluding Stallions) —						
One year and above,	35 698	36,251			553	1 53
Under one year,	13,079	13 153			74	0·56
Total,	189,287	186 773	2,514	1 35		
Other Horses,	23,962	23,251	711	3 06		
Total of Horses,	213 240	210,024	3,225	1 54		
Cows in Milk,	361 782	345 821	15,961	4 62		
Cows in Calf, but not in Milk,	44 952	52,802			7 850	14 87
Heifers in Calf,	48 541	53 666			5,125	9 55
Bulls being used for Service	10 208					
Other Cattle —		218,833	29 493	13 48		
Two years and above,	229,118					
One year and under two,	283 119	293,516			10,397	3 54
Under one year,	242 119	245 204			3,085	1 26
Total of Cattle	1 228 839	1,209,842	18 997	1 57		
Ewes kept for Breeding	2,820 718	3 014,702			193,984	6 43
Rams to be used for Service in 1919,	80 773					
Other Sheep —		1,067,255	82,227	7 70		
One year and above,	1 068,709					
Under one year,	2,425,494	2,706 241			370,747	13 26
Total of Sheep,	6 395 694	6,878,198			482,504	7 01
Sows kept for Breeding,	15 178	16,082			904	5 62
Boars being used for Service,	1 712					
Other Pigs,	120,739	111,925	10,526	9 40		
Total of Pigs,	137,629	128,007	9,622	7 52		..

(a) Excluding Mountain and Heath Land used for grazing (9,275,018 acres in 1919).
(b) Any Crop or Grass grown in Orchards is also returned under its proper heading.

AGRICULTURAL RETURNS FOR SCOTLAND.

ACREAGE under WHEAT, BARLEY (including BERE), and OATS in each County on 4th June 1919, with Comparison for 1918.

COUNTIES.	Wheat.		Barley (including Bere).		Oats.	
	1919.	1918.	1919.	1918.	1919.	1918
	Acres	*Acres*	*Acres.*	*Acres*	*Acres.*	*Acres.*
Aberdeen	17	28	23,256	21,173	207,552	228,885
Argyll	14	6	1,680	1,413	20,176	23,100
Ayr	2,156	2,110	525	418	51,140	56,593
Banff	23	9	7,458	6,523	52,226	57,661
Berwick	6,818	4,859	17,534	16,402	35,141	44,223
Bute	47	30	24	19	5,291	5,978
Caithness	...	...	1,202	1,189	33,245	35,645
Clackmannan ...	435	504	259	199	3,685	4,217
Dumbarton ...	975	1,062	77	43	8,749	8,980
Dumfries	145	119	661	394	50,485	57,284
Elgin or Moray . .	1,027	1,083	9,362	8,003	27,230	31,137
Fife	15,701	15,113	14,902	12,532	48,636	54,422
Forfar . . .	11,518	12,517	20,587	17,844	61,250	69,455
Haddington ..	7,774	8,086	14,748	12,384	18,881	22,895
Inverness	226	243	5,138	5,400	31,056	36,340
Kincardine ...	1,579	1,798	11,921	10,163	34,036	39,387
Kinross	337	320	371	226	8,283	8,935
Kirkcudbright ...	54	112	218	240	33,000	38,383
Lanark . . .	3,440	3,256	399	266	48,452	52,421
Linlithgow ...	3,201	3,051	2,325	1,822	12,742	14,242
Midlothian . .	7,477	7,528	5,696	4,377	23,511	26,626
Nairn .	44	6	2,152	1,828	7,039	8,309
Orkney	. .	...	4,231	4,405	35,920	38,683
Peebles . .	3	3	412	297	8,389	9,303
Perth . . .	8,884	9,042	5,287	4,705	83,268	92,103
Renfrew	2,376	2,334	61	46	12,556	13,780
Ross and Cromarty	1,372	1,949	8,556	7,298	35,483	39,376
Roxburgh	1,502	1,452	11,098	9,768	31,852	38,693
Selkirk	28	39	366	339	4,874	5,641
Shetland	...	. .	904	950	7,034	7,209
Stirling	2,283	2,241	1,480	1,202	22,579	24,419
Sutherland ...	3	23	642	564	8,151	8,819
Wigtown	137	139	416	403	37,784	40,679
Total	79,596	79,062	173,948	152,835	1,109,696	1,243,823

AGRICULTURAL RETURNS FOR SCOTLAND.

ACREAGE under BEANS, POTATOES, and TURNIPS and SWEDES in each County on 4th June 1919, with Comparison for 1918.

COUNTIES.	Beans.*		Potatoes.		Turnips and Swedes.	
	1919.	1918.	1919.	1918	1919.	1918.
	Acres	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Aberdeen	37	16	7,300	8,056	82,669	78,396
Argyll	103	60	3,826	4,435	6,055	5,794
Ayr	843	879	10,283	11,435	8,595	8,257
Banff	52	63	1,829	2,092	20,527	19,390
Berwick	821	823	2,576	2,863	22,712	20,846
Bute	54	54	1,251	1,443	1,426	1,326
Caithness	...	...	1,407	1,621	12,087	11,920
Clackmannan ...	294	359	456	449	798	736
Dumbarton	56	112	2,811	3,187	1,623	1,511
Dumfries	56	107	4,362	5,520	15,585	13,448
Elgin or Moray ...	18	8	1,829	2,126	14,187	13,698
Fife	392	405	17,438	18,358	21,925	20,543
Forfar	44	27	18,297	19,424	31,887	29,781
Haddington ...	138	191	7,758	8,201	13,157	12,112
Inverness	166	41	5,309	6,239	9,887	9,489
Kincardine	35	33	4,130	4,346	15,748	14,499
Kinross	9	4	1,231	1,435	2,589	2,240
Kirkcudbright ...	34	54	1,735	2,051	11,478	9,939
Lanark	168	122	6,614	7,363	10,409	9,676
Linlithgow ...	64	72	2,604	2,803	3,330	3,072
Midlothian	19	5	7,040	7,536	10,004	8,615
Nairn	.	...	270	322	3,908	3,767
Orkney . ..	.	...	2,444	2,831	13,857	13,418
Peebles	. .	...	490	541	3,557	3,167
Perth	1,201	1,098	19,807	21,436	26,970	24,044
Renfrew	148	152	3,460	3,909	2,418	2,344
Ross and Cromarty	14	8	7,242	7,839	14,831	13,880
Roxburgh	148	236	1,320	1,518	19,230	17,543
Selkirk	9	...	188	255	2,479	2,284
Shetland	...	...	2,459	2,332	1,097	1,060
Stirling	2,006	2,089	3,872	4,372	4,358	4,108
Sutherland	...	...	1,401	1,484	2,875	2,756
Wigtown	237	257	1,511	1,585	14,085	13,030
Total	7,166	7,275	154,550	169,497	426,343	396,689

* To be harvested as corn.

AGRICULTURAL RETURNS FOR SCOTLAND.

ACREAGE under RYE-GRASS and other ROTATION GRASSES and CLOVER, and under PERMANENT GRASS in each County on 4th June 1919, with Comparison for 1918

COUNTIES.	Rye grass and other Rotation Grasses and Clover.				Permanent Grass			
	For Hay		Not for Hay		For Hay.		Not for Hay.	
	1919	1918	1919	1918	1919	1918	1919	1918
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres.*
Aberdeen	47,441	45,014	225,234	215 411	1,677	880	29 031	27,440
Argyll	11 007	12,502	16,325	16 428	14,029	13,865	54,934	52,494
Ayr	27,091	25,465	47 162	47,074	21,751	21,106	139,899	133,900
Banff	9,275	8,783	57,276	54 432	513	537	8 685	8,710
Berwick	10 397	10 186	44,620	41 337	1 984	2,025	46,226	46 507
Bute	2 415	2,462	5,139	5,478	625	363	8,975	8 392
Caithness	9,849	9 462	25,104	23,993	780	751	23,124	22,556
Clackmannan	1,295	1 156	1 168	1,474	1 164	1,261	5,572	4 943
Dumbarton	5 734	6,157	5 404	5,166	2 353	2,034	19 372	18 878
Dumfries	18 385	18 808	49 904	46 654	18,203	18,093	88 021	86,567
Elgin	5,413	5,459	31 613	30 019	303	280	6 714	6 396
Fife	25 040	26,119	27,874	27,915	3,351	3 699	65 733	63,239
Forfar	21,385	21 677	56 439	52,170	1,913	1,129	22,419	22 238
Haddington	10,507	10 378	14 357	14 668	530	834	16,452	16,543
Inverness	11,884	11 510	19,772	18,195	7,577	7,074	55,928	52,532
Kincardine	12 308	12,167	30,319	28 385	508	186	7 636	7,471
Kinross	2,843	2,840	7,003	6 484	498	700	10 383	10,396
Kirkcudbright	8 216	8,665	39,800	37,442	11,901	11,994	73,106	72,551
Lanark	31,550	32,198	35,638	34,244	14,475	13,515	93 909	92,140
Linlithgow	7 047	7,179	3 639	3 279	1 515	1,282	20, 905	20,261
Midlothian	11,494	11,914	13,647	13,676	2,254	2 513	38 056	37,950
Nairn	1 534	1,521	8,938	7 869	56	68	1,441	1,619
Orkney	9,442	8,820	27,921	26,732	579	414	14,213	13,464
Peebles	2,429	2,557	10,681	11,350	1,389	1,536	22 537	21,452
Perth	32,500	32,343	55,467	51 941	11,360	10,385	79,056	77,478
Renfrew	9,932	10,356	5,788	7 071	6,575	5,853	40 606	37,920
Ross and Cromarty	13,117	12,539	29,116	27,796	2 550	2,576	24,015	22,849
Roxburgh	9,051	8,659	40,243	38,893	6,600	6,669	54,553	53,661
Selkirk	1,296	1,341	6,398	6,455	1,832	1,973	12,165	11,369
Shetland	1,385	1,363	615	602	1,625	1,604	11,377	12,227
Stirling	11,669	11,594	9,122	8,544	6,970	7,363	47,591	46,762
Sutherland	4,400	4,251	4,862	4,093	1,042	1,512	6,283	6,034
Wigtown	3,868	3,937	49,923	48,648	4,946	4,800	39,003	39 793
Total	393,098	389 472	1,006,521	964,818	154,008	148,874	1,191,413	1,158,732

AGRICULTURAL RETURNS FOR SCOTLAND.

NUMBER of HORSES, CATTLE, SHEEP and PIGS in each County on 4th June 1919, with Comparison for 1918.

COUNTIES	Horses.*		Cattle.		Sheep.		Pigs.	
	1919.	1918	1919.	1918.	1919.	1918.	1919.	1918.
	No	*No*	*No*	*No.*	*No.*	*No.*	*No*	*No.*
Aberdeen	30,644	29,731	176 449	172,608	183,772	213.585	10,936	10,111
Argyll	5,945	5.928	60,471	59,989	759,549	803,673	4,928	4,801
Ayr	10,171	9,997	114,633	114,296	340.578	358,660	12,126	11,435
Banff	8,531	8,280	44,923	43,496	59,819	64 959	2,805	2,260
Berwick	4,802	4,726	18,737	19,163	294,655	312,573	3,779	3,613
Bute	1 249	1,215	9,649	9,687	39,099	42,387	807	597
Caithness	5,590	5 689	20 812	20 769	134,356	143.373	1,914	1,742
Clackmannan	729	727	3,366	3,410	12,962	14.461	528	541
Dumbarton	1 842	1,789	14,629	14,476	64,106	72.040	1,189	1,038
Dumfries	7 415	7,373	70,929	68 802	512,867	538,965	9 600	7,988
Elgin or Moray	4 051	4 528	23 090	22 328	44 053	50,075	1,817	1,436
Fife	9,305	9,119	45,580	46 544	91,505	107,003	6,677	6,712
Forfar	9,306	9,171	47 766	47 371	149,356	105,196	6,761	6,927
Haddington	3 497	3 451	8,954	8 640	114,920	126,595	2,085	1,903
Inverness	8,016	7,960	48,050	46 664	494,075	529,790	1,719	1,265
Kincardine	4 907	4,861	25,765	25.034	38,398	42 859	2,255	2,048
Kinross	1,140	1,115	6,464	6 497	28,289	32,039	801	691
Kirkcudbright	5 110	4,898	57,067	55,698	336,013	358,587	11,986	10,375
Lanark	8 479	8 588	75,137	75 489	219,938	238,162	7,530	7,181
Linlithgow	2.243	2 175	11,704	11 615	15 002	15,767	1.084	1,182
Midlothian	3,874	3,729	17,630	17,773	157,732	171,041	10,028	9,940
Nairn	1,384	1,282	6,704	6,120	15,879	16,543	531	469
Orkney	6,370	6,575	33,463	32 478	33 444	36,173	1,658	1,405
Peebles	1,082	995	7,367	7 201	187,309	202,319	377	402
Perth	12,919	12,559	71,755	70,961	547.719	615,277	7,632	7,209
Renfrew	3,104	3,101	27,592	27,604	36.870	41,867	1,971	1,723
Ross and Cromarty	6,899	7,081	41,767	40 790	265,427	283,479	3,456	3,086
Roxburgh	4,068	4,034	20,176	19 462	489,676	517,809	3,245	3,081
Selkirk	598	001	3,611	3 322	163,377	174,767	359	323
Shetland	2,575	2,887	14 124	13,593	140.729	139,502	492	284
Stirling	4,705	4,686	32,933	32 785	110,031	122,650	2,192	2,082
Sutherland	2,155	2,208	11,158	10,739	200,809	207,498	553	457
Wigtown	5,526	5,414	55,478	54,438	112,390	118,434	13,808	13,700
Total	189,287	186,773	1,228,839	1,209,842	6,395,694	6,878.198	137,629	128,007

* Horses used for agricultural purposes, mares for breeding, and unbroken horses (including Stallions). "Other Horses" on agricultural holdings are not included; the total of these for Scotland is given in the summary table on p. 583.

ACREAGE OF CROPS AND NUMBER OF LIVE STOCK IN EACH COUNTY DISTRICT OF SCOTLAND on 4th June 1919.

COUNTY AND DISTRICT OF COUNTY		Wheat	Barley (including Bere)	Oats	* Beans	Potatoes	Turnips and Swedes	Rye grass and other Rotation Grasses and Clover		Permanent Grass		† Horses	Cattle	‡ Sheep	Pigs
								For Hay	Not for Hay	For Hay	Not for Hay				
		Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	No	No	No	No
Aberdeen	Aberdeen	3	6498	19,305		1639	9,936	7,472	23 865	87	2 541	3615	20,867	7,151	2481
	Alford		913	18,496	4	378	7,737	4,757	20 570	196	5,303	2763	16 979	37,130	630
	Deer		3085	47 132	14	2622	16 931	11,239	44 419	599	7,280	6730	38,331	22 787	1956
	Deeside	1	2526	16,182	6	479	7,048	5,807	18 029	43	3,822	2654	15,658	41,697	794
	Ellon	13	3386	31 350	8	850	12,463	6 465	34 014	283	2 787	3739	25 187	20,828	1027
	Garioch		3392	26 646	3	723	10,030	5 149	20 969	272	2 345	4111	22,333	12 170	1396
	Huntly		993	17 504		413	6 405	2,100	22 191	47	3 364	2688	13,538	31,491	1014
	Turriff		2463	30 937	2	706	11,115	4,272	32,177	150	1,589	4344	23,556	10,518	1638
Argyll	Ardnamurchan		1	587		282	83	611	151	1077	1,543	154	3,269	62,083	30
	Cowal	1	1	1,738		326	511	1,027	1,138	1517	5,750	397	4,831	139,185	173
	Islay		19	4 934	5	603	1,384	2 877	3,769	1853	16,012	1247	11,527	79,423	841
	Kintyre	1	815	5 163	05	491	2,343	1,542	8,529	982	11 424	1461	14 170	124,261	2595
	Lorn		19	2 995	2	824	741	2 451	789	3906	5,396	925	9,778	167,263	541
	Mid Argyll		15	2,200	1	469	660	1,735	1 238	2452	7.483	603	7,986	107 909	345
	Mull	12	810	2,499		741	333	1,754	711	2242	7 326	1158	8,910	70,425	403
Ayr	Ayr	331	31	13,016	294	1040	1 952	7,549	13 287	6869	38,204	2423	30,471	102 502	3851
	Carrick	341	402	12 358	243	4304	3 320	4 723	12 033	3725	32,188	2417	24,716	174,746	2966
	Kilmarnock	699	39	12,683	129	1128	1,605	8 302	12 786	5776	36,105	2764	32,535	27,626	4281
	Northern	785	53	13,083	177	2911	1 718	6,517	9 056	5381	33,402	2567	26,911	35,704	1028
Banff	Banff	23	6145	29 189	52	1239	12,225	5,010	32,314	330	2,333	4834	26,992	13,447	2048
	Keith		1313	23 037		590	8,302	4 265	24 062	183	6,352	3697	17,931	46,372	757
Berwick	East	3213	6812	10 038	314	1143	7 535	3,486	14,012	271	12 406	1605	5.504	72,159	1398
	Middle	3063	7021	12 157	431	807	8 217	4,688	11,185	813	18,320	1011	7 456	103,574	1538
	West	542	2801	12,946	76	536	6 060	2,223	19 423	900	15,500	1286	5,777	118,922	843

Bute	Arran	2	14	2,556	47	744	465	1,170	2,510	158	4,164	634	4,767	32,398	405
	Bute and Cumbrae	45	10	2,733	7	597	991	1,245	2,629	467	4,811	615	4,882	7,601	402
Caithness (not divided)			1202	33,245		1407	12,087	9,849	25,104	780	23.124	5590	20,812	134,356	1914
Clackmannan (not divided)		435	259	3,685	294	456	798	1,295	1,168	1164	5,572	729	3,366	12,962	528
Dumbarton	Eastern	797	18	4,590	28	1476	804	3.191	2,371	1220	8 085	1012	6,583	9,940	747
	Western	178	59	4,159	28	1335	819	2.543	3,033	1113	11,287	830	8.046	54,166	442
Dumfries	Annan	63	324	16,461	43	1438	4,551	5,271	13,709	2262	14,376	2258	15,687	41,836	2373
	Dumfries	64	102	11,717	3	1406	3,647	3,632	13,143	1970	11,891	1578	14.412	46,591	2126
	Langholm	5	14	2,991		220	1,050	1.399	2,433	3165	7.608	540	5.515	114.434	533
	Lockerbie	12	213	11,840	6	765	3,761	4,451	12,758	5816	22,914	1771	18,400	135,634	1836
	Thornhill	1	8	7.566	4	533	2.576	3,632	7 891	4981	31,235	1268	16,915	174,372	2732
Elgin or Moray (not divided)		1027	9362	27,230	18	1820	14,187	5 413	31.643	303	6 744	4951	23,090	44,053	1817
Fife	Cupar	4953	4689	15,613	86	6156	7,672	7,240	11.377	702	15,672	2754	12,500	35.405	1974
	Dunfermline	1573	787	9,259	206	1838	2,723	4 675	3,111	1284	19 747	1645	9,656	18 954	873
	Kirkcaldy	3450	2943	1 .873	31	3933	4,282	6 449	5.796	827	12,209	2167	10,438	16,620	2094
	St. Andrews	5725	6483	12.891	69	5511	7.248	7 576	7,590	538	18,015	2799	12 986	20.526	1736
Forfar	Arbroath	3214	5253	10 901		4304	6 626	4.487	9.241	147	2,552	1938	8.647	3,377	1125
	Brechin	2534	6962	19 027	43	4364	9,828	6 722	18,876	761	5.661	2654	13,825	59,136	1513
	Dundee	3196	3393	11 151	1	4679	6,120	4 410	9.146	298	3.301	1808	9.579	11.439	2148
	Forfar	2574	4979	20,171		4950	9,313	5.766	19.176	707	10,905	2906	15 715	75,404	1975
Haddington	Eastern	2532	5918	6,133	62	3059	5,030	3 436	5,398	304	8,574	1256	2,967	57.865	623
	Western	5242	8830	12 748	76	4699	8,127	7,071	8.939	226	10 878	2241	5.987	57,055	1462
Inverness	Inverness	57	1869	8,484	1	507	4.588	2,995	9,573	219	4.017	1575	7,089	35,826	749
	Aird	169	193	6,605	6	560	2.674	3,135	4.984	411	3,961	1141	6,282	37,835	589
	Badenoch		70	4.761		247	1 796	2,437	3.939	1094	8,660	810	4.965	90,218	186
	Lochaber		8	1 527	2	562	370	1,489	597	2120	2,189	433	6,002	137,558	136
	Skye		8	5.635		1319	337	1.534	522	2544	4,296	1079	10,994	133,759	46
	Harris, N. & S. Uist		2990	4,044	157	2114	122	294	157	1180	32,805	2978	13,624	58,879	13

* To be harvested as corn.

† See note on p. 587.

ACREAGE of CROPS and NUMBER of LIVE STOCK in each COUNTY DISTRICT of SCOTLAND on 4th June 1919—*continued.*

COUNTY AND DISTRICT OF COUNTY		Wheat	Barley (including Bere)	Oats	* Beans	Potatoes	Turnips and Swedes	Rye grass and other Rotation Grasses and Clover		Permanent Grass		† Horses	Cattle	Sheep	Pigs
								For Hay	Not for Hay	For Hay	Not for Hay				
		Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acre*	*Acres*	*Acres*	*Acres*	*No*	*No*	*No*	*No*
Kincardine	Laurencekirk	626	2804	10 476		1532	4 428	3 197	7 873	149	1,387	1194	5,881	11,141	577
	Lower Deeside	3	1342	3,851		710	1 783	1,905	3,312	88	284	717	3 332	139	556
	St Cyrus	744	2575	6 317	20	989	3 027	2,321	5,078	78	2,598	893	3,950	8,980	354
	Stonehaven	206	3509	8 948	15	652	4,298	3,338	8,922	44	2,282	1368	8,154	10,997	474
	Upper Deeside		1091	4 444		247	2 212	1,547	5,134	149	1,095	825	4,448	7,141	294
Kinross (not divided)		337	371	8,283	9	1231	2 589	2 843	7,003	498	10,383	1146	6,464	28,289	801
Kirkcudbright	Eastern	24	24	13 308	11	1002	4,552	3,029	15,661	2838	22,826	1924	20,006	59,999	3090
	Northern		27	2 026		141	905	649	2 092	2637	9,842	511	6,189	132,950	754
	Southern	30	151	13,814	13	401	5 035	2,961	10,168	4836	30,638	2203	25,351	65,408	7515
	Western		16	3 252	10	101	986	677	2 879	1590	9 800	472	5,521	77,656	627
Lanark	Lower Ward	1301	47	5 170	10	1452	675	3 119	1,060	2737	5 805	991	4,992	879	2687
	Middle Ward	2039	170	21,574	131	2617	3 772	17,248	12,071	6519	47,416	4012	39,183	29,635	2986
	Upper Ward	100	176	21 708	18	2545	5,962	11,102	21,607	5219	40 688	3476	30,962	189,424	1857
Linlithgow	Bathgate	411	439	6 300	14	659	1 209	3 371	1 435	954	13 618	1126	7,187	6,106	231
	Linlithgow	2790	1886	6 442	50	1045	2 121	3 676	2,204	561	6,777	1117	4,517	8 896	853
Midlothian	Calder	1076	829	6 506	2	1014	1 745	3,602	1 906	852	12 530	1113	5 626	32,532	846
	Gala Water	522	1539	6 727		392	3 889	1,583	9 273	417	14,608	789	3 726	88,376	239
	Lasswade	1912	2096	6,204	17	1823	2,883	3 60,	2,170	687	7 770	1087	4,106	30,567	946
	Suburban	3067	1232	3 984		2911	1,487	2,706	208	298	3,148	885	4,172	6,257	7997
Nairn (not divided)		44	2152	7 039		270	3,908	1 534	8 938	56	1 441	1384	6,704	15,879	531
Orkney	Mainland		1397	20 144		1284	7,146	5,693	14 905	250	7,287	3529	17,733	12 742	778
	North Isles		2455	10 679		807	4,805	2,475	9,754	238	5 723	2092	11,148	15,373	731
	So Ronaldshay and Walls		349	5,007		353	1,906	1,274	3,262	91	1,203	749	4,582	5,329	149

Peebles (not divided)		3	412	8,389		400	3 557	2,429	10,681	1389	22.537	1082	7,367	187,309	377
Perth	Blairgowrie	2584	2328	17,759	13	5297	7 123	6 338	14,242	896	11,298	2624	13 299	50,141	1882
	Central	840	181	18 432	29	4002	5 216	7,025	12,127	1497	16,475	2671	13,981	113,534	1428
	Highland	16	177	8 391		1023	2 954	4,674	5,090	2562	13,410	1526	10,084	180 411	1135
	Perth	4991	2270	26 200	521	7383	9,200	0,463	16 508	1763	20,793	3768	19,462	46,750	2450
	Western	453	331	12,396	638	2042	2 378	5,000	6,000	4642	17,080	2330	14,929	156.883	737
Renfrew	First or Upper	1435	13	5 725	57	1396	1,121	4,548	2,123	3816	21.228	1390	13,915	17,323	888
	Second or Lower	941	48	6,831	91	2064	1 297	5,384	3,665	2759	19,378	1714	13,677	19 547	1083
Ross and Cromarty	Black Isle	56	2754	8,219		791	4,179	2 948	8,130	253	1 319	1556	6,198	9,635	775
	Easter Ross	1127	1817	11,319	14	1378	5,097	4,078	11 479	395	5,309	1973	8,534	55,418	1721
	Mid Ross	188	1692	10,495		786	4,548	4,096	9,025	591	5,546	1024	9,918	69,933	893
	S W and Western	1	25	1,086		745	239	1 748	414	1139	2,097	382	5,456	76,443	65
	Lewis		2268	3.464		3542	168	247	68	172	9,744	1064	11,661	53,998	2
Roxburgh	Hawick and Liddesdale	51	196	4,316		267	2 187	1,612	4,725	3351	12,516	624	5,369	166,418	554
	Jedburgh	246	2165	9 846	28	201	5 387	2 524	12,784	1732	17,065	1243	5,704	140,721	817
	Kelso	1028	7372	10,646	97	553	7 756	3,127	14 236	865	12,414	1414	5,727	124,437	1310
	Melrose	177	1365	7,044	23	200	3 900	1,788	8,498	652	12,558	787	3,376	58,100	564
Selkirk (not divided)		28	360	4,874	0	188	2 479	1,296	6,398	1832	12,165	598	3,611	163,377	359
Shetland	Mainland		867	5,649		1984	948	1 056	523	1128	8 137	1724	10,738	111,376	285
	North Isles		37	1,385		475	149	329	92	497	2 940	851	3,386	29,353	207
Stirling	Central	951	763	9 196	1106	1659	1,894	4,178	4 073	3766	15 101	2101	12,751	36,786	1013
	Eastern	1081	681	7,557	843	945	1 305	4,006	2 023	1654	15,209	1355	8,078	3,979	698
	Western	248	36	5,826	57	1268	1,159	3,455	3,026	1580	17 191	1249	11,204	69,266	481
Sutherland (not divided)		3	642	8,151		1401	2 875	4,400	4 862	1642	6 283	2155	11,158	200,899	553
Wigtown	Machars	127	367	16,675	193	421	5,448	2 601	19,174	3213	27 275	2563	25,989	61,620	4096
	Rhins	10	49	21,109	44	1090	8,637	1,267	30,749	1733	12 628	2963	29,489	50,761	9712

* To be harvested as corn

+ See note on p 587.

ACREAGE under each Variety of Potatoes in Scotland (1919), as returned by Growers of 1 Acre and over.

Variety.	Acres.	Variety.	Acres.
A. FIRST EARLIES—		C. MAINCROPS—	
1. America	20	31. Abundance (including Culdees Castle, The Admiral, The Provost, The Crofter, and Favourite	2,862
2. Arran Rose ..	75	32. Arran Chief	32,477
3. Beauty of Hebron ..	84	33. Arran Victory	455
4. Duke of York (including Midlothian Early) ...	632	34. Bishop	38
5. Dunottar Castle... .	19	35. Burnhouse Beauty ...	72
6. Early Puritan	97	36. Champion ..	1,538
7. Early Rose .. .	21	37. Dominion	85
8 Eclipse (including Sir John Llewellyn) .	2,007	38. Evergood	3,273
9. Edzell Blue . ..	489	39. Golden Wonder .	3,767
10. Epicure	9,227	40. Irish Queen	79
11 May Queen	133	41. Kerr's Pink	1,061
12 Myatt's Ashleaf Kidney	15	42. King Edward VII. .	14,006
13. Ninetyfold	181	43 Langworthy (including What's Wanted) .	2,340
14. Resistant Snowdrop ..	6	44. Leinster Wonder .	39
15. Sharp's Express. .	648	45 Lochar (including Heather Bountiful) .	1,036
16. Sharp's Victor	133	46 Majestic	1,759
17 Snowdrop . ..	37	47 Northern Star	1,009
18. Witch Hill ...	40	48. President (including Iron Duke and Scottish Farmer) .	5,142
19. Other First Earlies not specified above ..	1,146	49. Rector	29
Total First Earlies	15,010	50 St Malo Kidney .	15
		51. Summit	86
B SECOND EARLIES—		52 Templar .	939
20. Arran Comrade .	846	53 Tinwald Perfection (including Rob Roy) ..	682
21. British Queen (including Pioneer) .	8,701	54 Twentieth Century ...	110
22 King George V	5,091	55 Up-to-Date (including Dalhousie Factor, Table Talk, Scottish Triumph, Dalmeny Beauty, Dalmeny Regent, Duchess of Cornwall and Mayfield Blossom	6,877
23 Conquest...	91	56 White City	174
24. Royal Kidney .	56	57 Other Maincrops not specified above ...	3,580
25. Great Scot (including Sir Douglas Haig, Southampton Wonder and Conqueror)	9,950		
26. Queen Mary	533		
27. The Ally ...	3,646		
28 The Duchess	20		
29 Windsor Castle .	24		
30 Other Second Earlies not specified above .	2,193		
Total Second Earlies ...	31,151	Total Maincrops ...	83,530

Total Area Planted . . ... . 129,691 Acres.

Note.—The counties of *Shetland* and *Sutherland* are entirely excluded.

The districts of Ardnamurchan, Islay, Lorn, Mid-Argyll and Mull in the county of *Argyll*, the districts of Badenoch, Lochaber, Skye, Harris, North and South Uist in the county of *Inverness*, and the districts of South-Western, Western and Lewis in the county of *Ross and Cromarty* are also excluded.

Printed under the authority of His Majesty's Stationery Office
By J SKINNER & CO., LTD, 27 THISTLE STREET, EDINBURGH.
(249.) 7997/189. 3500. 10/19.—J.S.&Co Ltd. (E.)

INDEX TO VOL. II.—1919.

	PAGE
Aberdeen Angus Cattle	456
Aberdeenshire, live stock production	327
Acetylene gas for destroying field mice (*Italy*)	108
Agricultural Executive Committees	425
Agricultural returns and statistics:	
Abstract of agricultural returns, 1919	533, 582
Acreage under each variety of potatoes, 1919	592
Estimated numbers of live stock during the years 1914 and 1918	290
Estimated produce of crops during the years 1914 and 1918	289
Estimates of produce of crops in 1918	84
Prices of dead meat	140, 293, 444, 577
Prices of feeding stuffs	144, 297, 448, 581
Prices of live stock	138, 291, 442, 575
Prices of potatoes	142, 295, 446, 579
Prices of provisions	141, 294, 445, 578
Prices of roots, hay, etc	143, 296, 447, 580
Agricultural reconstruction in France	549
Agriculture in the Outer Hebrides	465
Ammonium Nitrate, fertilising value	92
Anderson, John Beekeeping	169
Animal breeding, problems of	449
Anthrax, see *Diseases of Animals*	
Australia	
Blow fly pest in sheep	261
Destruction of wheat by weevils	414
Inter State conference of agricultural scientists	270
Sheep lice and ticks	418
Austria	
Artificial feeding of bees with pollen	269
Farm book keeping	542
Barclay, James R Scottish pure bred live stock	456
Barley	
Barley growing in Scotland	151
Leaf stripe	535
Pure line selection (*Canada*)	91
Bats value in control of insects (*France*)	109
Bean growing in Scotland	4
Bees	
Artificial feeding with pollen (*Austria*)	269
Beekeeping	169
Isle of Wight disease in hive bees	176
Nosema apis in hive bees	511
The common honey bee as an agent in pollination (*U S A*)	109
Belgium Treatment of mange in Horses	559
Buds, see *Wild Fruits*	
Book keeping and cost accounting	541
Bot flies of the horse	260 354
Brown, Wm The care of the horse's hoof	30
Cabbage maggot (*U S A*)	554
Canada	
Agricultural experiment stations	110
Bot flies on horses	260
Co operation in the egg industry	561
Flies and milk production	260
Legislation as to the sale of fertilisers	561
Substitutes in swine feeding	257
Cattle, see *Live Stock*	
Coal dust utilisation (*France*)	268

	PAGE
Commissions and Committees :	
Food (War) Committee—Composition of potatoes	398
Rural transport in Scotland	377
Sulphuric acid and fertiliser trades Departmental Committee	228
Wild birds protection Departmental Committee	560
Conacher, H M	
Metayage	374
Rural economy of France	49 203
Conferences Australian Inter State conference of agricultural scientists	270
Contagious abortion, see *Diseases of Animals*	
Co operation	
Co operative societies for bringing land under cultivation (*France*)	422
Egg industry in Canada	561
Corn Production Act	
Minimum rates of wages for agricultural workers 63, 110, 218, 275, 399	
Valuation of benefits or advantages for the purposes of the minimum wage	433
Costings	
Cost accounting and farm book keeping	541
Market milk production in the United States	93
Cottonseed, see *Feeding and Feeding Stuffs*	
Cream, see *Dairying*	
Crops (see also *Agricultural Returns, Experiments, Wheat, Oats, etc*)	
Barley growing in Scotland	151
Bean growing in Scotland	4
Conditions in 1918	89
Conditions in 1919 249 411, 552	
Estimated produce of crops during the years 1914 and 1918	289
Forage crops cultivation in Scotland	299
Fruit fly in corn crops	328
Grain drying sheds	81
Guaranteed prices for cereal crops of 1919 281, 388	
Improvement of agricultural crops by selection and hybridisation	10
Leaf stripe of barley	556
Oats measures against fruit fly	258
Produce and yield per acre in 1918	84
Pure line selection of oats and barley in Quebec (*Canada*)	91
Sulphur, effect of (*U S A*)	91
The Integral method for the growth of cereal crops	414
Wheat yields per acre and prices for 50 years (*U S A*)	90
Cultivation of forage crops in Scotland	299
Currie, James C M G The agricultural administrator in the Tropics	145
Dairying (see also *Official Orders*)	
Butter	
Churning sweet cream or acid cream (*Sweden*)	254
Renovated butter (*U S A*)	251
Cream production of clotted cream	97
Milk	
A pure milk supply	331
A study of two types of commercial milk	555
Cost of market milk production (*U S A*)	93
Effect of attacks of flies (*Canada*)	260
Experiments on determination of cow manure in milk (*U S A*)	96
Influence of the age of the cow on the composition and properties of milk and milk fat (*U S A*)	96
Production of milk of low bacterial content (*U S A*)	95
Production of veal *versus* that of milk (*France*)	556
Variations in composition	343
Testing of pure bred dairy cows (*New Zealand*)	95
Development Commissioners, Report for 1917 18	79
Development in agriculture, the foundations of	1
Denmark Manurial value of haulms and tops of root crops	92
Disabled ex soldiers, settlement on the land (*France*)	271
Diseases of animals	
Abortion disease (*U S A*)	99
Anthrax, flies as carriers (*U S A*)	100
Mange	
Curative treatment of horse mange (*Italy*)	419
Mange in horses (*Belgium*)	559
Epizootic lymphangitis (*Morocco*)	99
Louping ill	261

Diseases of Animals– *continued.* PAGE
Tuberculosis, researches from the standpoint of food hygiene (*France*) 259
Worm diseases in young stock 243
Worms in domestic stock (*U S A*) 261
Drainage, excavating drains by mechanical power 405
Duncan, Joseph F Scottish farm labour 498

Education
An experiment in rural education 237
Creation of Chambers of Agriculture in France 422
Education (Scotland) Act, 1918 37
Organisation of public professional teaching of agriculture (*France*) 272
The agricultural administrator in the Tropics 145
The foundations of development in agriculture 1
University research 64
Eggs, see *Poultry*
Electricity
Bajot and Gaillard electric ploughing set 263
Motorculture by electricity (*France*) 262
Utilisation of water power 34
Experiments
Abortion disease (*U S A*) 99
Agricultural chemistry, recent investigations 223
Agricultural experiment stations in Canada 110
Ammonium nitrate fertilising value 92
Bot flies and pernicious anæmia in horses 260
Bovine and swine tuberculosis (*France*) 259
Butter churning sweet cream or acid cream (*Sweden*) 251
Clotted cream production 97
Cost of market milk production 93
Cottonseed meal as a feed for egg production compared with beef scrap (*U S A*) 100
Decomposition of green and stable manures in soil (*U S A*) 93
Determination of cow manure in milk (*U S A*) 96
Digestion experiments with pigs in Illinois (*U S A*) 558
Effect of heat on trichinæ in pork (*U S A*) 558
Egg producing values of some Texas feeding stuffs (*U S A*) 418
Egg testing (*France*) 418
Epizootic lymphangitis (*Morocco*) 99
Fish meal as a feed for swine (*U S A*) 258
Flies as carriers of anthrax (*U S A*) 100
Gypsum, effect upon the solubility of potash in soils 417
Honey bees as agents in plum pollination (*U S A*) 109
Improvement of agricultural crops by selection and hybridisation 10
Influence of the age of the cow on the composition and properties of milk and milk fat (*U S A*) 96
Lime, chemical effects on application to soil (*U S A*) 116
Manurial value of haulms and tops of root crops (*Denmark*) 92
Meat production in relation to the capacity of cattle to gain weight (*Italy*) 417
Milk, a study of two types of commercial milk 557
Nitrogenous fertilisers (*U S A*) 416
Oat growing in Scotland 475
Oats and barley, pure line selection in Ontario (*Canada*) 91
Oats, cross breeding 90
Oats resistant to rust (*U S A*) 253
Pea nut, food value (*U S A*) 98
Peat carbonisation and distillation (*Ireland*) 108
Potato peelings and heather as coarse fodder for horses (*Holland*) 98
Poultry, effect of daily inhalation of ethyl alcohol and other poisons (*U S A*) 101
Production of milk of low bacterial content (*U S A*) 95
Red clover 393
Relation of weed growth to nitrogen accumulation in the soil (*U S A*) 93
Seaweed as cattle food (*Holland*) 257
Seaweed as a poultry food (*France*) 100
Seeds, effect of soaking in water 270
Seeds, relation of size to productive value 389
Sewage fertilising power (*Italy*) 253
Smut in oats 222
Soil acidity (*U S A*) 414
Substitutes in swine feeding (*Canada*) 257

Experiments—*continued.* PAGE
Sulphur, effect on different crops and soils (*U.S.A.*) 91
University research 64
Warble flies, destruction of 100
Worms in domestic stock (*U.S.A.*) 261
Explosives, use in planting trees (*France*) 421
Exports of implements, twine, etc. from the United States, 1915-17 267
Ewart, Professor J. Cossar: The intercrossing of sheep and the evolution of new varieties of wool 159

Fagan, T. W.:
Composition of linseed recovered from home-grown flax 491
Oats, their milling and by-products 307
Farm book-keeping and cost accounting 541
Feeding and feeding stuffs (see also *Official Orders*):
Albuminoid requirements for live stock (*Switzerland*) 255
Cottonseeed meal compared with beef scrap for egg production (*U.S.A.*) .. 100
Digestion experiments with pigs in illness (*U.S.A.*) 558
Digestible hay cake and hay paste 97
Egg-producing values of some Texas feeding stuffs (*U.S.A.*) 418
Fish meal 88
Fish meal as a feed for swine (*U.S.A.*) 258
Locust beans (*France*) 419
Pea nut, food value (*U.S.A.*) 98
Potato peelings and heather as coarse fodder for horses (*Holland*) 98
Recent investigations in agricultural chemistry 223
Seaweed as a poultry food (*France*) 100
Seaweeds as cattle food (*Holland*) 257
Swine feeding (*Canada*) 257
Value of tree leaves for live stock 256
Fish meal 88, 258
Findlay, Wm. M., and Wm. Smith: Barley growing in Scotland . . 151
Flax:
Composition of linseed recovered from home-grown flax 491
Utilisation of stalks of flax cultivated for seed 252
Flies, see *Insects and Pests.*
Food:
Food chemistry 412
Food preparations made with blood and meat, mixed with yeast (*France*) 267
Tuberculosis, researches from the standpoint of food hygiene (*France*) 259
Forage crops, cultivation in Scotland 299
Forestry:
Damage to young growth of western yellow pine due to grazing of live stock (*U.S.A.*) 268
Douglas fir (*Holland*) 106
Forestry and agriculture 41
Forestry and hill farms 197
Larch (*Sweden*) 107
Testing of forest seeds, 1887-1912 240
The bark of Scots pine and spruce (*Sweden*) 269
Training in practical forestry 73
Timber beetle 561
Use of bats in the control of insects injurious to pine woods (*France*) . 109
Use of explosives in planting trees (*France*) 421
Woodlands and woodland industries in relation to small-holdings 364, 507
Foxes, the Fennel fox (*France*) 270
France:
Agricultural reconstruction 549
Béfort and Gaillard electric ploughing set 268
Bovine and swine tuberculosis 259
Coal dust, utilisation for heating greenhouses 268
Co-operative societies for bringing land under cultivation 422
Creation of Chambers of Agriculture 422
Crossing qualities of the Rouen duck 559
Egg testing 418
Explosives, use in planting trees 421
Fennel fox in captivity 270
Food preparations made with blood and meat mixed with yeast 267
Haulage of ploughs 264
Locust beans 419
Métayage 374

France—*continued.* PAGE
Motoriculture by electricity 282
Organisation of professional teaching of agriculture 272
Peat, carbonisation and distillation 108
Production of veal *versus* that of milk 556
Rural economy of France 49, 203
Seaweed for poultry feeding 100
Settlement of partially disabled ex-soldiers on the land 271
The function of agricultural engineers as regards the makers of power-farming machinery 262
Tractors—hints on use 102
Tractor ploughs for use in steeply sloping land 264
Trials of disc harrows with tractors 104
Use of bats in control of insects 109
Frit-fly, see *Insects and Pests.*
Fruit:
Common honey bee as an agent in plum pollination (*U.S.A.*) 109
Fruit tree pests in Britain in 1919 560
Pollination and setting 407
Raspberry growing in Scotland 20
Fungi:
Leaf-stripe of barley 535
Rhizoctonia disease, or stem rot, on potatoes 482
Rose blotch fungus 269
Selection of oats resistant to rust (*U.S.A.*) 553
Smut in oats 222
Wart disease of potatoes 135, 284

Germany: Agricultural labour 539
Goat keeping in Scotland 402
Grain drying sheds 81
Grant, John A. W.: Rural housing 369
Greece: Control of field mice by acetylene gas 108
Gypsum, effect on the solubility of potash in soils 417

Haldane, Rt. Hon. Viscount: The foundations of development in agriculture 1
Harvey, Elsie J., and John Rennie:
Isle of Wight disease in hive bees 176
Nosema apis in hive bees 511
Hay (see also *Crops* and *Official Orders*):
Digestible hay cake and hay paste 97
Red clover 933
Heather and potato peelings as a coarse fodder for horses (*Holland*) 98
Herb growing in Scotland 82
Hill farms and forestry... 197
Hodge, J. M: Raspberry growing in Scotland 20
Holland:
Douglas fir 106
Potato peelings and heather as coarse fodder for horses 98
Seaweeds as cattle food 257
Horses, see *Live Stock.*
Horticulture, life history of the rose blotch fungus in Great Britain 269
Housing 369

Improvement of agricultural crops by selection and hybridisation 10
Improvement of high lying grass land 59
Increased food production 249
Insects and Pests:
Birds beneficial to agriculture 560
Blow fly pest on sheep (*Australia*) 261
Bot flies 260, 354
Cabbage Maggot (*U.S.A.*) 554
Flies... ... ... 99, 100, 260
Frit fly 253, 323
Fruit tree pests in Britain in 1919 560
Gooseberry green fly 559
Red currant green fly 559
Sheep lice and ticks (*Australia*) 418
Stem eelworm 554
Ticks 99, 418
Weevils (*Australia*) 414

Insects and Pests—*continued.* PAGE
Wireworms and leather-jackets ... 554
Warble fly ... 100, 245
Ireland: The Irish dressed meat trade ... 556
Isle of Wight Disease: see *Bees.*
Italy:
Active virus against field mice ... 270
Agricultural labour ... 540
Horse mange ... 419
Meat production in relation to the capacity of cattle to gain weight ... 417
Safety devices for chaff-cutters ... 105
Sewage, fertilising power ... 253

Labour:
Agricultural labour in other countries ... 539
Demobilisation of pivotal men ... 85, 248
Education (Scotland) Act, 1918 ... 37
Issue of vouchers to agricultural workers ... 85
Minimum rates of wages for agricultural workers 63, 110, 218, 275, 399
Scottish farm labour ... 498
Valuation of benefits or advantages for the purposes of the minimum wage 433
Land improvement, high lying grass lands ... 59
Land reclamation—the Forth ... 238
Land settlement:
Land settlement in Switzerland ... 545
Settlement of partially disabled ex-soldiers (*France*) ... 271
Lauder, Alexander: A pure milk supply ... 331
Legal decisions affecting agriculture ... 273, 423, 562
Linseed recovered from home grown flax ... 491
Live stock (see also *Agricultural Returns, Dairying, Diseases of Animals, Experiments, Official Orders*, etc.):
Cattle:
Aberdeen Angus cattle ... 456
Shetland cattle ... 533
Testing of pure bred dairy cows (*New Zealand*) ... 95
General:
Crosses between sheep and goats ... 259
Estimated numbers of live stock during the years 1914 and 1918 ... 290
Problems of animal breeding ... 449
Live stock production in Aberdeenshire ... 327
Schemes for improvement of live stock ... 409
Scottish pure bred live stock ... 456
Horses:
Bot flies ... 260, 354
Mange ... 419, 559
The care of the horse's hoof ... 30
Insects and Pests:
Blow fly pest on sheep (*Australia*) ... 261
Bot flies on horses ... 260, 354
Flies ... 99, 100, 260
Ticks ... 99, 418
Warble fly ... 100, 245
Worm diseases in young stock ... 248
Sheep:
Some effects of sheep rearing on the natural condition of Scotland ... 190
The intercrossing of sheep and the evolution of new varieties of wool ... 159
Swine:
Digestion experiments with pigs in Illinois (*U.S.A.*) ... 558
Fish meal as a feed for swine (*U.S.A.*) ... 258
Movable pig houses (*U.S.A.*) ... 101

M'Donald, Colin: Agriculture in the Outer Hebrides ... 465
MacDougall, Captain A. R.: The improvement of high lying grass land ... 59
Machinery:
Agricultural machinery in the United Kingdom ... 102
Agricultural utilisation of tanks and heavy tractors ... 420
Bétort and Gaillard electric ploughing set (*France*) ... 263
Dirube and Sabaria system of cable traction applied to agriculture ... 103
Exports of implements, etc. from the United States, 1915-17 ... 267
Haulage of ploughs (*France*) ... 264
Hints on the use of an agricultural tractor (*France*) ... 102

Machinery—*continued.* PAGE
Mechanical drainage ... 405
Milling of oats ... 307
Motorculture by electricity (*France*) ... 262
Motor saw mounted on a hand cart (*Switzerland*) ... 265
"Once Over" quack grass killer (*U.S.A.*) ... 265
Potato drying plant in Rhodesia ... 105
Rotary harrow attachment for sulky and multiple gang ploughs (*U.S.A.*) 264
Russell turnip turner ... 105
Safety devices for chaff cutters (*Italy*) ... 105
"Scott" process and plant for drying potatoes ... 266
The function of agricultural engineers as regards the makers of power farming machinery (*France*) ... 262
The International Harvester Corporation's sheaf shocker (*U.S.A.*) ... 420
The plough bottom and its action upon the furrow slice (*U.S.A.*) ... 104
The production of groats and oatmeal ... 265
Traction on bad roads or land ... 103
Tractor ploughs for use in steeply sloping land (*France*) ... 264
Trials of disc harrows with tractors (*France*) ... 104
"Universal" electric drive thresher (*Switzerland*) ... 105
Malcolm, John, B.Sc : The growing of beans in Scotland ... 4
Mange, see *Diseases of Animals.*
Manures (see also *Crops* and *Official Orders*) :
Decomposition of green and stable manures in soil (*U.S.A.*) ... 93
Fertilisers :
Alsace potash deposits ... 76
Ammonium nitrate, value of ... 92
Availability of nitrogen in nitrate of soda, ammonium sulphate, etc. (*U.S.A.*) 416
Departmental Committee on sulphuric acid and fertiliser trades ... 228
Legislation in Canada as to the sale of fertilisers ... 561
Recent investigations in agricultural chemistry ... 228
Sewage ... 253
Haulms and tops of root-crops (*Denmark*) ... 92
Meat :
Effect of heat on *trichinae* in pork ... 558
Irish dressed meat trade ... 556
Meat production in relation to the capacity of cattle to gain weight (*Italy*) 417
Production of veal *versus* that of milk (*France*) ... 556
Métayage in France ... 374
Mice, see *Vermin* and *Pests.*
Milk, see *Dairying.*
Milling :
Oats ; their milling and by-products ... 307
Production of groats and oatmeal ... 265
Morocco : Epizootic lymphangitis ... 99
Munro, D. G. : Stock production in Aberdeenshire ... 327

New Zealand :
Testing of pure-bred dairy cows ... 95
Treatment for furniture beetle ... 561

Oats (see also *Agricultural Returns, Crops, Experiments, etc.*) :
Experiments in cross-breeding ... 90
Milling and by-products ... 307
Oat-growing experiments in Scotland ... 475
Production of groats and oatmeal ... 265
Pure line selection (*Canada*) ... 91
Selection of oats resistant to rust (*U.S.A.*) ... 553
Smut ... 222
O'Brien, D. G. : *Rhizoctonia* disease, or stem-rot, on potatoes ... 482
Official Orders and Circulars :
Board of Agriculture for Scotland :
Constitution of Agricultural Executive Committees and Scottish Council of Agriculture ... 425
Guaranteed prices for cereal crop of 1919 ... 281, 388
Minimum rates of wages for agricultural workers ... 63, 110, 218, 275, 399
Potatoes, inspection of growing crops of immune varieties ... 428
Potatoes, wart disease of ... 135, 284
Sale of Hares (Scotland) Order, 1919 ... 288
Wart Disease of Potatoes (Scotland) Order, 1918 ... 284

Official Orders and Circulars—*continued.* PAGE
Ministry of Food:
Barley 112
Butter 133, 432
Cattle feeding stuffs 282, 428
Cereals (restriction) 113, 562
Cream 432, 571
Eggs 133, 288
Feeding stuffs 125, 566
Fertilisers prices 571
Grain 284
Horses rationing 128
Live stock 131, 287, 428, 566
Milk 132, 429, 567
Oats 112, 428
Potatoes 113, 122, 286, 565
Poultry and game 132
Seed potatoes 124
Outer Hebrides, Agriculture in 465

Paterson, Principal W. G. R.: The cultivation of forage crops in Scotland ... 299
Peanut, food value of the 98
Peat: Carbonisation and distillation of peat, etc. (*France*) 108
Pigs, see *Live Stock—Swine.*
Portugal:
Agricultural labour 541
The "integral" method for the growth of cereal crops 414
Potash: The Alsace deposits 76
Potatoes (see also *Agricultural Returns, Experiments* and *Official Orders*):
Acreage under each variety in 1919 592
Composition of potatoes 398
Maximum prices, 1919 286
Observations on some degenerate strains (*U.S.A.*) 252
Potato drying plant in Rhodesia 105
Potato peelings as coarse fodder for horses (*Holland*) 98
Rhizoctonia disease or stem-rot 482
"Scott" process and plant for drying potatoes 266
Wart Disease Order, 1918 284
Poultry and Eggs (see also *Agricultural Returns, Experiments* and *Official Orders*):
Co-operation in the egg industry in Canada 561
Cottonseed meal *versus* beef scrap as a feeding stuff (*U.S.A.*) 100
Crossing qualities of the Rouen Duck (*France*) 559
Effect of daily inhalation of ethyl alcohol and other poisons (*U.S.A.*) ... 101
Egg-producing values of some Texas feeding stuffs (*U.S.A.*) 418
Egg testing (*France*) 418
Use of seaweed in poultry-feeding (*France*) 100
Problems of animal breeding 449
Profit-sharing in agriculture 229

Raspberries, see *Fruit.*
Rats, see *Vermin* and *Pests.*
Red clover 393
Rennie, John, and Elsie J. Harvey:
Isle of Wight disease in hive bees 176
Nosema apis in hive bees 511
Rhizoctonia disease, or stem-rot, on potatoes 482
Ritchie, James:
Bot flies of the horse 354
Recent investigations on frit-fly in corn crops 323
Some effects of sheep rearing on the natural conditions of Scotland ... 190
Rural economy of France 49, 203, 374
Rural education, an experiment in 237
Rural housing 369
Rural industries 359, 586
Rural transport in Scotland 377

Schlich, Sir Wm., K.C.I.E: Forestry and agriculture 41
Scott, Professor W. R.: Rural industries 359
Scottish Council of Agriculture: Constitution 425
Scottish farm labour 498
Scottish pure bred live stock 456

	PAGE
Seaweeds—utilisation as cattle food (*Holland*)	257
Seaweed as a poultry food (*France*)	100
Seeds and seed-testing:	
Agricultural seeds in 1919	212
Effects of soaking in water	250
Relation of the size of seed to its productive value	389
The testing of forest seeds during the years 1887-1912	240
Variations in seed tests resulting from errors in sampling (*U.S.A.*)	251
Sewage, fertilising power (*Italy*)	253
Sheep (see also *Live Stock*):	
Effects of sheep rearing on the natural condition of Scotland	190
Spread of sheep lice and ticks in Australia	418
The inter-crossing of sheep and the evolution of new varieties of wool	159
Shetland cattle	533
Smith, Wm., and Wm. M. Findlay: Barley growing in Scotland	151
Smith, W. G.: Forestry and hill farms	197
Soils:	
Chemical effects of applying lime (*U.S.A.*)	416
Decomposition of green and stable manures in soils (*U.S.A.*)	93
Effect of gypsum upon the solubility of potash in soils (*U.S.A.*)	417
Effect of sulphur (*U.S.A.*)	91
Improvement of high lying grass land	59
Investigations into soil acidity (*U.S.A.*)	414
Recent investigations in agricultural chemistry	223
The relation of weed growth to nitric nitrogen accumulation (*U.S.A.*)	93
South Africa: Potato drying plant	105
Stanfield, Professor: Mechanical drainage	405
Stem-rot on potatoes	482
Stock production in Aberdeenshire	327
Sulphur: Effect on different crops and soils (*U.S.A.*)	91
Sutherland, John: Woodlands and woodland industries in relation to small-holdings	364, 507
Sweden:	
Butter, churning of sweet cream or acid cream	254
Farm bookkeeping	542
Larch	107
The bark of Scots pine and spruce	269
Swine, see *Live Stock*.	
Switzerland:	
Albuminoids in the feeding of live stock	255
Farm bookkeeping	544
Land settlement	545
Universal electric drive thresher	105
Tocher, J. F.: Variation in the composition of milk	343
Tractors, see *Machinery*.	
Tree leaves in live stock feeding	256
Tropics, the agricultural administrator in the	145
United States:	
Abortion disease	99
Cabbage maggot	554
Chemical effects of applying lime to soil	416
Cost of market milk production	93
Cottonseed meal as a feed for egg production compared with beef scrap	100
Decomposition of green and stable manures in soil	93
Digestion experiments with pigs in Illinois	558
Effect of daily inhalation of ethyl alcohol and other poisons on poultry	101
Effect of grazing upon Western yellow-pine production in Arizona and New Mexico	268
Effect of gypsum upon the solubility of potash in soils	417
Effect of heat on *trichinæ* in pork	558
Egg-producing values of some Texas feeding stuffs	418
Experiments on determination of cow manure in milk	96
Exports of implements, twine, tractors and gas engines, 1915-1917	267
Fish meal as a feed for swine	258
Flies as carriers of anthrax	100
Food value of the pea nut	98
Influence of the age of the cow on the composition and properties of milk and milk fat	96

United States—*continued.* Page
Investigations into soil acidity 414
Movable pig-houses 101
Nitrogenous fertilisers 416
Observations on some degenerate strains of potatoes 252
Production of milk of low bacterial content 95
Relation of weed growth to nitric nitrogen accumulation in the soil ... 93
"Renovated" butter 254
Rotary harrow attachment for sulky and multiple gang ploughs 264
Selection of oats resistant to rust 553
Sulphur, effect on different crops and soils 91
The common honey bee as an agent in plum pollination 109
The International Harvester Corporation's sheaf shocker 420
The "Once-Over" quack grass killer 265
The plough bottom and its action upon the furrow slice 104
Treatment for worms in domestic stock 261
Variations in seed tests resulting from errors in sampling 251
Wheat yields per acre and prices for fifty years 90

Vermin and pests (see also "*Live Stock*"):
Active virus against field mice (*Italy*) 270
Control of field mice by acetylene gas (*Greece*) 108
Rats, extermination of 69
The Fennel fox in captivity, to replace the domestic cat (*France*) 27
Vole plague in Hampshire 420
Voles, see "*Vermin.*"

Wages, see *Labour and Wages.*
Warble flies, see "*Live Stock Pests.*"
Water Power, Utilisation of 34
Watson, J. A. S.: Problems of animal breeding 449
Weeds:
Destruction of weeds which affect the oat crop 479
Relation of weed growth to nitric nitrogen accumulation in the soil (*U.S.A.*) 93
The "Once-Over" quack grass killer (*U.S.A.*) 265
Wheat (see also *Agricultural Returns*, *Crops* and *Experiments*):
Destruction by weevils (*Australia*) 414
Yields per acre and prices for 50 years (*U.S.A.*) 90
Wild Birds:
Birds beneficial to agriculture 560
Havoc caused by bullfinches 560
Protection of wild birds in the British Isles 560
The value of tits 421
Women:
Rural Institutes 86, 247, 410, 552
Women's work in agriculture 246
Woodlands and woodland industries in relation to small holdings ... 364, 507
Worms in domestic stock ... 261