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The Agricultural Market Report

Prepared and Edited by

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Average prices week by week at selected markets are furnished by Market Reporters specially appointed by the Ministry, and in addition special articles on agricultural conditions at home and abroad, likely to affect the demand for and prices of British produce, are included each week.

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CONTENTS.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 1.

APRIL, 1922.

NOTES FOR THE MONTH.

Expenditure on Agricultural Education and Improvement of Live Stock.

In a speech at Wells on 3rd March Lt.-Col. Rt. Hon. Sir Arthur G. Boscawen (Minister of Agriculture and Fisheries) referred to the recommendations of the Geddes Committee with regard to the annual expenditure of the Ministry. Before the appointment of the Committee, he said, the Ministry made a cut of £1,161,000 and the Committee proposed a further reduction of £285,171. The Cabinet had agreed, however, to a reduction of £215,000 in place of the £285,171, the chief differences being the following :—The Committee had suggested the discontinuance of the live stock schemes, and especially milk recording, but in Sir A. G. Boscawen's opinion milk recording was one of the best things that the Ministry did, and had splendid results. He was glad to say that he had been able to save it, and also the rest of the live stock schemes, except the heavy horse-breeding scheme.

With regard to agricultural education and research, he said it would be remembered that at the time of the repeal of the Corn Production Acts, an extra million pounds had been given for education and research as part of the arrangement made with the National Farmers' Union, and it was understood that this was in addition to what was being spent on these objects before. The Geddes Committee, while leaving the million (which is a single sum, not annual expenditure) had suggested a big reduction on the previous sum, but this would amount to the breach of a definite undertaking. The Cabinet had decided that the agreement with the farmers must stand, and the million would be retained in addition to what was being spent before.

Of this million, £850,000 had been allocated to England and Wales, and a scheme for the application of this sum for the de-

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destroyed. It is hoped that the brief descriptions of them and of their life histories, together with the excellent coloured plates, may help towards their wider recognition and protection.

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The Agricultural Index Number.

THE average of the market prices of all descriptions of agricultural produce during February showed a slight rise as compared with the previous month, this being the first break that has occurred in the downward movement of prices since August, 1921. Prices in February were on the whole 83 per cent. in advance of the average of the three years 1911-13, as against an increase of 77 per cent. in January.

The following table shows the percentage increase during each month from 1919 to the present time :—

Month.	1919.	1920.	1921.	1922.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
January	148	213	186	77
February	150	205	172	83
March	150	199	158	—
April	153	199	141	—
May	132	169	112	—
June	128	164	102	—
July	141	174	100	—
August	138	177	116	—
September	148	181	105	—
October	166	191	90	—
November	182	197	84	—
December	207	194	82	—

Owing to the changes since 1911-13 in the varieties of potatoes principally grown, it has been necessary to revise the basis of the calculations for this description of produce, and to base figures on the most representative varieties. It will be observed that the alteration to the general index number is only 2 points.

Practically all commodities shared in the upward movement experienced during February, the chief exceptions being barley, which was practically unchanged, milk and butter, which fell 8 points and 7 points respectively, and hay, which declined a further 3 points. The greatest increase was in the case of fat sheep, which rose from 60 per cent. above the pre-war level in January to 83 per cent. in February. During February fat cattle were about 65 per cent. and pigs 80 per cent. above the prices in 1911-13.

Prices of cereals showed a somewhat smaller increase compared with pre-war days, wheat being about 45 per cent.;

barley 51 per cent. and oats 47 per cent. above the average for 1911-13. Feeding stuffs on the whole were also rather dearer in February than in January. Milling offals and cotton cakes were cheaper, but the decline in these feeding stuffs was more than counterbalanced by the increased prices of linseed cakes, maize and maize meal and brewers' grains. The average declared value of imported barley during February was about £9 14s. per ton as compared with £10 8s. in January, while oats averaged about £9 6s. per ton.

The reduction in fertiliser prices was continued during the month, basic slag being considerably cheaper than in January while nitrate of soda and superphosphate also showed slight reductions. Sulphate of ammonia for February delivery was 10s. per ton dearer than for delivery during the previous month.

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Agricultural Shows and the Entertainments Duty.

The Ministry frequently receives communications relative to the exemption of agricultural shows from entertainments duty. It may be pointed out that exemption from this duty rests, not with the Ministry of Agriculture, but with the Commissioners of Customs and Excise. The legal position and the proper method of applying for a grant of exemption are explained below.

All such Shows are " entertainments " within the meaning of the Finance " New Duties " Act, 1916, and therefore Entertainments Duty must be paid unless the Commissioners of Customs and Excise have granted a Certificate of Exemption.

The conditions of exemption are contained in Section 7 of the Finance Act, 1921, and are as follows, viz. :—

(a) That the entertainment is provided by a society (including a company, institution or other association of persons by whatever name called) which is established solely for the purpose of promoting the interests of the industry of agriculture (including horticulture and the breeding of animals of any description) and which is not conducted for profit.

(b) That the entertainment consists solely of an exhibition of the products of the industry of agriculture (including horticulture and the breeding of animals of any description), or materials, machinery, appliances or food stuffs used in the production of those products.

If any extraneous attraction, such as a band, sports, fireworks, etc., is included in the proceedings, the Show does not satisfy condition (*b*).

Where it is desired to claim exemption, an application must be made to the Commissioners of Customs and Excise, Custom House, London, E.C.3., not less than 14 days before the Show, accompanied by copies of the Rules and last Balance Sheet of the Society and Programme of the Show. If a certificate of exemption is not received before the show, entertainments duty must be paid.

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Hedge and Stump Clearing.

SINCE the widespread adoption of tractor cultivation the problem of uprooting tree stumps and removing hedges has become one of considerable importance. Representative methods of doing this work were therefore tested by the Ministry of Agriculture in the early part of 1921, and the results systematically recorded and tabulated. A report* on the trials prepared by the Research Branch of the Ministry was published recently. The results have all been worked out on a cost basis and, throughout, the economic standpoint has been primarily considered. While tractor cultivation has been principally kept in view, the information contained in the report should be of value to those engaged in clearing land for gravel digging and other purposes, or in removing trees for landscape and market gardening.

Included in the test were hand tools, timber jacks, the De Jersey stump extractor (a machine from Finland operated by hand), the Hercules Triple Puller (an American machine on the windlass principle operated by horses), a ploughing engine, and steam and motor tractors, as well as explosives. Details of the tests and figures of cost are given in the publication referred to, and a summary of the conclusions arrived at is as follows :—

Where only a short length of hedge or a few stumps are to be extracted, there appears to be no advantage in going beyond the existing resources of the farm, especially if the work is done in a slack period of the year when it is a question of finding work for the men retained. Hand tools will suffice, but a tractor fitted with a winding drum will be useful, particularly in dealing with light stumps, which it should be able to remove without grubbing.

* Miscellaneous Publication, No. 35, 53 pp., 1 map and 13 figures. Price 2s. 6d. net, post free, from the Ministry, 10, Whitehall Place, London, S.W.1.

Where any considerable amount of work is involved hand-methods would prove too expensive and protracted, and a mechanical device or explosives should be used. The advantages of explosives are low cost, clean extraction and shattering of the timber, and unlimited capacity. Their use is, however, restricted by the proximity of buildings, roads, and railways, and there must always be a certain amount of danger to the operator. This last, however, can be almost entirely eliminated by proper precautions. There can be no doubt that for operations upon a large scale, explosives provide the most rapid and economical means of removing stumps.

If time is not an important factor, and the plan is to clear a large area gradually, mechanical appliances will compete in efficiency and economy with explosives. Where heavy timber is present, machines of the types of the De Jersey and Hercules should prove suitable, although neither type is likely to remove light hedge growth economically as compared with a tractor (steam or motor) provided with a winding drum. The necessity for anchoring, the restricted capacity of the grab attachments in dealing with a number of small stumps, the amount of winding necessary, whatever the resistance offered, are all factors, which by increasing cost in proportion to the volume of timber lifted limit the economic use of the former types of machine. The choice of methods is therefore largely dependent upon the relative proportions of light, medium, and heavy timber. Where all is light, the tractor may be recommended; where all is heavy, a machine of the De Jersey or Hercules type; where there is a mixture, it is a matter for the judgment of the person undertaking the work.

Without capital, it is impossible to clear any large area of land quickly, and in most instances economy and convenience dictate that the work of clearing should be restricted to a few chains a year. Where more than this is attempted, it is necessary to weigh up very carefully the cost and the increased revenue that will be obtained. This is a problem that can only be decided in each individual case.

The full report should be read by anyone who contemplates a substantial amount of hedge clearing or stump extracting. Methods are explained in detail and costs worked out minutely. With this information before him, it should be possible for the reader to determine the most economical method to be adopted in any given circumstances.

This report is the first of a series which the Ministry proposes to publish on specific agricultural operations. A report on

drainage machinery, based upon extensive tests, is already at an advanced stage.

* * * * * *

Payment of Claims under the Corn Production Acts.

THE Ministry has now completed the work of paying out the sums due under the Corn Prices Guarantee. The bulk of the payments were made on 1st January last. In all some 188,000 separate payments have been made, totalling approximately £14,000,000.

The Ministry desires to make it known to occupiers of land who have received Orders of Payment on H.M. Paymaster General in this connection, that such orders are liable to be cancelled if not presented for payment within a reasonable time after issue. Any farmer who has not yet cashed his order therefore should do so at once. The orders must be presented for payment through a bank.

* * * * * *

Meeting of the International Agricultural Institute.

THE sixth Session of the General Assembly of the International Agricultural Institute will open in Rome on 8th May next, and the Minister of Agriculture and Fisheries has appointed the following delegates to attend on behalf of this country :—Sir Thomas H. Elliott, Bart., K.C.B. (British Delegate on the Permanent Committee of the Institute), Sir Francis Floud, K.C.B. (Permanent Secretary of the Ministry) and Mr. R. J. Thompson (an Assistant Secretary of the Ministry).

The programme to be dealt with by the Assembly is extensive, including the consideration of a number of reports on the organisation of the Institute and the work carried out by its various branches, and also reports on such subjects as the increase of agricultural production, agricultural meteorology, agricultural book-keeping, and a proposal for the establishment of an International Institute for Research into Plant Diseases.

In addition, the United States Government will submit a number of proposals for action by the Institute with the object of improving the collection and publication of agricultural statistics in the adhering countries. Though the work which the Institute endeavours to do in connection with agricultural statistics may seldom come directly to the notice of farmers, nevertheless the publication of full and prompt information

as to crop prospects, harvests, and numbers of live stock in all the countries of the world is of considerable importance to them, as prices in this country are dependent upon world prices, which are greatly influenced by such reports.

* * * * * *

Thoroughbred Stallion Show.

The Annual Show of Thoroughbred Stallions arranged by the Ministry in conjunction with the Hunters' Improvement and National Light Horse Breeding Society, was held at the Royal Agricultural Hall, Islington, from 28th February to 2nd March. The principal purpose of the show is the selection of stallions for the King's Premiums which are awarded by the Ministry under its scheme for the encouragement of Light Horse Breeding. The premium stallions are required to serve mares at low fees, which are prescribed by the Ministry. The routes to be travelled by the premium stallions are arranged at the close of the show.

This year 88 stallions were entered, as compared with 97 last year, and 57 King's Premiums, including 12 Super Premiums, were awarded. The King's Champion Challenge Cup for the best Premium Stallion was awarded to "*Gay Lally*," the property of the Compton Stud, the reserve horse being "*Scarlet Rambler*," belonging to Captain T. L. Wickham-Boynton and Mr. H. A. Cholmondeley. These two horses obtained the same distinctions last year and in 1920. The principal winners were the Compton Stud, who obtained four Super Premiums (including the King's Cup) and three King's Premiums.

Arrangements are being made for the award of a limited number of Ministry's Premiums to Stallions which will travel approved routes.

* * * * * *

Conciliation Committees in Agriculture.

The Conciliation Committees continue to work satisfactorily, and there are now 42 agreements of which 24 are for periods including the corn harvest. A gratifying feature of the past month is the fact that agreements have now been reached in several areas where negotiations between the two sides had been somewhat protracted, notably in Norfolk, Suffolk, Lincolnshire, West Riding, Bedfordshire, Huntingdonshire and Oxfordshire. Details of the current agreements appear on pp. 93-96.

A RECORD OF 12 YEARS' DEVELOPMENT ON A 1500 ACRE FARM.

WILFRID S. MANSFIELD and D. BOYES.

THE Shippea Hill Estate of Messrs. Chivers and Sons is situated 7 miles from Ely, at the junction of the Cambridge, Norfolk and Suffolk borders. It lies in the fen country, and has on the north the Little Ouse (or Brandon River) and on the east the Lakenheath Lode, while on the west it touches the main road from Littleport to Mildenhall. The Great Eastern Railway Company's line to Norwich runs through the centre of the estate, and the railway station of Shippea Hill is on its western edge.

Like most of the fen country, the district is very thinly populated, and though there is a railway station there is no village of Shippea Hill. The parish is large and extends as far as Lakenheath, a distance of 3½ miles.

The estate lies in two drainage areas, Burnt Fen and Sedge Fen, and it was after the first of these that the railway station was originally named. At the request of the local farmers, who feared the effects of the prejudice against potatoes grown on fen soil, the name was, however, changed; the justification for this procedure being the fact that the soil on the estate is not black fen soil at all, and that potatoes grown on it are of good quality. Indeed, the " once grown " seed it produces is eagerly sought after by the neighbouring black land farmers.

As is usual with land in the fen districts, the estate lies at a lower level than the river which drains it, and all drainage water has therefore to be lifted by pumps. As might be expected, the water table is high, and a system of open drainage by means of ditches (" dykes ") is necessary. Naturally the expense of such a drainage system is heavy, but, on the other hand, there are certain advantages, one of these being that the height of the water table can, to some extent, be controlled. In a season such as that of 1921 this ability to keep up the water table has been of great value; particularly was this demonstrated last season in the case of one field of strawberries which yielded at the rate of 3 tons 17 cwt. per acre, a fact that emphasises once more the value of irrigation for this crop in a dry season.

The estate is about 3 miles long and, at its centre, about 2 miles wide. It is contained in a ring fence, and its area is about 1,570 acres, of which 102 acres are " washes " (land bordering on a river and liable to flooding) and 226 acres grass land.

The soil is of a very unusual character, consisting of from 2 to 6 feet of "shell marl" overlying 7 to 10 feet of peat, beneath which lie sand and gravel. This layer of shell marl is known locally as "White Land," and forms a soil which is easy to work, though in places too open and spongy. It is also deficient in humus, and some years ago an attempt was made to remedy this defect by the application of large dressings of peat. The experiment was a failure. Not only was no benefit derived from the dressings, but actual harm was done to the soil, which, after the lapse of several years, has not yet fully recovered.

Wheat, oats, mangolds, potatoes and green vegetables are the crops naturally suited to the soil. The grass land provides an abundance of keep, and, though this is not of the highest quality, it is excellent for milk production.

Condition of the Estate before 1909.—Before its purchase by Messrs. Chivers the land was in the hands of many owners. There were three farms, of some 300 acres each, two of which were owned and farmed by one individual. In addition, there were two smaller holdings of 155 and 119 acres respectively, the larger of the two having no buildings on it at all. The remainder of the land was cut up into small detached portions which were in the hands of different owners and were farmed "off-hand."

For the most part the land was in a very low state of cultivation; fields were choked with couch and other rubbish, and were poverty-stricken to a degree. Yields were poor and the general level of farming was extremely low. In fact, it was asserted that wheat could not be grown on this soil unless there was a mass of couch and twitch growing with it! With the exception of the two farms already mentioned as being farmed by the landlord, where a higher state of cultivation prevailed, very little dung ever reached the land, and the use of artificial manures was almost unknown. The principal crops were wheat, oats, and barley, but a few potatoes and mangolds were also grown.

There were three reasons for the state of affairs which has just been described: lack of labour, lack of transport facilities, and lack of farm buildings. The first of these was due to the shortage of accommodation. On the whole of the estate there were only 13 cottages, and there was only one building which could be really described as a "house." The cottages were of wood, one storey high, and were very small. Labour, other than that resident on the estate, was difficult to procure, and had to be drawn from the village of Lakenheath, 3½ miles distant.

In 1909 this estate of 1,570 acres gave regular employment to 29 men only, or not quite 2 men per 100 acres.

Even if a plentiful supply of labour had been available it would still have been impossible for the original occupiers of the estate to grow the bulky crops for which the land is most suitable. Apart from the main road from Littleport to Mildenhall, which touches the estate on one side, there was no made road of any description; and, although the railway station was not far from any of the farms as the crow flies, yet to reach it a journey of from four to five miles over fen "droves" was necessary.

Only those who have seen a fen drove in winter can realise the significance of this assertion. It is, however, sufficient to remark that such droves rapidly become quite impassable if anything in the nature of heavy traffic is attempted.

Obviously, then, all carting had to be done in the autumn or during spells of frosty weather; and therefore it was out of the question to contemplate growing large acreages of potatoes and vegetables.

As regards the shortage of farm buildings, it is hardly necessary to remind practical men of the impossibility of farming arable land without a proper equipment of these. Successful arable farming implies the use of dung; and to have ample supplies of dung buildings are essential. In the case of the Shippea Hill estate the buildings were quite inadequate for the acreage they had to serve and, moreover, were of a very poor description, being as often as not mere ramshackle wooden sheds.

It will be easily seen from the foregoing that for the development and improvement of such an estate a large amount of capital was needed. Moreover, even if one of the farms had by chance come into the possession of an enterprising and wealthy man he would have been unable to develop the land without the co-operation of neighbours. The only possible solution of the problem was the purchase of the whole estate by some person who was able and willing to spend the large sum of money necessary for its development.

Development of the Estate.—In 1909 Messrs. Chivers purchased 900 acres of land lying in the centre of the estate. This portion included land which now forms part of Railway Lodge Farm, Adventurer's Farm, Lea Farm and Albion Farm. In order to ease the transport problem it was proposed to obtain communication with the main road by making up Farthing Drove and by running a siding from the railway line at a point opposite Railway Lodge Farm. These plans turned out to be impracticable. The work of making up Farthing Drove was begun, but it soon became apparent that the task

Above, Chicory and Herb Drying Factory.
Centre, Old Cottage.
Below, New Cottages.

would be far too great to be accomplished with the means then available. In addition, it was found that the proposed siding would necessitate the erection of a signal-box and the permanent employment of two signalmen.

A solution of these difficulties was discovered in the purchase of Station Farm. This ran right up to the main road and, moreover, adjoined Shippea Hill station. It was therefore possible to run a siding from the station to Railway Lodge Farm without having the expense of maintaining a special signal-box. This siding was constructed, and the work of developing the estate proceeded rapidly.

The next purchase was that of Decoy Farm, which lies on the opposite side of the railway line. The disused duck decoy, after which the farm was named, occupied a tract of about 17 acres, covered thickly with brushwood and small trees. The work of clearing the disused decoy was begun at once, and the faggots thus obtained were used in the construction of a road running along the new siding from the station to Railway Lodge. The foundation of this road was of faggots overlaid with clinkers, the whole being topped with a granite facing.

From the point where the full gauge siding ended a system of light railways began to radiate to the surrounding farms, no less than 9 miles of railway being laid down. Thus it became possible to continue road-making in every direction, a task which previously could not be undertaken.

The most important and urgent problem was obviously that of transport; when that had been solved the work of development could be carried out in other directions. It will be easily seen that the construction of so many roads and railways required a large amount of labour, and since further development of the estate would also involve the erection of a large number of buildings, it became necessary to have labour resident on the spot. In 1910, therefore, a dormitory with accommodation for 100 men was erected at Railway Lodge, together with mess rooms and a central kitchen. In these buildings the extra labour required for road-making, building, and work on the land was housed.

Great difficulties were encountered when the work of putting up farm buildings and cottages was begun. It will be remembered that the surface soil of the estate consists of a layer of shell marl resting on peat; the erection of any heavy building in such circumstances obviously demands great care in order to avoid subsidence. The procedure adopted in this case was to

drive in piles through the layer of peat to the gravel below, and on these piles to make a concrete platform on which the building was erected.

Hand in hand with these developments went the work of bringing the land into a profitable state of cultivation. As new buildings were erected the head of stock on the farms was increased and more dung became available. In addition, large quantities of London dung were imported, as well as hundreds of tons of artificials. Early potatoes were at first grown on a large scale, but owing to the late frosts, which are a characteristic of this part of the fen country, their culture was abandoned in favour of main crop varieties for which conditions are particularly suitable, about 1,500 tons having been produced during the season of 1921.

When the estate was first taken over in 1909 there were three orchards, 30 acres in all, one having been recently planted. This last showed such promise that it was decided to plant others, each with top and soft fruit. These have proved very successful, and fruit growing is now a feature of the estate.

Even the "washes" which are under water during the winter for weeks at a time have been utilised. Three varieties of willows are grown on them, and these supply more than enough osiers for the manufacture of all the baskets needed by Messrs. Chivers, and a large surplus is available for sale. In the season 1920-1921 nearly 150 tons of osiers were produced.

Present Condition of the Estate.—There are now nine farms on the estate, each with its own staff under a foreman, the whole nine being under the control of a resident manager whose office is in telephonic connection with each farm. Two of the farms are devoted entirely to fruit, four are fruit and arable farming combined (one of these has in addition a herd of dairy cows), two are ordinary arable farms, and one is a poultry farm.

The number of cottages has been increased from 13 to 42, and there are two houses; 300 people can be housed and fed in the present dormitories and mess rooms, and an electric laundry, a bakery and a co-operative store render this colony of workers to a large extent independent of the outside world. This independence of the estate is also emphasised in another direction by the presence of a carpenter's shop and a blacksmith's shop, where all repairs necessary to implements and buildings can be carried out.

The idea of growing chicory on the estate had been entertained from the first, and a factory for chicory roasting was one of the

first buildings to be erected. This has now been increased in size, and plants for the distillation of peppermint and the drying of herbs, such as parsley, spearmint and sage have been added to it.

Some idea of the extent of these "side-lines" will be given by the following figures. The total weight of chicory handled by the factory during the 1920-1921 season was 1,036 tons, and about 50 tons of green herbs have been dealt with.

Since 1909 the range of crops has been greatly increased. To the limited list grown by the former occupants of the estate have been added market garden crops, top and soft fruit, and herbs. There are now 212 acres under fruit, the principal crops being plums, apples, gooseberries, strawberries and raspberries. A very large acreage of potatoes is grown every year, and large quantities of cabbage, cauliflower, and celery are sent to the London markets.

During the last season some 500 tons of fruit were grown. Among the market garden crops celery and cabbages were most important, 4,507 rolls of the former and 4,725 tallies (a tally is 5 dozen) of the latter being sent away. There were also 972 tallies of cauliflowers. Wheat (1,292 qr.) and oats (1,219 qr.) were the chief cereals, and among the various "oddments" were 42 qr. of rye, 21 of mustard, 40 tons of swedes, and 200 tons of seeds hay.

Pigs and poultry are now important features of the estate. The pigs are Large Whites, some 45 sows being kept. The whole of the stock bred are fed off for bacon, their food consisting mainly of home-grown corn and chat potatoes. There is a central poultry farm, under the control of a lady manager, where incubation and rearing are carried on. The aim here is to obtain about 1,500 pullets annually, of which 500 are kept under the intensive system at the central farm, while the remaining 1,000 are distributed over the other farms (on each of which the manager has an assistant) and kept on the colony system. The breed is White Leghorn and the total number of eggs laid on the estate last year was 207,500.

Numbers of bullocks are fed annually and a pedigree herd of Lincoln Red Shorthorns is kept for milk production. In order to provide feed for these animals mangolds are grown in quantity (2,876 tons this season), and do extraordinarily well on this soil. The past season was particularly favourable for this crop, and four fields on the estate yielded over 60 tons per acre of cleaned roots, hot sunny weather combined with a high water table having much to do with this result.

The head of stock on the estate is a large one. In addition to the pigs previously mentioned there are 72 horses and usually about 200 head of cattle, but in spite of this a vast quantity of London dung has to be imported every year, this importation being necessitated by the presence of so large an acreage of strawberries and market garden crops in the scheme of cultivation.

In its present condition the estate offers a remarkable demonstration of the results that can be achieved by enterprise and organisation when these are backed by capital. To an undiscerning eye no material could have appeared less promising than this tract of country as it stood previous to 1909: water-logged and weed-ridden, without roads, isolated, and altogether poverty-stricken. The task of developing such land might well have seemed not only insuperably difficult, but hardly worth while. Yet at the present time one finds that, instead of the 29 men permanently employed on it in 1909, there are no less than 150 men and 50 women (*i.e.*, 9 men and 3 women per 100 acres), and, moreover, that at certain periods of the year, such as the fruit-picking season, 200 extra men and women are required. In addition to this, the amount of produce taken from the land annually has enormously increased.

It is hardly necessary to emphasise the value to the community of the work which has been briefly outlined in the preceding pages: the increase in the resident population of this area and the increase in its productivity are facts which have an unmistakable significance. But it is, perhaps, worth while pointing out the violent contrast between the use made of capital at Shippea Hill and its misuse in certain other parts of these islands. In the one case we see a low state of cultivation turned into a high one, and a great increase taking place in the resident population; while, in the other, we have the spectacle of a low state of cultivation becoming a state of no cultivation at all, and a population being literally driven into towns or overseas to earn its livelihood. There can be no question as to which of these courses is designed to benefit the nation.

* * * * * *

HOW TO PRODUCE CLEAN MILK.

J. Mackintosh, O.B.E., N.D.A.,
National Institute for Research in Dairying, University College, Reading.

The production and handling of milk on the farm consists of a long chain of operations which differ materially in nature and in the conditions under which they are carried out. Milk production may be said to begin with the selection of the cows, and handling, in so far as the average farmer is concerned, to end with the delivery of the churn of milk at the railway platform or the wholesalers' or retailers' premises.

Attention to detail at all stages in the chain is desirable, but it must be helpful to those engaged in the work to know the *relative importance* of the different operations. It cannot yet be said that all stages in this chain have been sufficiently investigated, but it is nevertheless possible to summarise the conclusions arrived at by different workers; fortunately, these conclusions are more or less in complete agreement as to the factors which are of prime importance in the production of clean milk. These factors are as follows:—

(*a*) The animals producing the milk, and the workers at all stages, should be in good health and free from any disease which may be carried by milk.

(*b*) The utensils used should be thoroughly cleaned and sterilised.

(*c*) The cows, and particularly their udders and teats, should be thoroughly cleansed before milking.

(*d*) The milking pail should have a small opening, thus lessening the space whereby dust and dirt may fall into the milk.

(*e*) The milk should be cooled soon after milking to a temperature of 50° F. or lower, and maintained at a low temperature afterwards.

The steps which may be taken by farmers to bring these factors, and particularly the last four, into active operation on their own farms will now be considered in detail.

Health of the Cows and of Workers in Cowshed and Dairy.—The importance of guarding against milk conveying infection either from the cows or from the dairy workers has been realised for many years, and the subject has been dealt with in several Acts of Parliament and Orders made under certain Acts.

The chief of these are the Dairies, Cowsheds and Milk Shops Orders, 1885, 1886 and 1889; the Infectious Diseases Prevention Act, 1890, and certain Orders of local application, such as are in force in Liverpool and Manchester. Copies of these can be obtained from His Majesty's Stationery Office, or from the offices of different local authorities, and as the duties of the farmer or dairyman are plainly stated further reference to these Orders is unnecessary here.

On 1st September, 1922, unless Parliament otherwise determines, the Milk and Dairies (Consolidation) Act, 1915, will come into force, and thereafter this Act will be the chief legal enactment relating to the handling of milk. Copies of the above Orders and Acts should be procured and studied by all dairy farmers.

Cleanliness of Utensils.—There is a wealth of evidence to prove that one of the most frequent and fertile sources of contamination is the utensils used in the handling of milk. It is therefore of fundamental importance that they should be thoroughly washed and sterilised.

Methods of Washing.—To attain this end they should be rinsed with cold water immediately after use. It is often customary after the morning milking to leave the milking pails, cooler, etc., unwashed until after breakfast; during the interval a thin film of milk tends to dry on to the sides, especially in warm weather, and the utensils are then more difficult to cleanse. If they are rinsed with cold water immediately after use the washing will be made more easy. Hot water should not be used for the first rinsing of milk vessels, because the heat causes some of the milk to dry on the sides, and in a short time the tinned surface becomes covered with a thin layer of dried milk, which can only be removed by repeated scouring with sand or other scouring substance.

The utensils should then be thoroughly washed in hot water containing some soda or other cleansing agent, and afterwards rinsed in clean hot water. The final process is the scalding or steaming. If steam is not available the utensils should be immersed in boiling water for, say, three minutes, or in the case of utensils such as a cooler or churn, which cannot be placed in an ordinary copper, boiling water should be poured over or into them until they are too hot to be touched by the hand. If steam is available all utensils should be steamed for at least three minutes over a steam jet or in a sterilising tank. After scalding or steaming they should be inverted on a rack in a

clean place to drain and dry; they must not be dried by means of a cloth—this would tend to reintroduce germs into the newly sterilised vessels. The heat which has been imparted to the metal by the boiling water or steam should be sufficient to dry the utensils almost at once. They should remain on the rack until required for further use. Where there are ample buildings, this rack should be in a clean room, but on many farms stands or racks for dairy utensils are out of doors in the sun. This is not a drawback provided they are well protected from dust or other contamination.

The equipment required for thorough washing and sterilising of milk utensils is not expensive. On small farms there is often a copper for boiling water, and even where the supply has to be obtained from the kitchen it is still easily possible to ensure that the utensils are properly cleaned. A simple steaming outfit without a boiler has also been recently introduced* which will give excellent results at a low cost. It has been designed for small farms. On larger farms the installation of a boiler is not a very expensive item, and the steam may be used for cooking pigs' food as well as for heating water and sterilising dairy utensils.

Construction of Utensils.—Thorough cleaning will be made easier by using only well tinned utensils with the seams flushed smooth with solder and without corners and crevices. Many farmers, for the sake of economy, use galvanised iron pails for milking, but pails of this material are very much more difficult to clean and are seldom found in a satisfactory condition. It is much truer economy to have the best make of utensils and avoid loss of milk by souring. The milking and carrying pails and measures are easy to wash, and special attention should be given to corners and crevices at the seams and spouts. The cooler presents greater difficulties; it should be detached from its stand and placed in a tub, on its own feet, for washing—if allowed to rest on the edge of a tub the bottom becomes dented and uneven, and is made much more difficult to clean and dry. The weakness of the bottom is one of the greatest defects of the ordinary farm cooler, and makers might with advantage consider the strengthening of this part. The folds should be sufficiently wide to be easily cleaned, and no strainer should be included as part of the cooler; such strainers are usually of wire gauze, and are quite ineffective.

* Particulars may be obtained from the National Clean Milk Society, 3, Bedford Square, W.C.1, or from the National Institute for Research in Dairying, University College, Reading.

The receiver or pan of the cooler is easy to clean, but special attention should be given to the tap. Old-fashioned taps with a cavity above the inlet hole are very difficult to clean and should have this cavity filled up. Most new taps have no such cavity and no crevices.

Strainers and Straining.—Strainers should consist of as few pieces as possible. Those made of wire gauze only are not merely useless, but do much more harm than good.

Where cloths are used for straining, whether as part of a metal strainer or simply tied over the mouth of a cooler pan, several should be provided so that a clean one may be available for each milking. Such cloths should be of very fine mesh, and must be most carefully washed and boiled, following the method already described for utensils. Strainers containing a layer of cotton wool are also very effective, particularly those where the milk falls on a metal plate first, instead of directly on to the straining material. The latter does not have to bear the weight of the falling milk, hence there is less chance of the particles of dirt being forced through the strainer. The amount of brownish sediment retained by the strainer is a good indication of the degree of cleanliness of the cows, and of the care taken in milking; in fact, the strainer has a greater value for this purpose than for any other; the passing of milk through a strainer may take out small pieces of straw and hairs, but the soluble matter and the numerous germs are simply washed through and even more completely distributed throughout the milk than was the case before straining. On the modern dairy farm the true use of a cloth or cotton wool strainer is to enable the milker to detect evidence of udder trouble before it could be found by handling the udder or the act of milking.

Churns.—The churns used for the conveyance of milk from the farm are often a fertile source of contamination, but in this case the purchaser of the milk often has a greater share of the responsibility than the farmer. Many large firms supply churns and undertake to send them to the farmer in a clean condition. If they should arrive at the farm in an unsatisfactory condition it is scarcely to be expected that the farmer will cleanse them as they ought to be cleansed. He may not have the time, labour or equipment required to cleanse and sterilise the large 17-gallon churn in common use. There is an overwhelming case in favour of the use of a smaller churn, in so far as ease of cleansing and handling are concerned. When churns arrive at the farm in an unclean condition they should be washed and scalded or steamed

in the manner already described, so far as time and equipment permit.

Farmers who are also retailers of milk have the additional responsibility of ensuring the cleanliness of the cans or bottles used in distribution. The method of washing previously described is likewise applicable here, and care should be taken in the purchase of delivery cans and churns to see that their internal construction as to seams, angles and taps is such as to make thorough washing as easy as possible.

Milking Machines.—Where milking machines are used the question of thorough cleansing is of even greater importance than where only hand milking is practised. All parts of the machine which come in contact with the milk must be thoroughly cleansed at least once daily, and the time required for this work necessarily varies according to the construction of the machine. Those with simply-made teat-cups, the minimum amount of rubber or celluloid tubing, the fewest joints, and with milk receivers without crevices and easily washed by hand, will be most advantageous in this respect, whatever may be their merits or demerits in others.

The mode of washing recommended by successful operators and careful students of this subject is as follows: Immediately after milking clean cold water should be drawn through the teat-cups, milk tubes and receivers, and all parts thoroughly rinsed. They should next be taken to pieces and washed in hot water containing soda or washing powder, the teat-cups, claws and tubes being well brushed inside and out. The teat-cups and tubes should then be fitted together and clean hot water drawn through followed by scalding water or steam. They may then be hung up to drain and dry and left thus until next milking. Another effective method of treatment is to immerse the cups and tubes between milkings in clean cold water containing a disinfectant—lime water, brine, and a mixture of brine and lime water have been found most satisfactory in America. When the teat-cups and tubes have been properly washed and steamed after the morning milking, it is sufficient to rinse them thoroughly with cold water in the evening. It is also necessary to guard against contamination of the milk by entrance of water from the vacuum pipes or oil from the pulsator, and to see that badly worn rubber parts are renewed when necessary.

Cleanliness of Cows.—In the cleansing of the cows, attention must be given to the hind quarters, flanks, udder, teats and the part of the belly immediately in front of the udder. When the

cows are at pasture day and night it is easy to keep these parts clean but when they are in the cowshed during the night it may be very difficult indeed. Much depends on the construction of the floor of the stall. Where the cowshed has single or double stalls of such a length that the manure falls into a fairly deep gutter, or where some other method is adopted to prevent the cow fouling the rear part of the stall, the cows will be much cleaner than where the cowshed has neither stall partitions (travises), raised standings nor gutters. On the other hand, if the removal of the manure be attended to frequently, ample litter provided and the cows groomed daily or before each milking if necessary, exceptionally clean milk can be produced in a very badly constructed cowshed.

The cleaning of the hind quarters, flanks, etc., will be made much easier if these parts are clipped by means of horse clippers when the cows begin to lie in overnight. The udder may also be clipped, but the objection is often raised that this will lead to cold in the udder, bad quarters and other troubles. In several herds well known to the writer, the udders have been clipped every winter for from two to eight years and there have been no bad results. In any case, the long locks of hair often found on the udders of newly calved cows should be removed when milking is recommenced. These long locks often get very dirty and, when included in the hands in the grasping of the teats, cause contamination of the milk and kicking or restlessness on the part of the cow.

Immediately preceding milking, the flanks, if dirty, should be washed clean by means of a brush and water; the udder and teats should always be washed and, when necessary, the loose moisture dried off afterwards by a clean cloth. Clean water should be obtained from time to time as required. It is most important that the sole of the udder and adjacent parts should be made clean, because it is from these parts that hairs, dust and dirt fall downwards into the milking pail. The writer has often found cows which appeared to have been thoroughly cleaned, yet close examination showed that the slight hollows between the teats and sometimes the left flanks and sides of the udder were dirty. It is not sufficient occasionally to wipe the udder and teats with a moist cloth when sitting down to milk; this may at first moisten the hair of the udder and prevent the loosening of particles of dust, but the udder soon becomes filled with hot milk, both skin and hair are quickly dried, and when the udder is shaken during the process of stripping, loose

hairs and dust are detached and fall on the top of the milk. Observant milkers have often noticed that a pailful of milk which appeared clean has, after stripping, received a thin covering of brownish particles. The cleaning previous to milking should be so thorough that this cannot happen.

Milking.—After cleaning the cows, the milkers should wash their hands and proceed to milk. If overalls are provided for wearing during milking, so much the better, but they are not essential. A pail or basin of water, with soap and towel, should be provided at a convenient place, so that the milkers may wash their hands before commencing to milk each cow. The opening at the end of the teat may contain particles of dirt and a considerable number of germs, hence it is desirable that the first two or three streams of milk from each teat should be drawn on to the floor of the stall or gutter or into a small pail used only for this purpose. If drawn on to the floor of the stall, this milk should be washed away after milking so that the litter or floor of the stall may be sweet and clean—otherwise harmful germs may grow and ultimately find their way into the teats and thence to the udder when the cow lies down. Where the rear part of the stall has a porous floor which cannot be properly washed, it it is advisable always to collect the first few streams into a pail: this milk may be used for calves and pigs. When a large herd of cows has to be cleaned and milked, it may be found most economical in labour to make one boy or man responsible for all the washing and drawing of the fore milk.

It is necessary here to discuss briefly the question of wet or dry milking. The custom, so prevalent in the South of England, of moistening the hands with milk occasionally to make teats and hands more pliable, is always objectionable, especially so when the teats and udders have not been cleaned. At the same time, it must be recognised that where one or more of the teats are small or do not deliver the milk in an even stream, it is well-nigh impossible to prevent some milk getting on to the hands: also, milkers who at other times are engaged in hard manual labour undoubtedly feel the need of some lubricant to make the hands more flexible for the operation of milking. This need is still greater in the case of cows which have thick-skinned teats or are hard to milk for other reasons.

Much of the criticism of dry-hand milking comes from those who have never tried this method in conjunction with systematic washing of the udder and teats. Where the method of cleaning described above is practised, it will be found that both milkers'

hands and cows' teats become more flexible, and wet-milking with milk as the lubricant becomes unnecessary and is soon recognised as a dirty habit. When a cow has sore teats, it is permissible to use vaseline during milking, but in such cases great care must be taken that the milk never touches the hands. In severe cases the milk thus obtained should not be mixed with that offered for sale.

From personal experience the writer has found that the adoption of dry milking, combined with careful cleaning, has resulted in the skin of the teats becoming of a soft yet tough texture, with a greater freedom from sores, and the whole operation of milking has become much more easy and pleasant.

Attention should also be paid to the cleanliness of the milking stools, especially the upper parts of the legs. Where the hands are allowed to become wet with milk, this part of the leg, unless regularly washed, gradually acquires a layer of dried milk. This accumulation is not merely an evidence of carelessness and dirty habits; it is also a ready means of carrying infection from a cow with a bad teat or quarter to another cow, because the leg of the stool is the first thing touched on rising from a cow, and the last thing touched on sitting down to milk again. A dirty stool leg may easily nullify all washing of the hands between the milking of individual cows.

Milking Pails with small Openings.—The common type of milking pail is widest at the mouth, so that it may be easy to milk into, but this advantage has the corresponding disadvantage that all the pieces of litter, hairs and dust which fall from the udder cannot but drop into the milk. Numerous types of pails have been designed to lessen this defect, and the use of the best of them has been found to lessen considerably the amount of dirt and germs gaining entrance to the milk. Some types have the opening so reduced in size that milking becomes much more a matter of good aim than usual, and such pails also require more careful washing than ordinary pails. If properly washed and sterilised, however, they are of great assistance in the production of clean milk, particularly so where the cleaning of the cows has not been very carefully done. When the udders and adjacent parts are washed clean, there is not the same advantage to be gained from the use of such pails. It is worthy of note that those who have used pails of this type find that the slightly increased loss of milk at milking times from part of streams of milk failing to enter the pail is balanced by the reduced loss when a fractious cow or heifer upsets the pail. Because of the

small opening, little or none of the milk is spilt on these occasions.

When a milking machine of the suction type is used, all the advantages accruing from the use of a milking pail with a small opening are obtained. The amount of visible dirt gaining entrance to the milk is undoubtedly lessened in cases of mechanical milking, at least so far as the milk drawn by the machine is concerned, but the germ content may be increased and the keeping quality and flavour of the milk depreciated if the parts with which the milk comes in contact are not kept scrupulously clean. Where stripping is done by hand after the removal of the machine, it is desirable that all the precautions already described should be taken as to cleanliness of udder and teats, otherwise the strippings will contain exceptionally large amounts of dust, hair and dirt and increase the germ content of the milk while at the same time raising the percentage of butter fat.

Cooling of the Milk.—Where milk is sold for direct use as a food, it should be cooled at the farm as soon as possible after milking. The use of coolers on farms has become increasingly common in recent years, and in spite of the additional risk of contamination by the passing of the milk through and over the different parts of the cooler, there is no doubt that effective cooling greatly lessens the loss of milk by souring and prevents the growth of the germs which may have gained entrance to the milk. Effective cooling, however, depends primarily on a supply of cold water, and there are many farms which are very badly off in this respect. They may be in a district where the supply is limited in extent and the use of a cooler is impossible. Under these circumstances something may be accomplished by placing the pails of warm milk in a trough of water. Where the water can be kept running through the trough good results may be obtained, but where the trough has to be filled from a pond or well it is doubtful if the results obtained warrant the expenditure of the necessary labour. These conditions are most often found on small farms and may be aggravated by the existing supply being badly contaminated, especially in summer, thus making it more difficult to clean the utensils. The production of wholesome and good keeping milk on such farms is a difficult matter, and probably the best that can be done is to keep the cows clean, wash the milking pails carefully, and have the milk as soon as possible after milking collected and transported to a depot where it can be cooled to a low temperature by means of a brine plant. The cleaning of the churns in which the milk is transported

should be carried out at the depot and they should be returned to the farm in a clean, dry condition.

On large farms the difficulty of water for cooling has often been overcome by the introduction of a supply from a county or district main or by pumping from a well to a storage tank located in the roof of the milk cooling room or adjacent building. Under these conditions the problem is merely one of making the best use of available supply. Every farmer who cools milk should have a thermometer in use to find out the temperature to which the milk is cooled. With a fair volume of water and sufficient time it is easily possible to cool the milk to within two degrees of the temperature of the water entering the cooler; *e.g.*, with water at 58° F. the milk should be cooled to 60° F.

When the cowshed and milk cooling room are situated near each other, the best results will be obtained by each milker carrying the milk from each cow in turn to the cooler; this gives ample time for efficient cooling. When the situation is not so convenient, the milk may be collected in carrying pails and conveyed to the cooler from time to time. These carrying pails usually stand in the cowshed and should be provided with lids to prevent dust and splashes of manure falling into the milk. On many farms it has been found of great assistance to have a milk receiving pan fitted up on the other side of the wall from the cooler, and a short wide pipe leading through the wall and emptying into the pan of the cooler. By this device much carrying of milk may be saved and the risk of contamination by dust when each milker enters the cooling room with milk is very greatly lessened. Where the milkers must pass in front of the cooler to empty milk into the pan, or where there is the risk of dust blowing on to the falling stream of milk, a sheet of tin (tinned sheet iron) may be hung in front of the cooler as a protection.

After the milk has been cooled the churns should be closed and kept in a cool clean place until despatched from the farm. Where the milk leaves the farm once daily, special care must be given to the storage of that milk which has to be kept for the day or night; in this case the mouths of the churns should be covered by the lids or by clean cloths.

Relative Importance of Methods and Equipment.—In the preceding pages special emphasis has been laid on the *methods* which should be adopted in the production of clean milk and comparatively little has been said about the equipment. The reasons for this concentration on how the work should be done

rather than on the provision of buildings and apparatus are two in number. Firstly, the amount of actual "hand work" in milk production and management is very great, hence almost everything depends on the individuals doing the work. If the person doing the work is taught the *best way* and *does it*, a very great improvement can be brought about with little or no expenditure. Secondly, the cost of improving existing buildings or erecting new cowsheds and dairies is sure to be heavy, and if the production of clean milk were primarily a matter of new buildings and high expenditure, little or nothing would be done for many years.

It is desirable, however, to study this question from different points of view and to maintain a due sense of proportion. It is quite correct to say that clean milk of the highest standard can be produced under very primitive conditions, provided attention is given to the cleanliness of the utensils, the cow and the milker, but it may not be a practical proposition to attempt to maintain such a standard of cleanliness, day after day, summer and winter, without taking steps to improve the cowshed or the water supply and thus lessen the expenditure of time and labour. The point of view of the cowman or milkers must also be appreciated; if nothing is done by the master to prevent cows wading in filthy mud or lying down amongst manure, one must not be surprised if exhortations to greater cleanliness meet with little response from the men. On the other hand, through carelessness or ignorance as to proper methods an ideal cowshed and dairy with a complete plant may turn out milk which soon goes sour.

The variation in the construction and internal arrangement of cowsheds in this country is extreme—some are so bad that no description can be attempted, and others are very good indeed—and, in this article, it is unnecessary to attempt to lay down any general rules beyond stating that there should be good light and ventilation, and stalls and floors so constructed that they will assist in keeping the cows clean. Regulations as to ventilation, airspace and superficial area have little to do with clean milk production apart from their bearing on the health of the cows.

With regard to the milk room, in the past too little attention has been given to its situation and construction. Broadly speaking, each farm from which milk is sold should have a clean cool room in which the cooling is done, the full churns stored until despatched and the clean utensils and churns kept after washing until again required. The washing of the utensils should be done in another place—a lean-to open shed would do for this

purpose so long as they were properly washed and kept free from contamination.

One point in the equipment of a farm for milk production is supremely important, namely, the water supply for cooling and cleansing purposes. Where this is defective the tenant farmer can hardly be held responsible. Suggestions have been made in the preceding pages as to the means likely to give the best results, but it should be clearly recognised that in some districts the lack of an ample supply of water constitutes a handicap in clean milk production which can only be overcome by considerable capital expenditure and fair arrangement between landlords, tenants and any others interested.

The relative importance of equipment and methods must therefore vary from farm to farm according to local conditions, and each farmer should study the problem as it presents itself on his own farm. On general grounds it is interesting to note that in the Inspection Report Card for Dairy Farms issued by the Ministry of Health, 100 points are allotted to Equipment and 400 points to Methods.

Financial Aspect of Clean Milk Production.—The practical farmer would consider this article very incomplete if some reference were not made to the financial aspect of the subject.

The greatest hindrance to greater cleanliness in the past has been the difficulty, if not the impossibility, of obtaining a higher price for a cleaner and better keeping product. There has at the same time been a lack of recognition of the importance of cleanliness in lessening the losses which occur through the souring of milk and cream; through the production of butter and cheese of bad flavour and low market value and through ill-health and depreciation in dairy herds.

The first point from the financial side, therefore, is that the loss which each dairy farmer suffers from sour milk or similar causes in the course of the year could be greatly lessened by giving a little more attention to the cleanliness of the utensils, the cow and the manner of milking. It is impossible to estimate the value of this loss so far as each farmer is concerned and it is equally impossible to estimate the cost of the extra time and labour required to bring about an improvement. In many cases no extra time is necessary—all that is required is to make better use of the time at present spent in washing of utensils.

The second point is that cows kept under clean conditions are healthier and able to make a more productive use of their food than those housed and milked without any regard to cleanliness.

Dirt brings disease and loss. All-round cleanliness helps to make a healthy herd and increase the milk yield.

The problem of obtaining a better price for a better article is a difficult one, but the prospects for the future are brightening.

The initiation of Clean Milk Competitions amongst farmers is a movement of great promise. The awards in these competitions are made on the basis of a bacteriological and chemical examination of the milk and an inspection of the equipment and methods in use at the farm. Diplomas are awarded to those competitors attaining a sufficiently high standard and money prizes provided for the milkers—a welcome recognition of the fact that success in this work, as in so many others, is dependent on the co-operation of all grades of workers. Successful competitors in these competitions have every right to expect, and in some instances have already obtained, a higher price for their milk; further, the result of the efforts made by the others cannot but be beneficial, particularly as a concise report on his own conditions of production is sent to each competitor.

Competitions of this nature, if introduced into other counties by Farmers' Societies, by large wholesale dairy companies or by city councils may well become general and popular, and they will certainly be exceedingly helpful in improving the milk supply at its source in the manner which is least controversial and most successful, namely, by the action of the farmers themselves.

With regard to the production of milk under the strictest conditions of cleanliness, the Ministry of Health has taken over and is carrying on the scheme initiated by the Ministry of Food whereby licences were issued to producers and distributors complying with certain conditions permitting them, and them only, to describe milk produced under such licence, as Grade A and Grade A (Certified) milk.* The demand for and the supply of milk of this high quality at a corresponding price is gradually increasing throughout the country, and though rapid progress cannot be expected, it is a great advance to have a high, but nevertheless attainable standard set up and recognised by the producer, the distributor, the consumer and the Government.

* See H.M.L. 6 and H.M.L. 7 = Licences permitting the use of the designations "Grade A (Certified) Milk" and "Grade A Milk"—obtainable from the Ministry of Health, Whitehall, London, S.W.1.

CULTIVATION OF THE HOP CROP.

IV.—COMMERCIAL VARIETIES OF HOPS.

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IN the description which follows no attempt has been made to enumerate all the varieties of hops grown in England, but the best commercial varieties which are commonly grown in England have been selected and their more important characteristics given.

Characters of Commercial Importance.—The characters of commercial importance in a hop are the following :—

Order of Ripening.—In the list given below the varieties have been arranged approximately in the order in which they ripen, but it will readily be understood that this will vary with season, district and treatment of the hop-garden. A knowledge of the order of ripening may be of use in helping a beginner in planting to arrange his gardens so that the late hops may not be exposed by the picking of the earlies. It is of course necessary with any considerable acreage that the hops grown comprise early and late sorts, so that they can be picked as they successively become ripe, without overtaxing the drying capacity of the oasts, as well as providing a reasonably long hop-picking season for the pickers.

Vigour of Growth.—This character is of importance since it largely determines the width of planting and the height of wire work which should be adopted. It is also to be taken into account in connection with resistance to disease—Aphis (" greenfly "), hop mould and red mould, canker and nettlehead—a very important factor in successful commercial hop-growing, and a subject of which unfortunately there is little scientific knowledge.

Suitability to Soil and District.—For reasons which are little known, varieties are greatly influenced by these two factors, and beginners should only introduce a new variety to a district after a thorough preliminary test.

Ease of Picking.—This factor is important in the cost of production; some varieties can be picked much more cheaply than others, *e.g.*, Fuggle's than the true Golding varieties.

Keeping Properties.—A knowledge of this character gives a guide to the beginner in deciding the sequence of picking—

some varieties will "hang" or "keep" much better than others. It should, however, be remembered that variety is not the only factor; other factors concerned are (1) absence of disease (Aphis or "mould"), and (2) character of soil.

Quality.—This is a peculiarly elusive factor, yet very important; it is likely to be particularly prominent in coming years. Owing largely to ignorance in the brewing trade, the commoner or "flat-catcher" hops have in recent years been more profitable to produce than the better varieties. The tide is now turning in the other direction.

There are two methods by which quality may be judged: firstly, by the senses—the eye, the nose, and the hand ("rub"—which give a good idea of the brewing value, and secondly, by chemical analysis, a method which has not been largely employed because the brewing chemist has not yet decided the relative importance of the various resins and other constituents of the hop. Not until these points are settled, can the plant-breeder proceed to build up new commercial varieties of hops which will be truly economic.

Yield.—This character, while affected within certain limits by various factors, is yet distinctive of the variety.

Male Hops.—It is now generally well recognised that the planting of male hops at the rate of one male to every 200 female "hills" throughout the hop-garden is of fundamental importance. In addition, it is a good plan to plant a number of male hops in the lew row on the S. and W. sides of the garden, because the S.W. wind is the prevailing one at the time of year when the hops are in "burr" and the male hop is scattering its pollen. It has been shown* that the effect of adequate fertilisation of the female flowers (the hop-burr) is to increase the crop by several hundredweights per acre. This has been definitely ascertained with respect not only to such "Golding" varieties as Canterbury Whitebine, Bramling, and Amos's Early Bird, but also to Fuggle's. Another important advantage that is secured by the planting of male hops is that the burr period (during which attacks of mould are most to be feared) is appreciably shortened, since as soon as this is fertilised by the pollen-dust from the male hop it sets into hop.

* Howard, A.: Hop Experiments (Bulletin I, S.E. Agric. Coll., Wye (1904–1905).

Salmon, E. S. and Amos, A.: On the Value of the Male Hop (Leaflet S.E. Agric. Coll., Wye (1908), and in Journ. Inst Brewing, XIV, 309–331 (1908).

Salmon, E. S.: The Pollination and Fertilisation of Hops (Journ. Board of Agric., Vol. XX, 953–966 (1914); Vol. XXI, 22–31, 123–133, 213–220 (1914).)

It should be remembered, however, that the planting of too many male hops in the hop garden will result in the production of too much seed in the hop-cones, and an appearance of seediness in the " side " of the dried hop sample, which is legitimately regarded by the brewer as depreciating the market value of dried hops.

The mere indiscriminate planting of male hops in a hop garden is not, however, sufficient to ensure adequate fertilisation. Other points need attention :—the male hops to be effective, must set free their pollen at the time of the appearance of the " burr " of the particular variety of hop among which they are planted. The male hops therefore need to be distinguished according to the period at which they produce pollen, viz., earlies, mid-season and late, so that one or other of these may be selected for planting with the female variety of similar character. There are, however, some males which flower either so early or so late that their period of pollen-production does not coincide with the burr periods of commercial varieties of hops; these are, of course, quite useless. Again, some varieties of male hops are very susceptible to mould or to the nettlehead disease and such if planted may become the centres of infection of the whole garden; these also should be eliminated.

It is, of course, impossible to prepare a classification of male hops; the fact that the hop plant is dioecious, *i.e.*, the male and female flowers are produced on separate plants, makes it impossible to identify any male hop as being of the same variety as any given female hop.

In the list of the (female) varieties of hops given below, only those have been included which possess the characters necessary for a good commercial variety, viz., a sufficiently vigorous constitution to withstand from time to time unfavourable climatic conditions; the yielding power necessary to produce a remunerative crop; and a crop reasonably easy to pick, which " hangs " well and is of fair quality. Where any variety is superior, or inferior, to this standard, the fact is mentioned under the particular variety.

It may be pointed out that the stock of most varieties on the market is far from pure and contains individuals which are obviously not " true " or of weak stamina. This is particularly the case with Fuggle's, Bramlings and Mathons. It is worth the while of any grower to breed up pure stocks from a single robust plant of many of the older varieties. A reputation once gained for pure stock would lead to profitable business with hop-sets.

For information as to the suitability of some of the varieties to certain districts, and on other points, the writers wish to express their thanks to the following gentlemen:—Viscount Wolmer, Mr. H. Lillywhite, Mr. J. C. Messenger, Mr. E. G. Shew, Mr. W. L. Pritchett and Mr. J. Moore.

Early Varieties.—*Prolific.*—The earliest hop, with very large cones which are easily picked; crops heavily. Little grown on account of its poor quality.

Amos's Early Bird.—Ripens a few days before the Bramling. Suitable for the best loams and Greensands; grown in parts of Kent and Hampshire and considerably in Herefordshire and Worcestershire. This variety, like the Bramling, is liable to be adversely affected by a cold or wet summer, when the cones may be small and difficult to pick. Highest quality.

Bramling.—This variety is universally grown on the best soils throughout the hop growing districts but its acreage is unfortunately declining. Highest quality.

Mid-season Varieties.—*Tolhurst.*—Largely grown in certain districts; grows vigorously on nearly all soils, crops very heavily and is easily picked. Quality poor. This is a favourite variety on account of its cropping powers, but is coming into disfavour on the market on account of its lack of good brewing properties.

Mathon.—Grown only in Herefordshire and Worcestershire on the best loamy soils; in some seasons inclined to make too much bine, which is not fruitful and consequently difficult to pick; keeps well when healthy. Highest quality.

Cobb's.—Grown largely, especially in Kent, on loam and the lighter soils; grows vigorously and crops heavily; easy to pick, but does not keep well. Medium quality. This is a good commercial variety.

Tutsham.—Very similar to the above; with better keeping powers. In order to counteract the tendency of this variety to produce, on strong soils, too much bine, it is the practice in some districts to pull the hills very hard and to train up only the latest bines. This is a good commercial variety.

Farnham Whitebine.—Grown only in Hampshire and Surrey, on good loams. Highest quality.

Fuggle's.—Most suitable for heavy clay soils; grown almost to the exclusion of other varieties in the Weald of Kent and Sussex. Has a vigorous constitution, but is inclined to produce little bine unless stimulated by heavy nitrogenous manuring; crops very heavily in average seasons and does well in wet seasons, but suffers in dry summers; easy to pick; keeps well.

Is a very good "copper" hop, and an excellent commercial variety for heavy soils.

Rodmersham Golding.—Not grown except in a few districts in Kent on good loams. Has a weak constitution and the hills are liable to die away from "canker." Easy to pick. Highest quality.

Late Varieties.—*Petham Golding* and *Canterbury Whitebine.*—Only grown on the best loams, chiefly in Kent. Frequently grow too much bine, and in wet summers develops only a small crop. Highest quality. Although the quality is second to none, the area devoted to the cultivation of these two varieties is now small.

Colgates.—The latest hop; grown on heavy land, chiefly in the Sussex Weald and in Herefordshire. Crops heavily, but the cones are small. A "copper" hop.

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SILAGE FOR MILK PRODUCTION:

A COMPARISON WITH ROOTS AND HAY.

PROFESSOR R. G. WHITE, M.Sc., and E. J. ROBERTS, B.A., B.Sc.,
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IN March, 1921, it was decided to discontinue the Ministry's Arable Dairy Demonstration Farm near Denbigh, and the Ministry offered a quantity of silage, then in a clamp on the farm, for the purpose of a feeding experiment.

Owing to the shortness of notice and the rapid approach of the grass season, nothing in the way of an elaborate experiment could be arranged, and as most farmers in the district had large root surpluses, it was not easy to secure a suitable farm for the experiment. Ultimately, Messrs. Hooson, of Brookhouse and Colomendy farms, near Denbigh, kindly consented to carry out the experiment, and grateful acknowledgment is due to them for the ready and willing help they rendered throughout. Milk recording was immediately commenced on their farms to facilitate the selection of two uniform lots of cows.

It was decided that each experimental lot must include at least eight animals, and it soon became obvious that it would be impossible to get two such comparable lots on one farm. As the best arrangement possible under the circumstances, eight cows were selected at Colomendy and eight at Brookhouse.

The following were the two experimental rations fixed upon, the two being estimated to supply similar quantities of starch equivalent (about 12.6 lb.) and digestible protein (2.72 lb.) a day.

Silage Ration.	*Roots Ration.*
40 lb. Silage.	40 lb. Mangolds.
6 lb. Seed Hay.	15 lb. Seed Hay.
4 lb. Oat Straw.	4 lb. Oat Straw.
8 lb. Mangolds.	2 lb. Earth Nut Cake.
2 lb. Earth Nut Cake.	3 lb. Soya Bean Cake.
3 lb. Soya Bean Cake.	1½ lb. Oats.
1½ lb. Oats.	1 lb. Barley.
1 lb. Barley.	

It will be seen that in the silage ration 40 lb. of silage was substituted for 32 lb. mangolds and 9 lb. seeds hay. 40 lb. of silage was expected to contain 4.64 lb. starch equivalent and 0.41 lb. of digestible pure protein. 32 lb. mangolds and 9 lb. seeds hay were taken as containing 4.58 lb. starch equivalent and 0.42 lb. digestible pure protein. In making these calculations at the commencement of the experiment it was assumed that the composition of the silage would be similar to that given in Wood and Halnan's Tables for Oat and Vetch Silage. As stated below, it was subsequently found that the silage used did not come up to these figures, and therefore it is probably safe to assume that in the experiment, silage suffered from a slight handicap. The silage was made in 1920 from spring-sown oats and peas, which produced an excellent crop. A shallow pit was excavated in the field and filled with the green oats and peas, the clamp ultimately being carried up to a considerable height, and compressed by drawing the loaded carts over it. The soil thrown out from the pit was then placed on the sides and top of the clamp. When the heap was opened in the following March it was seen that the material had rotted to a depth of about nine inches on both the top and sides of the clamp. Mr. Hooson estimated that the amount of waste was 25 per cent. of the whole, but, unfortunately, there was no means of weighing the material to check this. It is doubtful, however, whether the proportion of weight was really so high. The waste material seemed large in bulk, but owing to the greater solidity of the main mass of the heap as compared with the outside, the weight would probably be much less than the volume of the waste material would suggest. Except for the waste at the outside, the silage taken out in March, April and early May was in excellent condition and very much relished by the stock.

The following is the average analysis of several samples tested by Mr. McLean, Lecturer in Agricultural Chemistry :—

	per cent.
Moisture	76.60
Crude protein (including 2·10 per cent true protein) ...	3·50
Fat	1·05
Fibre	9·15
Ash	2·30
Soluble Carbohydrates	7·40

It will be noticed that these figures show a higher content of moisture and a lower percentage of carbohydrates than many other published figures. This may be due to the exceptional nature of the season of 1920, which was extremely wet and cold, or it may be that silage produced in a west country district is normally lower in feeding value than that produced in the drier and more sunny eastern counties from which most of the available analyses have been obtained.

Plan of Experiment.—The first step consisted in placing all the cows at both farms on the same ration in order to enable the selection for the experiment to be made. This preliminary ration included a small amount of silage so as to accustom the animals to it. Eight cows at each farm with approximately the same total milk yield and comparable as regards age, date of calving, etc., were then chosen. This was done after inspection of the milk records for the 20th, 21st and 22nd of March. This preliminary recording period of three days is admittedly short, but it was found necessary to curtail it as much as possible so as to make it possible to complete the experiment by the end of April.

At the end of the preliminary period the rations of both lots were gradually adjusted so that on the 27th March the Brookhouse cattle were on the full silage ration, and the Colomendy cattle on the roots ration. This was continued for 14 days, records of the milk yields being taken twice daily at both farms. The rations were then gradually reversed so that in the second period Colomendy cows received silage and the other lot had the full root and hay ration. Seven days were allowed for the gradual reversal of the rations.

The following shows the plan of the experiment :—

	Brookhouse.	*Colomendy.*
Preliminary period up to March 22nd ...	Same rations.	
23rd to 26th March	Transition.	
27th March to 9th April (14 days) ...	Silage ...	Roots.
10th April to 16th April (7 days) ...	Transition.	
17th April to 30th April (14 days) ...	Roots ...	Silage.

Results.—Yield of Milk for Eight Cows.

Period.		*Brookhouse.* lb.		*Colomendy.* lb.		*Remarks.*
March 20th, 21st, 22nd	3 days	555½	Preliminary	558½		
March 23rd to 26th	4 days	710½	Transition	770¾		
March 27th, April 2nd ...	14 days	1,221	Silage	1,243½	Roots	22½ lb. in favour of roots.
April 3rd, April 9th ...		1,192		1,187		5 lb. in favour of silage.
April 10th, April 16th ..	7 days	1,074	Transition	1,178		
April 17th, April 23rd ...	14 days	1,045	Roots	1,188	Silage	143 lb. in favour of silage.
April 24th, April 30th ...		996½		1,166		170 lb. in favour of silage.

Taking the weekly yield of milk there is very little difference between the silage and the roots-fed cows during the first period of the experiment, but during the second period the results are decidedly in favour of the silage ration, there being a difference of 313 lb. of milk in favour of the silage during the last fourteen days.

Average Daily Milk Yield at each Centre.

Period.		*Brookhouse. Average Daily Yield, (8 Cows).*		*Colomendy. Average Daily Yield. (8 Cows).*	
Mar. 20–26	(7 days)	Preliminary period	lb. 181	Preliminary period	lb. 190
Mar. 27–Apr. 9	(14 days)	Silage	172	Roots and Hay	173
Apr. 10–16	(7 days)	Transition	153	Transition	168
Apr. 17–30	(14 days)	Roots and Hay	146	Silage	168

As the experiment proceeded there was a tendency for the yield to drop in both cases, but, during the last fourteen days, while the yield at Brockhouse (on roots and hay) went on decreasing, the yield at Colomendy (on silage) was on the whole well maintained, and it is not unreasonable to suppose that the silage was responsible for this " stiffening " in the yield.

We are indebted to Mr. Arthur Amos of the School of Agriculture, Cambridge, for information regarding similar experiments, the lines of which were followed so far as circumstances allowed.

* * * * * *

RAILWAY RATES AND AGRICULTURE.

As there seems to be some misapprehension with regard to the rights and opportunities of agriculturists to secure a reduction in the present burden of railway rates, the Ministry has prepared the following memorandum setting out the situation created by recent administration and legislation.

1. By Section 3 (1) (c) and (e) of the Ministry of Transport Act, 1919, Railway Companies whose undertakings were in possession of the Crown were required to follow any directions the Minister of Transport might give as to the rates, fares, tolls, dues and charges to be charged, and such Railway Companies were authorised to charge the rates, etc., directed by the Minister notwithstanding any agreement or statutory provisions then limiting their charging powers.

2. By Section 21 of the Ministry of Transport Act, 1919, a Committee was established called the Rates Advisory Committee, consisting of five persons, two being representatives of the interests of trade and agriculture nominated by the Board of Trade after consultation with the Central Chamber of Agriculture among other bodies, one representing transportation and one labour, with a Chairman experienced in law. An additional member was afterwards appointed by the Minister under a discretionary power conferred by the same section. This Committee was set up for the purpose of giving advice and assistance to the Minister and for safeguarding any interests affected by any directions the Minister of Transport might give as to the charges to be made by the railways, and when considering any question of increase the Committee was to advise the Minister how any increased revenue found to be necessary could best be raised from the various branches of railway traffic.

3. In October, 1919, the Minister of Transport requested the Rates Advisory Committee to advise him as to the best way of raising additional revenue to the extent of £45,000,000 per annum. This sum was subsequently increased by £5,000,000. The Rates Advisory Committee reported to the Minister on 16th December, 1919, and the Minister, in the latter part of December, 1919, adopting the recommendations of the Committee, directed the Railway Companies to increase the tolls, rates and charges published in their rate books by certain percentages and flat rate additions on and from 15th January, 1920.

4. Under the Minister of Transport's direction, and in accordance with the advice of the Committee, agriculture received

preferential treatment, for while rates on coal and coke traffic were increased 25 per cent., Class A 30 per cent., Class B 40 per cent., Class C 50 per cent., and Classes 1 to 5 60 per cent., plus in each case a flat rate addition varying from 3d. to 1s. per ton, such articles as fruit, vegetables, hay and straw were only increased 25 per cent. plus the appropriate flat rate addition. The rates on fresh milk, manure in bulk or packed, basic slag, and lime for agricultural purposes were not increased at all.

5. On 7th July, 1920, the Minister of Transport informed the Rates Advisory Committee that it was estimated the Railways would show a deficiency of £54,500,000 per annum as from 1st April, 1920. As the Government had decided that the Railways were to be on a self-supporting basis, and not to be subsidized by the taxpayer, the Committee were instructed to advise what increase was necessary in rates, tolls, fares, dues and charges to yield by the end of June, 1921 (subsequently extended to 31st July, 1921), the total deficit which had begun to accrue from 1st April, 1920.

6. As the result of the Committee's findings, the increased rates dating from 15th January, 1920, were rescinded and altered tolls, rates and charges on and after 1st September, 1920, were authorised. With the sole considerable exception of manure in bulk, packed manure, basic slag and lime in 2-ton loads for use as agricultural manure in the United Kingdom, which were increased 50 per cent. plus certain flat rate additions, the rates on all traffic in Classes A to C and 1 to 5 (including coal and coke) were increased by 100 per cent. over the rates in existence on 14th January, 1920, plus flat rate additions varying from 6d. to 1s. per ton.

7. On 19th August last the Railways Act, 1921, received the Royal Assent, and by Section 60 of that Act the Railway Companies are empowered until the "appointed day," when standard charges come into force, to make such charges as were in force on 15th August, 1921, which charges are (as respects merchandise) the increased charges mentioned in paragraph 6 which came into operation on 1st September, 1920, subject to the proviso that any representative body of traders may apply to the Rates Tribunal set up under Part III of the Railways Act to reduce the charges now in operation or any of them, and any trader interested in any particular charge may apply to reduce that charge.

8. The Rates Tribunal is a permanent court, consisting of 3 members appointed for a term not exceeding 7 years and in

accordance with Section 20 of the Railways Act, has been constituted as follows :—

Sir F. Gore-Browne, K.C., an experienced lawyer, President; Mr. G. C. Locket, of Messrs. Gardner, Locket and Hinton, a person experienced in commercial affairs; and Mr. W. A. Jepson, late Assistant to the General Manager of the London and North Western Railway, a person experienced in railway business.

9. The Act further provides for the constitution of two panels to be called the General Panel and the Railway Panel respectively. The General Panel is to consist of 36 representatives of Trade and Labour, two of whom are to be nominated by the Minister of Agriculture and Fisheries to represent agricultural interests. The Railway Panel is to consist of eleven persons nominated by the Railway Companies' Association, and one person nominated by the Minister of Transport to represent those railways and light railways not parties to the Railway Companies' Association. The members of the General Panel nominated by the Minister of Agriculture and Fisheries are Sir Walter W. Berry, K.B.E., and Mr. A. E. K. Wherry, O.B.E.

10. When the Rates Tribunal comes to consider any particular agricultural case, two members may be added to the Tribunal, one from the General Panel and one from the Railway Panel, either at the instance of the Tribunal or the Minister of Transport or upon the application of any of the parties to the case, and it is provided that the person to be selected from the General Panel shall, as nearly as may be, be a person with knowledge of the technicalities that may arise in the particular case.

11. The Rates Tribunal is ready to deal with any application that may be made to it under Section 60 of the Act. Information as to the procedure to be adopted, until the permanent rules of the Tribunal are issued, may be obtained from the Secretary at 2, Clement's Inn, Strand, W.C.2. Temporary directions have been issued as a Stationery Office publication.

12. It is probable that the present railway rates will remain in operation for some time, and it is possible that they may continue until the "appointed day" (which is not likely to be before 1st January, 1924), unless the Railway Managers can be induced to reduce them or unless a successful appeal is made to the Rates Tribunal.

As a result of negotiation between the Railway Companies and the organisations representing the interests concerned, the rates between stations in England and Wales on coal, coke

and patent fuel, limestone for chemical works, lime in Class "B" of the General Railway Classification for iron and steel making purposes, and iron and steel in Class "B" have been reduced to the rates in operation on the 14th January, 1920, plus 75 per cent. with a flat addition of 4d. per ton. The Caledonian, Glasgow and South Western, and North British Railway Companies have granted similar concessions, with the exception that the reduced rates on coal, coke and patent fuel apply only when the traffic is forwarded to blast furnaces and steel works. Reductions in the rates for iron-ore, ironstone and limestone for blast furnaces and steel works have also been granted. These reductions apply experimentally for a period of 12 months. It is for Farmers' Organisations to consider therefore what useful action they can take on these lines, or by appealing to the Rates Tribunal, to protect their own industry.

13. With regard to Railway Rates for the future—Part III of the Railways Act, 1921, gives effect to the main recommendations of the Rates Advisory Committee set out in its report to the Minister of Transport dated 22nd December, 1920 (Cmd. 1098), and so far as it relates to the settlement of standard rates may be summarised briefly as follows:—

(1) The Railway Companies will submit to the Rates Tribunal not later than 31st December, 1922 (unless the Minister of Transport extends the time) schedules of rates in the form set out in the Fourth Schedule to the Act based on the classification upon the settlement of which the Rates Advisory Committee are now engaged. Except for the purpose of settling this classification this Committee have now no functions with regard to charges or other matters relating to railways.

(2) The Schedules will be published, and after hearing all parties interested and desirous of being heard, the Rates Tribunal will fix the rates and name a day (in the Act called "the appointed day") when the new rates are to come into operation. These new rates will be called the Standard Rates and Railway Companies will be bound to charge all traffic at these rates unless an exceptional rate has been granted or continued in conformity with the provisions of the Act. The Act provides for the modification of the Standard Rates or any particular Standard Rate at any time after the appointed day upon application to the Rates Tribunal by the Railway Companies or by Traders.

14. The provisions of the Railways Act with regard to exceptional rates are most important, and may be summarised briefly as follows:—

(i) All exceptional rates in operation immediately before the day when the Standard Rates come into force (*i.e.*, the appointed day) will cease to operate, but if a trader interested in any such exceptional rate agrees in writing with the Railway Company before the appointed day for the continuation of his exceptional rate, with or without an increase

of the rate, his traffic will continue to be charged at such rate, provided that such rate is not less than 5 per cent. below the Standard Rate; provided also that if such rate is more than 40 per cent. below the Standard Rate the rate shall, before the appointed day, be referred to the Rates Tribunal, and, if so referred, shall continue until the Tribunal have determined the matter. If the Railway Company refuse to agree, the Secretary of the Railway Company should be notified in writing by the trader that he desires his exceptional rate to be continued and that he requires that the matter be referred to the Rates Tribunal. If this course is taken the exceptional rate will continue until determined by the Rates Tribunal and the onus of proving that it ought to be altered or ought not to continue will be upon the Railway Company.

(ii) No rate which has not been applied to the charging of merchandise actually forwarded within two years preceding the 1st day of January, 1923, shall be continued unless the trader can prove to the satisfaction of the Railway Company or Tribunal that its non-application is due to abnormal condition of trade, or that a rate of equal amount to the same station is in operation from some other place in the same group.

(iii) After the appointed day new exceptional rates may be granted by a Railway Company provided they are not less than 5 per cent. and not more than 40 per cent. below the Standard Rate chargeable and subject to the Railway Company reporting the rate to the Minister of Transport.

(iv) After the appointed day no new exceptional rate may be granted by a Railway Company which is less than 5 per cent. or more than 40 per cent. below the Standard Charge applicable unless the sanction of the Rates Tribunal is first obtained.

(v) If a Railway Company refuses to grant a new exceptional rate any trader may at any time apply to the Tribunal and the Tribunal may grant whatever rate it thinks fit.

15. (i) It will thus be seen that those interested in agricultural rates should examine the schedules of Standard Rates referred to in paragraph 13 hereof with the greatest care as soon as they are published and lay any objections they may have before the Rates Tribunal in the manner and within the time that will be specified when such schedules are published, and take steps to appear before the Rates Tribunal when the schedules are considered so that their rates may be fixed on an equitable basis.

(ii) The Standard Rates as finally settled will be published and notice given of the day when they will come into force. The Rates so settled will have to be carefully examined, and in cases where the existing exceptional Rate applicable to any particular traffic is 5 per cent. or more below the appropriate Standard Rate, and where any hardship would result from the cancellation of such exceptional rate, the Railway Company should be approached with a view to continuing such exceptional rate under the provisions referred to in paragraph 14 (i).

16. The Railways Act further provides that the standard charges and all exceptional charges shall be reviewed at the end of the first complete financial year after the appointed day and at the end of each succeeding year, but the Minister of Transport may direct that no review shall take place as respects any year after the second annual review unless requested by the Railway Company or by the Board of Trade at the instance of any representative body of traders.

17. **Conditions of Carriage.**—Before 31st March, 1922, or within such further time as the Rates Tribunal may permit, the Railway Companies are required to submit to and publish in such a manner as may be prescribed by the Rates Tribunal the terms and conditions on which :—

(*a*) Merchandise other than live stock;

(*b*) Live stock;

(*c*) Damageable goods not properly protected by packing;

will be carried by rail.

The terms and conditions so submitted will be considered and settled by the Rates Tribunal after hearing any representative body of traders who may desire to be heard, or any person who may obtain a certificate from the Board of Trade that he is in their opinion a proper person to be heard, or any other party whom they consider entitled to be heard.

The Rates Tribunal will publish in the London and Edinburgh Gazettes the terms and conditions which they consider just and reasonable, and fix a date, not earlier than two months after such publication, when they shall come into operation.

The terms and conditions so settled shall be the standard terms and conditions of carriage for all Companies and shall be deemed to be reasonable.

18. The jurisdiction of the Rates Tribunal with regard to standard rates and terms and conditions of carriage extends to merchandise traffic by passenger as well as goods trains, but a Railway Company is not under obligation to carry by passenger train any merchandise other than perishable.

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SHROPSHIRE SHEEP.

ALFRED MANSELL.

AT the latter end of 1882 the breeders of Shropshire sheep established the first Sheep Breeders' Association of the world, and in 1883 its first Flock Book was published.

The formation of the Association was hastened to some extent by the great demand which had sprung up during the years 1880 to 1882 for Shropshire sheep for export, mainly to the United States and Canada, and buyers were asking for certificates of purity and origin.

The publishing of a flock book and the issue of export certificates gave a great impetus to the export trade, and it is estimated that no fewer than 20,000 Shropshire sheep were exported during the first decade of the Flock Book's existence, and a steady and remunerative foreign trade has been maintained ever since, either for crossing with Merino or native breeds of sheep, or to found pure bred flocks, which would hereafter furnish rams for a similar purpose.

The position the breed occupies in the United States is shown by the following official statement:—

The total number of pure-bred sheep in the United States on 1st January, 1920, was 463,504. Shropshires come first with 124,453, equal to 26½ per cent., Rambouillets next with 106,819, Merinos follow with 59,876, etc., etc.

History.—The antiquity of the breed is beyond doubt, for Anderson in his "Origin of Commerce" gives the price of Shropshire wool in 1343 as £9 6s. 8d. per sack, and Smith in his History of Wool and Woollen Manufacturers (*Chron. Rusticum*, 1641) quotes the price of Salop (Shropshire) wool as £6 6s. 4d. per sack for home use and £9 6s. 4d. for exportation. Smith further says that the wool of Shropshire was the choicest and dearest in England.

The Shropshire sheep is descended from a breed which has been known to exist from time immemorial on Morfe Common, near Bridgnorth, the Longmynd Hills, near Church Stretton, and Cannock Chase in Staffordshire, though the latter were somewhat heavier sheep and darker in feature than those bred in Salop. It is a down breed of beautiful symmetry on short legs, with lean fleshy back and deep full legs of mutton, with dense wool of best staple and of high quality.

By careful selection and judicious mating of its own variety this popular breed has been brought to the leading position it now occupies. It has been by developing the strongly inherited characteristics of the native breed of the district that all the best flocks have been built up, and when in 1853 at the Gloucester Royal Show the breed was recognised a great encouragement was given to breeders to place their breed in the front rank.

In the work of improvement the breeders were careful to preserve the well-known reputation for hardihood, fecundity, early maturity, and excellence of wool and mutton.

Value for Crossing.—Abundant testimony could be given as to the value of the Shropshire ram for crossing purposes, but the following experiences, selected out of many, are convincing:—

Mr. John Gregg, of New Zealand, in an article on "The best Mutton Sheep" about 20 years ago, says: "I use nothing but Shropshire rams on my crossbred ewes. I find that my Shropshire wool or a strong dash of that blood gives about 1½d. per lb. more than any coarse crossbred."

Mr. G. S. Kempe, writing on the Midland Association's Show at Campbeltown, Tasmania, in 1900, says Shropshires in Tasmania have secured a very strong foothold. Lambs for the export trade need to be "thick in flesh, light in offal, solid, square, well coupled behind, and early maturing," and these qualities may be looked for from the Shropshire cross with either the Merino or Lincoln ewe on almost any pasture or in any climate which can keep sheep profitably.

In New Zealand equally good results are obtained, *vide* the following remarks from an eminent firm of London Meat Salesmen, in February, 1896:—

"In answer to your enquiry the most popular sheep and lambs from North Canterbury (New Zealand) are Shropshire crosses, and pure Merinos have simply no chance against them from a butcher's point of view. The New Zealand Shropshire cross lambs are especially acceptable amongst high-class frozen meat butchers."

In an able Paper on crossbred sheep read at Buffalo, U.S.A., Professor Shaw, of the Ontario Agricultural College, after referring to the improvement of the Merino without lessening the value of the wool, and the breed or breeds best adapted for that purpose, says it is a fact that some breeds do not answer as well as others. He further says that the only sure evidence that we can have that one breed will be able to effect improvement in another is that furnished by actual demonstration. Tried by this test the Shropshire ram has been found eminently adapted for the purpose of improving the average foundation stocks

(Merinos and Merino Grades) in the United States. Continuing, he says the Shropshire ram blends admirably with the Grade Merino Stock, covering the bony framework with lean and juicy meat, widening the body and making it deeper and thicker throughout. It also blends well with the grade Leicester sheep by increasing their hardihood and improving the quality of the meat by intermingling fat and lean.

As recently as 1912 four of the largest firms in Australia (W. Angliss & Co., John Cooke & Co., T. Borthwick & Sons, Ltd., and Sims, Cooper & Co.) operating in the export trade, addressed a letter stating that, as the largest exporters in the trade in Victoria and also doing extensive business in South Australia and New South Wales, they felt it only right and their duty to sound a note of warning and at the same time give advice to breeders. They state that—

"In the early years of the export lamb trade in Australia it was largely built up and made successful by breeders using pure Shropshire rams, the crosses from which we have proved by experience are eminently fitted for the best English trade. Maturing quicker than most other crosses, the Shropshire lamb at the earliest possible age is good in the most valuable joints, back, loin and leg, and running to meat rather than fat, gives better results in dressed dead weight in proportion to live weight than any other cross we know of.

"For some years the majority of breeders followed the right track and bred the Shropshire cross, but the last two or three seasons, owing largely, we believe, to the rise in cross bred wool, the majority have swung the other way and tried to breed an export lamb got by sires of other breeds, with very varying results, trending, however, in the wrong direction. The consequence is that we now find it impossible to get as big a proportion of lambs fit for the best home trade as formerly, these other crosses compelling a larger number of rejects than is usual from the Shropshire, and those accepted not being equal for our purposes to that cross.

"And as regards seasons, our experience is that the Shropshire cross in a bad or indifferent season will come out even better in proportion than in a good one, when compared with other breeds, as regards percentage fit for export. So we must warn breeders that they are on the wrong track in dropping the Shropshire, and our advice to them, if they want to help us to expand this trade and make Australian lamb more popular and a better price in the old country, and therefore more payable to the breeder, is to go in again largely for the Shropshire. Not for a moment do we want to disparage other breeds. All have their good points for their own special purposes, but we say unhesitatingly that throughout Australia for the export lamb trade we have found the Shropshire cross the best. Breeders must remember that the export trade can never be fostered and developed as it should be by their trying to make the home trade a dumping ground for simply unsuitable surplus stock bred for wool as the first and main consideration, and that if they value this trade and desire to increase it to the immensity we believe possible, then they must cater for the trade and breed a lamb suitable for the best English customer."

FIG. 1.—Shropshire Ram.

FIG. 2.—Shropshire Ewe.

Wool.—The quality of Shropshire wool can be classed as 50 to 56, with a staple of nice length, dense, fine in texture, and always readily saleable. Mr. S. B. Hollings, the Bradford Wool Expert, reporting on wool from a Shropshire-Merino cross, the property of Mr. W. A. Hart, of South Africa, writes as follows :— " It was sound in staple, very shafty, nice combing length, very clear, and free from wasty matters, though in the grease, and a good colour. The quality, as can only be expected, was hardly of a 60's count, it being classed as a 56's wool, but for all that, in a blend of wool for ' tops ' of our average 60's, such as is largely consumed in Bradford (England) it would have been used most readily."

This good opinion of the wool was subsequently confirmed by wool experts on Bradford Exchange, and also by two noted wool brokers, Messrs. H. P. Hughes & Son and Messrs. Buxton, Ronald & Co.

Then again, at the Royal Show at Darlington in 1920 Mr. E. Craig Tanner's Shropshire Wool exhibit won the Champion Prize offered by the British Wool Federation for the best exhibit of wool in all the classes, a unique and highly prized distinction. Sixteen pure breeds of sheep were represented, in addition to four classes for crossbreds.

Showyard.—The establishment of the Shropshire Sheep Breeders' Association in 1882, combined with the great export demand, induced breeders to enter the Showyard, with the result that at the Royal Agricultural Show held at Shrewsbury in 1884 no fewer than 875 Shropshire sheep were exhibited, against 420 of all other breeds added together. At this Show 60 breeders exhibited, hailing from many counties, including Ireland.

In the United States and Canada Shropshires are far more largely represented than any other breed. At the Chicago (U.S.A.) Show of 1921, the Grand Champion Wether, beating all breeds in open competition, was a Shropshire, exhibited by Mr. Jesse Andrews.

Prices.—Shropshire Sheep have for many years (fully 40) commanded high prices, rams ranging up to 400 guineas, ram lambs to 180 guineas, ewes up to 70 guineas and ewe lambs to 40 guineas. These are of course for exceptional specimens, but at the same time good Shropshire Sheep have always found a ready market at very remunerative prices to the breeders. Prices naturally vary according to the reputation of the flock and the quality, but at the present time the best class of rams can be bought at from 80 guineas to 150 guineas, and useful sorts

from 20 guineas to 40 guineas. The best class of ewe will now cost from 12 guineas to 15 guineas, and a very useful class of ewe from 7 guineas to 8 guineas.

Type.—The best type of Shropshire should possess (particularly in the male) a well-developed head, with clean and striking expression of countenance, a muscular neck well set on good shoulders, the body symmetrical and deep, placed as squarely as possible on short strong legs, due regard being paid to grandeur of style, the face and legs should be a nice soft black (not sooty) the head should be nicely covered, and the wool generally should be fine, of great density and length of staple.

The skin should be nice cherry colour and the belly and scrotum (in the males) should be well woolled.

Objections.—Horns in ram; speckled face, ears or legs; long heavy ears; thin open wool.

In all breeds there are more or less two types, and it is to a certain extent the case with Shropshire Sheep. Some favour the short-legged, symmetrical, deep, lean-fleshed sheep, covered with a dense heavy fleece, while others prefer the longer-legged animal with more size, and possibly a little more bone. Personally I have always considered the Shropshire Sheep as a medium-sized sheep of good quality with a robust constitution, maturing early at small cost, admirably adapted as a general purpose sheep. What I wrote some years ago I again repeat, and it fully expresses my views on medium versus large sheep. Some farmers prefer a big, coarse sheep on long legs, but I am quite convinced of this, that the best rent-paying class is the moderate-sized sheep of good quality, because the butchers can sell them the more readily and at better prices, and a greater weight per acre can be raised than where the larger and coarser sheep is resorted to, for 100 ewes in the former instance require as much land for their support as 130-140 well-bred moderate-sized ewes.

Fecundity.—150 to 175 lambs per 100 ewes is the usual average. A census which the writer took some years ago from 11,666 ewes gave a return of 168 lambs per 100 ewes, and in addition to this Shropshire ewes are excellent mothers and great milk yielders.

Adaptability and Hardihood.—The breed flourishes in every county in England, the humid climate of Ireland, the Highlands of Scotland and the mountainous districts of Wales, at altitudes up to 1,000 feet above sea level, and it is equally at home in every country in the world.

Descended originally from a semi-mountain breed, it is notoriously strong in constitution, and capable of withstanding extreme variations of heat and cold and is one of the most hardy breeds in existence. During the prolonged droughts which periodically visit Australia the hardihood of the Shropshire Sheep has been strikingly exemplified. Mr. Ralli, of Balaclava, South Australia, on his return home, wrote as follows :—

"I arrived home all right, and found that 32 per cent. of my flock sheep had perished during the 1906 drought, although the run was 23 per cent. understocked, and that, instead of marking several thousand lambs, some 500 were all my share for the year's increase. I must tell you 68 per cent. of my Merino ewes died, and that those left only gave 8 per cent. of lambs, whilst the Lincoln cross-bred dry sheep lost 48 per cent. of their numbers. And now for a Shropshire comparison with these breeds. I lost one ewe of my stud flock, and this by a dog, and the sheep, Mr. Kempe tells me, had by no means the best of the country to live on, and were wholly unfed by artificial means ; but the best test of their hardihood comes from the grade flocks. These numbered one-fifth of the sheep ; their loss has been but 8 per cent., and their increase 55 per cent. Mr. Kempe also tells me these grades had more to withstand than the others, as they were thought to be hardier, and so were given worse country to run on. This evidence of the Shropshire's value to this country of uncertain rainfall is to me overwhelming."

Management.—A few words about management of Shropshire Sheep. These sheep in their native counties are not kept all the year round between hurdles like some breeds, but are run on the pastures a good deal. When required they are good folding sheep, and do very well on roots, kale, cabbage, etc.

Shropshires do not require a large amount of corn, in fact they do better on moderate allowances of artificial food and are really very economical feeders. The secret of management is to keep the lambs going from birth and arrange for a steady supply of suitable green foods.

A great point with lambs is to keep them on land which has not previously been heavily sheeped, and the more often the land is turned over by the plough the less the danger of parasitic disease. The usual custom is to mate the ewes to drop their lambs from the end of January to mid-March, and great care is taken in the mating both as regards conformation and pedigree. It is the usual practice to put them on fresh pastures at this period (rutting season). It is considered that it usually results in an early and prolific fall of lambs.

After the mating season is finished the ewes run on old pastures without any artificial assistance except in inclement weather, and as the season advances trough food is usually given, but great care must be taken to have a good supply of troughs,

and so avoid crushing. This artificial help usually consists of a mixture of oats, bran, and linseed cake, or boiled linseed mixed with a small amount of pulp and cut stuff. Feeding pregnant ewes entirely upon a dry ration is not recommended, but at the same time roots should be used vary sparingly.

It is considered of great importance to get the ewes and lambs from the lambing fold as early as possible, and for this purpose the young seeds supply all that is wanted, and in the case of twin lambs the ewes are put on a generous diet and when possible the lambs are allowed to run forward. The pasture is often supplemented with roots, kale and cabbage.

Weaning usually takes place at the end of May or early in June according to circumstances, but it is found in practice that the food supplied at weaning time should be of a highly nutritious character and such as can be easily assimilated. Fresh seeds, supplemented with artificial food, with vetches, kale, or cabbage, provide all that is required. This carries the lambs to early autumn, when they are folded on roots, kale, etc.

It is the usual custom to keep the breeding ewes during the summer on the poorest pastures that the farm affords, otherwise they are apt to lay on more flesh than is desirable in a breeding flock.

To provide the young sheep with a regular rotation of green crops and other suitable foods the breeder must exercise considerable forethought. This can easily be done by planting so much winter tares and rye in the autumn; following up with spring tares, early Enfield Market cabbage, planted in February or March, according to the weather; the drilling of the early Enfield cabbage, early sheep fold and ox cabbage at intervals during the spring and summer months; assisted with white turnips, rape, kale, kohl rabi, in suitable quantities. A large flock can be kept in this manner.

* * * * * *

THE LARGE BLACK PIG.

SANDERS SPENCER.

THIS is another of those breeds of pigs which have increased enormously in popularity since a society was formed to register the pedigrees of the pigs of the breed and to protect the interests of its breeders. Unlike the Cumberland and the Gloucester Old Spots the Large Black appears to have had a dual origin, as large pigs of a black colour were bred to a considerable extent in the Counties of Essex, Suffolk and a portion of Cambridge

and also in the South-West of England long before the first pig society was formed. The black pig of the Eastern Counties was a long pig square in the quarters, with light fore end, rather flat ribs, fine in the hair, skin and bone, and somewhat long in the face and on the leg. The sows were prolific, and very good milkers; the young pigs were hardy and quick growers. These pigs were eminently suited to the outdoor life they led as most of the sows and the store pigs had the run of the pastures near the homestead during the winter and in many instances were folded or ran loose over the temporary grasses, mainly clovers sown on the arable lands, alternately with peas or beans each four years. A considerable number of these black pigs were also fattened on "seeds," the additional food usually being the beans or peas grown on the farm. This feeding off the clovers and annual grasses with pigs was considered to be a splendid preparation for the following wheat crop.

The large black pig common in the south-western counties was of a somewhat different character, being shorter in the head, body and legs, heavier in the jowl and shoulder and not so square in the hind quarters nor so good in the hams. The variation in substance and the amount of fat carried might have been due in part to the climate and to the varying food requirements of the miner with his very severe toil and the less arduous employment of the Eastern Counties' residents. The Cornish large black shared with the Essex type those very valuable characteristics, prolificacy, free milking, hardihood and quick growth when young.

The south-western large black pig was not generally known beyond its borders until the bacon factory was built at Redruth. For some time nearly the whole of the fat pigs killed thereat were of the large black type common within the district. Although the factory was well equipped and managed on scientific principles the bacon failed to command the best prices on the markets beyond the district. The sides of bacon were declared to be too heavy in the fore-end, too short and with hams of a shape not suitable for the best markets. Some of the bacon was also said to be too fat and the bone too heavy. Boars of another colour were introduced but the local prejudice in favour of the black colour was great.

A few years earlier, consumers of pork and manufacturers of bacon had become dissatisfied with the short, thick and compact pig with an excessive proportion of fat which had become general in the Eastern Counties. One of the results of the

objections raised and of the discussion in the Press was the rehabilitation in public favour of the long-backed lean-fleshed large black which furnished long sides of lean bacon but was not so well suited for the fresh pork trade. A happy idea was acted upon by some Eastern Counties' pig breeders who proceeded into Cornwall for the purpose of inspecting the Cornish type of large black pig. It resulted in the purchase of a number of the thick compact and heavy-fleshed pigs which when crossed with the boars of the Eastern Counties large black produced a far more suitable pig for bacon curers than could possibly be bred from a pure South-Western or Eastern Counties bred pig. The interchange of breeding pigs between the two distant districts resulted in the evolution of a black which can fairly claim to be the equal of any breed of pig for the production of large litters of quick-growing and early-maturing pigs. There is much to be said in favour of the claim that no breed of sow when crossed with a suitable white boar is superior, if equal, to a Large Black sow in the production of pigs for the highest price bacon.

The Large Black pig has extended to all parts of England and Wales and has actually invaded Scotland, where until quite recent years the breeding of pigs was by no means general or popular. Many Large Black pigs are also found in Ireland where the sows are very successful in producing pigs for the bacon factories when crossed with the thick type of Large White or Large White Ulster boars . It is also claimed that no breed of imported pig can withstand the climate of South Africa so well as the Large Black. For some reason, not explained, pigs of nearly all other pure breeds degenerate quickly in South Africa, where the dairying and bacon industries are fast becoming very important, so that it is possible that the export trade in Large Black pigs to tropical or semi-tropical countries is likely to become of considerable extent. No further proof of the great popularity of the Large Black pig in the British Isles is required than the fact that the members of the Society number about 1,700.

The revised scale of points is as follows :—

Head.—Medium length and wide between the ears ...	5
Ears.—Long, thin, inclined well over the face, with nose of medium length	4
Jowl.—Medium size	3
Neck.—Fairly long and muscular	3
Chest.—Wide and deep	3

FIG. 1.—Large Black Sow.

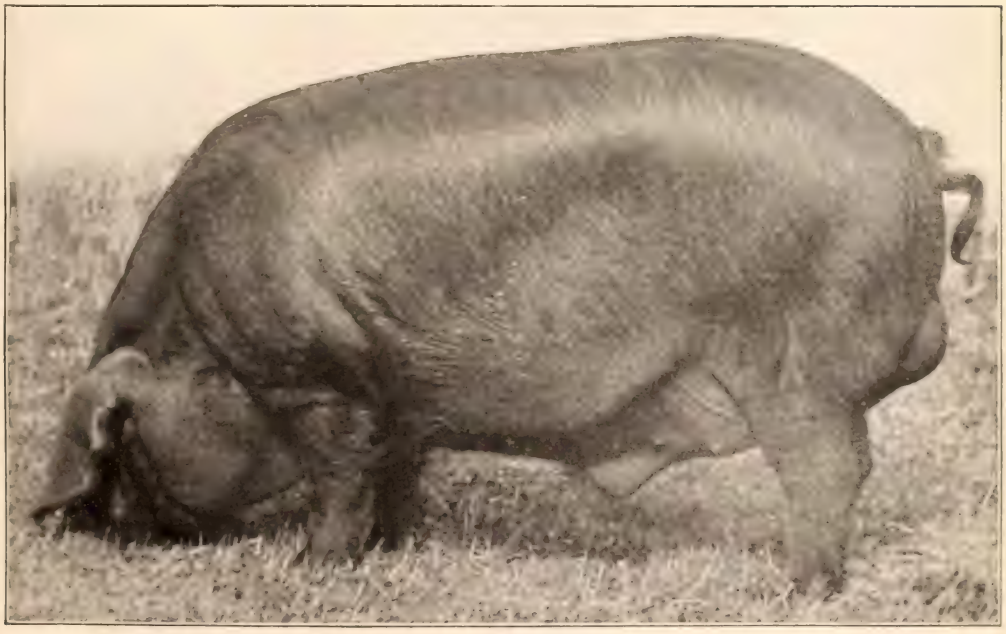

FIG. 2.—Large Black Boar.

Shoulders.—Well developed, in line with the ribs ...	8
Back.—Long and level	15
Ribs.—Well sprung	5
Loin.—Broad	5
Sides.—Very deep	8
Belly and Flank.—Thick and well developed	7
Quarters.—Long, wide and not drooping	8
Hams.—Large and well filled to hocks	10
Tail.—Set high, of moderate size	3
Legs.—Short, straight, flat and strong	5
Skin and Coat.—Fine and soft, with moderate quantity of straight silky hair	8
	100

Objections.

Head.—Narrow forehead or " dished " nose.
Ears.—Thick, coarse or pricked.
Coat.—Coarse or curly, with rose; bristly mane.
Skin.—Wrinkled.

Disqualification.

Colour.—Any other than black.

* * * * * *

DEPTH OF SOWING GRASS AND CLOVER SEEDS.

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The cultural operations connected with the covering of grasses and clover seeds vary considerably, not only in different parts of the country but very often on different farms in the same district. The underlying principles of many of these operations are diametrically opposite: for instance, some authorities hold the view that the best results are obtained by merely sowing the seeds on the surface during a wet spell, while others advocate drilling the larger seeds, such as rye grasses, tall fescue and cocksfoot along with the seeds of the nurse crop, thus covering the seeds to relatively great depths.*

The covering operations commonly practised bury the seeds to varying depths intermediate between these two extremes. It

* "A better way to lay down land to pasture." By Professor T. Wibberley. Hunter's Annual Price List, 1920.

is the practice of some to cover the seeds lightly by merely rolling them in; others aim at covering the seeds more deeply by using various kinds of harrows—chain, bush, and peg harrows, or a special seed harrow. Moreover, the depth at which the seeds are buried not only depends on the kind of harrow used but also on the number of times the operations are repeated. A coulter drill or the Cambridge roller fitted with a special seed box is not infrequently employed.

As a general rule the nature of the soil and the depth requirements of the different seeds are not taken into consideration when deciding on the method to employ; this is generally based on the custom of the district.

In view of the general tendency to increase the acreage under grass and the losses which frequently occur as a direct result of poor take, which are the more serious in the case of leys intended to be left down for a number of years, greater attention should be paid to field problems connected with laying down land to grasses and clovers.

The best depths for sowing seeds of different cereals have been investigated by Perkins and Spafford in Australia,* while the best depths for sowing red clover seeds have been investigated at Wisconsin and Michigan Experiment Stations, U.S.A.† As far as the writer is aware, but few experiments dealing with grasses and clovers have been previously carried out in this country.‡

Aims and Description of the Experiment.—The investigations here discussed were carried out during 1919 and 1920 with the following species:—

Clovers.—Red Clover.
White Clover.
Grasses.—Perennial Rye Grass.
Cocksfoot.
Meadow Foxtail.
Rough Stalked Meadow Grass.

Pot Cultures.—A preliminary experiment was conducted at the laboratories with numerous pot cultures.

All pots used were of uniform size. The soil had been air dried. The seeds were sown on the surface and at depths of

* Experiments Relating to the Depths of Sowing of some Agricultural Seeds. By Perkins and Spafford. Journal of Dept. of Agriculture, South Australia, Vol. XV, Nos. 3-6, 1910.

† Forage Plants and their Culture. By Charles V. Piper, 1914.

‡ Findlay has conducted experiments with Red Clover, but does not give detailed results: see Red Clover, Bull. No. 24, The North of Scotland College of Agriculture, by Wm. M. Findlay, N.D.A.

$\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, and $1\frac{1}{4}$ in.; these eight depths constituted a series.

The method of procedure adopted in preparing the pots for germination was as follows: Each pot was first filled to the required depth—marked on the pot—with a definite amount of soil in accordance with the volume of the pot below the depth mark. After the soil had been carefully levelled to the depth mark 100 seeds were sown at 1 cm. apart. The seeds were covered to the appropriate depth by filling the pot with a calculated weight of soil, which was then compressed and levelled to the "surface mark." By this method all the pots received equal weights of soil, which occupied equal volumes and which was compressed to the same degree of compactness, while the seeds were buried to the exact depths required. The pots received the same initial amount of water, and were afterwards watered every two or three days as required. Each series was allowed to germinate at room temperature and was treated alike in all respects. The number of surface seedlings was counted every seven days. For the purpose of these experiments the term "surface seedlings" is applied, in the case of surface sowings, to seedlings with radicles properly fixed in the soil, and in the case of covered sowings only to seedlings which had reached the surface.

Box Cultures.—During May, June and July, 1920, a similar experiment was carried out in boxes in the open, but protected from birds by means of a wire cage. Seeds were sown on the surface and at eight depths from $\frac{1}{8}$ in. to 3 in., 500 seeds being sown in each box in rows 1 in. apart and $\frac{1}{3}$ in. between the seeds in the rows. The ordinary soil, which had been freed of stones, was used for this purpose. The method of procedure adopted in preparing the boxes for germination was similar to the method described under pot cultures; the surface seedlings were counted every 14 days.

Bed Cultures.—This experiment was carried out on duplicated beds 42 in. by 18 in. on one of the Station's experimental grounds. 500 seeds were sown in each bed in rows 2 in. apart and $\frac{3}{4}$ in. between the seeds in the rows. The different depths were gauged by means of a graduated wooden frame of the same dimensions as the beds. The frame was pressed into the soil until the required depth was reached. The soil was then removed and the floor of the frame carefully levelled. The seeds were covered by replacing the removed soil, which was pressed down to the original surface mark.

Table showing (a) *the percentage number of Surface Seedlings, and* (b) *the weight of Green Fodder given by various species of Grasses and Clovers when the seeds were sown at different depths.*

	Red Clover Germination = 94 %			White Clover Germination = 98 %		Perennial Rye Grass Germination = 89 %			Cocksfoot Germination = 80 %		Meadow Foxtail Germination = 66 %		Rough Stalked Meadow Grass Germination = 70 %	
	Surface seedlings percentage		oz. Green Fodder	Surface seedlings percentage		Surface seedlings percentage		oz. Green Fodder	Surface seedlings percentage	oz. Green Fodder	Surface seedlings percentage		Surface seedlings percentage	
Experiments ...	Pots	Boxes and Beds	Beds	Pots	Boxes	Pots	Boxes and Beds	Beds	Boxes and Beds	Beds	Pots	Boxes	Pots	Boxes
No. of seeds sown at each depth ...	800	1500	1000	400	500	800	1500	1000	1500	1000	600	500	600	500
Days after sowing ...	40	28	—	28	28	35	28	—	28	—	42	31	49	49
Surface (uncovered)..	36	43	6	67	75	80	51	18	57	4½	25	46	57	32
⅛ inch	93	90	20	98	81	86	73	49	69	11	15	62	27	35
¼ inch	91	90	16	97	90	83	72	57	64	15	21	49	16	27
⅜ inch	85	89	13	97	92	85	72	47	63	12½	23	48	14	24
½ inch	66	87	9	96	91	84	72	49	65	10	23	42	11	21
⅝ inch	54	—	—	95	—	86	—	—	—	—	22	—	10	—
¾ inch	43	89	8	96	86	86	71	54	59	8½	19	43	9	9
1 inch	68	85	6	94	66	83	66	50	50	5½	23	42	4	6
1¼ inch	59	—	—	84	—	82	—	—	—	—	18	—	2	—
2 inches	—	53	very small	—	2·4	—	48	21	16	1	—	5	—	0
3 inches	—	6	0	—	0·4	—	10	4·	0	0	—	0	—	0

Owing to the abnormally wet weather experienced during the summer of 1920, the sowing of this experiment was postponed until the latter half of August: unfortunately the season proved to be too late for sowing white clover, meadow foxtail and rough stalked meadow grass, and as the germination was too poor the seedlings of these species were not counted.

The numbers of surface seedlings of the other three species were counted four weeks after sowing, while the produce from the duplicate beds was cut and weighed about eight months after sowing (8th April, 1921). At the same date the number of tillers per plant was counted on 50 typical plants from each bed.

The number of seeds employed in these three experiments was:—

Pot Cultures	26,800	seeds.
Box „	27,000	„
Bed „	54,000	„
Total ...	107,800	„

Soil.—The soil used in the pot and box experiments was taken from the plot on which the beds were sown. It was a light loam, which is the typical soil of the district.

Seeds.—The seeds used in the three experiments were carefully selected from the same bulks. All light and imperfect seeds were discarded, while the clover seeds were rubbed between sandpaper so as to reduce the number of hard seeds present; the rubbing had the effect of increasing the percentage germination of red clover from 81 to 94. The selected seeds were tested for germination before commencing the investigations.

Red Clover.—A glance at the Table will show that the number of surface seedlings at depths of $\frac{3}{8}$ in. and over was very considerably lower in the pot cultures than at corresponding depths in the box and bed cultures. The poor results given by the pot cultures can be explained by the fact that the seeds were sown much too thickly in the pots—about 10 times as thickly as normal field seeding. As a result, the layers of soil overlying the seeds were completely raised by the pressure exerted by the very broad cotyledons of the seedlings, so that practically the only seedlings that reached the surface were those which were fortunate enough to work their way up through the cracks in the soil.

A comparison of the results given by the different depths in the box and bed experiments proves very conclusively that red clover seeds should never be left uncovered. Covering the seeds

to the very shallow depth of $\frac{1}{8}$ in. had the effect of increasing the number of surface seedlings by more than 100 per cent. It is also equally clear that only failures in "take" may be expected when the seeds are covered to depths of 2 or 3 in. since at 2 in. only 53 per cent. reached the surface while the 3 in. depth gave only 6 per cent. of surface seedlings.

These experiments show that the best results are obtained when the seeds are buried to a depth of not greater than 1 in. To ensure that the seeds are properly covered a method of covering by which the seeds are buried to average depths of $\frac{1}{2}$ in. to $\frac{3}{4}$ in. should be adopted. Moreover, the young seedlings will not run so much risk of being killed off as a result of a sudden spell of dry weather at these depths as they would if covered too lightly. Although $\frac{1}{8}$ in. to $\frac{1}{4}$ in. beds gave heavier yields than the $\frac{1}{2}$ in. and $\frac{3}{4}$ in. beds in a very wet season, it is highly probable that these yields would be reversed in a normally dry year.

It appears from the following figures, which give the average number of stems per plant at about eight months after sowing, that surface and deep sowings (*e.g.*, 1 in. and 2 in.) have a detrimental effect on stem formation during the early stages in the life of the plants :—

Depths	Surface	$\frac{1}{8}$ in.	$\frac{1}{4}$ in.	$\frac{1}{2}$ in.	1 in.	2 in.
Number of stems per plant	2·2	3·0	2·8	3·2	2·6	2·4

The Causes of Failure of Surface Sowings.—When the red clover seeds are left uncovered the thick radicles of the seedlings are unable to enter the soil immediately germination takes place. This is partly due to the very blunt nature of the root tips and partly to the fact that the root hairs are too short and matted to act as such efficient organs of anchorage as in the case of certain of the grasses. As the radicles and hypocotyls increase in length the seeds are pushed back often to a distance of $1\frac{1}{2}$ in. before any of the seedlings become fixed, but if the seeds are held in position by a light covering of soil the radicles are able to force their way into the soil at once. That this is the case was proved by the following experiment. Seeds were sown on the surface in four pots. The seeds in two of the pots were lightly pegged down by means of notched matchsticks, the other two pots were kept as controls. The results 10 days after sowing are given below :—

	Percentage Germination.	*Percentage seedlings with radicles fixed in the soil.*
Pegged ...	95	84
Unpegged ...	92	4

A rough surface very materially assists the seedlings to become attached to the soil. Two series of tests were put up: in one case the seeds were sown on the surface on soil previously pressed and in the other on a non-pressed surface; in the former case 35 per cent. and in the latter 63 per cent. of the seedlings became fixed to the soil. It would thus appear obvious that the soil should not be rolled prior to sowing when it is not intended to cover the seeds.

Germination is slower from surface than from covered seeds; and especially so if the soil is inclined to be fairly dry. The following figures giving the percentage of germination fourteen days after sowing show the extent of the difference:—

	Surface.	*At ½th in.*
Pot Cultures	52	88
Box	36	90

Effect of Light on Germination.—That light has not the same detrimental (or even any retarding) effect on the germination of red clover seeds as it has on the germination of certain grass seeds* was shown by the following experiment. In order to equalise evaporation a number of surface sown pots were covered with large petrie dishes, half of which had been made impermeable to light by covering them with thick, brown paper. Both series were allowed to germinate under normal room conditions. The average results after 10 days' germination were:—

	Germination.
Exposed to light	95 per cent.
Kept in the dark	90 per cent.

The Behaviour of Red Clover Seeds when Covered at different Depths.—The seeds were sown at 12 depths varying from ⅛ in. to 6 in. round the sides of large glass tubes in order to keep the seeds and seedlings under observation. The tubes were covered with brown paper and kept in a dark room at ordinary temperature (maximum about 12° C.).

It was found that the seeds germinated equally well and at about the same rate at all depths down to 4 in.—the percentage germination at these depths only varied from 75 per cent. to 85 per cent., but at 5 in. only 10 per cent. of the seeds germinated, while at 6 in. not a single seed germinated although water was imbibed by the seeds. The failure of the seeds to germinate at depths of 5 and 6 in. was no doubt due to lack of

* Contributions regarding the germination of unhulled and naked Timothy seeds. By M. Heinrich, Landw. Versuchst. 93; Botanical Abstracts, Vol. VII, No. 3, 1921.

sufficient air at these depths, since the other factors controlling germination were constant for all the tubes.

The percentage number of seedlings that had reached the surface in 22 days after sowing is given below:—

Depth.	*Percentage Surface Seedlings* *
$\frac{1}{8}$ in.	65
$\frac{1}{4}$ and $\frac{3}{8}$ in.	75
$\frac{1}{2}$ in.	55
1—6 in.	0

This experiment shows that red clover seedlings are unable to reach the surface when sown too deeply, and this mainly on account of the large surface which the broad cotyledons offer to the resistance of the soil. When buried at depths of 1 to 4 in. the pressure was so great that the hypocotyls of many seedlings were forced to assume a horizontal position, some being bent right back and forced to grow in the same direction as the radicles. Even at the fairly shallow depths of $\frac{3}{4}$ to 1 in. the seedlings experienced considerable difficulty in working their way through, as was shown by the very tortuous course followed by the much thickened hypocotyls.

Conclusions.—(1) The best depth at which to sow red clover seeds in light loamy soils appears to be $\frac{1}{2}$ to $\frac{3}{4}$ in.†

(2) Only a very small percentage of the seedlings may be expected to establish themselves if the seeds are left uncovered.

(3) Many of the seedlings are unable to reach the surface if the seeds are buried to depths of over an inch.

(*To be concluded.*)

* * * * * *

* The soil in the tubes was pressed very hard, hence the reason for the percentage of surface seedlings being lower than in the pot experiments.

† cf. Findlay (loc. cit.) who states that he obtained the best results when the seeds were covered by about $\frac{1}{2}$ in. of soil; he also states that it is necessary to sow the seeds deeper on a dry than on a wet soil.

THE WORTHING FRUIT GROWING INDUSTRY.

A. G. Leeney.

In that part of Sussex which is bounded by the river Adur on the east and the Arun on the west there lies, between the South Downs and the sea, a tract of land some fifteen miles by four miles, whereon has been developed the Worthing fruit growing industry.

The natural advantages are many: the soil for the most part is rich and deep, the hills to the north are of sufficient height to keep off the cold north and north-east winds, while the L.B. and S.C.R. line from London to Brighton and Portsmouth, with stations every two or three miles, runs through the centre of it, providing an efficient service to London and the northern markets. There is an unfailing water supply, ample sunshine and an average rainfall.

Worthing's fruit fame goes back some 600 years, when the great Archbishop, Thomas-à-Becket, had a country residence at West Tarring, now a part of the borough of Worthing, in the garden of which he grew the luscious figs which for many centuries constituted Worthing's chief claim to fame in the fruit world. Figs are still grown, although Worthing has now to give the palm for quality to Guernsey. In the Worthing district there are now some 250 fruit growers, who between them employ somewhere between 1,500 and 2,000 men, and if the individual successes have not been so striking as in some other districts, at least it can be claimed that the industry has afforded to those engaged in it a comfortable living in one of the most favoured climates in the world.

It is difficult to realise in these days, when the consumption of tomatoes in this country exceeds 100,000 tons per annum, that it is less than fifty years since the first glass-house for growing tomatoes for market, was put up in Worthing, while the tomato itself was regarded by the retailer as somewhat of a curiosity and was labelled by him "Love Apple": indeed the fruit trade itself is of comparative modern development, as men who are still engaged in the business well remember.

Although mere names will not mean much to the majority of readers, it will interest many growers still living to mention that O'Bryrne, George Purser, and George Beer were among the pioneers of the glasshouse industry, and that parts of their

original houses are still in existence, although probably rather like the boy's pocket knife, which had had four new blades and two new handles. It was quickly realised that tomatoes, cucumbers and grapes could be grown to perfection under glass, and the pioneers were followed by the men who had gained a little experience as foremen and " hands " of the earlier growers.

The growth of the industry was rapid for twenty-five years. The houses most in favour for cucumbers were 16 ft. wide with 10 ft. rafters, and for tomatoes and grapes 20 ft. wide with 14 ft. rafters. While probably these sizes are most suitable for cucumber and grape growing, the Guernsey and Lea Valley growers consider the Worthing tomato houses to be much too small.

The popular south coast resorts have developed greatly during the past twenty years, and one would think that the fruit-growing industry would have expanded to a commensurate degree. The demand for tomatoes, cucumbers and grapes has enormously increased all over the country during the same period, but the demand has been supplied by the Lea Valley, the Channel Islands, and by Holland and Belgium, while the development of the Worthing district has been slow. At one time an easy first, Worthing now has to take third place to Guernsey and the Lea Valley.

It is worth while to compare the conditions ruling in the three districts in order to ascertain, if possible, the reason for Worthing's failure to advance as rapidly as other districts. The chief factors are cost of land, quality of land, climate and transport.

In the matter of cost, land in the Channel Islands costs more than in the Worthing district, which in its turn is much more expensive than the Lea Valley; for quality, land at Worthing is at least the equal of either of the other districts, and is almost certainly superior to the Lea Valley. So far as climate is concerned, Guernsey has an advantage over Worthing for earliness, while in this respect the Lea Valley is a very bad third. Earliness, however, is not the only factor: the Channel Islands are exposed to the full force of the Atlantic south-westerly gales, and growers are compelled to erect much heavier, stronger, and therefore more expensive, structures than their competitors on the mainland. Worthing is also exposed to the wind, and, while growers can build much cheaper than Guernseymen, they are compelled to build considerably heavier than the Lea Valley men.

Transport.—It is when transport is considered that one realises the advantages the Lea Valley growers have over those

of Worthing and the Channel Islands. The North London men gather their crop in the morning, load it on motor lorries at the packing sheds, whence it is taken by road to Covent Garden in less than two hours. Worthing is sixty miles from Covent Garden, and, although three attempts have been made to establish a motor-lorry service, they have all failed to compete successfully with the railway. The Worthing men do, however, pack in the morning and load the fruit train which leaves Worthing station at 12.30 mid-day, the produce arriving at Covent Garden between 4 and 5 in the afternoon. In the matter of transport the Guernseymen are at an even greater disadvantage; the G.W.R. and the L. and S.W.R. give an excellent service of both passenger and cargo boats, but, even so, the produce does not reach Covent Garden until the morning of the second day after despatch.

The difficulty of transport is a real one, but it is not sufficient to explain Worthing's recent slow progress.

The Worthing Glass-Houses.—The lay-out of the Worthing nurseries is faulty and uneconomical. For the most part the houses are small, and they are scattered and heated by a multiplicity of small boilers set in an equally large number of stokeholds, awkwardly placed and difficult of access. The Worthing pioneer, and, unfortunately, his successor of to-day, thought in terms of houses; the Lea Valley man, on the other hand, has had the experience of earlier growers to build upon, and has always thought in terms of acres. While the Worthing grower has thought of putting up houses in which to force stuff, the Lea Valley man has conceived the idea of covering in acres of ground with glass, in order to grow produce under artificial conditions. His lighter and therefore cheaper structures, involving less capital outlay, and the large saving effected in transport, have enabled him to produce at a lower cost than either of his principal competitors.

Crops.—In the matter of packing great strides have been made. It seems almost incredible in these days, when "trunks" are chiefly used for packing chrysanthemums, that at one time the favourite package for cut bloom was the 1s. cross-handle basket. There are men still engaged in packing at Worthing who used to pack chrysanthemums in the cross-handles. The cultivation of the chrysanthemum is carried on extensively in the district, the mid-season and late varieties being "lifted" to follow cucumbers, tomatoes, and grapes, which with the chrysanthemums form the leading crops grown locally. Mush-

rooms and carnations are also specialised in by a few firms with much more than a local reputation. Early beans and forced strawberries are also important crops, although Worthing no longer maintains its reputation for the latter.

Worthing tomatoes have a great reputation, but Covent Garden regards Worthing grapes as of more importance, and the early Hambros, which have long been a speciality of the district, are eagerly sought after by the commission salesmen for distribution all over the country. In this domain Worthing has advantages which even now are not fully realised; climatic conditions rule the Lea Valley right out, while both the Guernsey and Belgian growers have transport difficulties to contend with, which in the case of grapes are greater than with tomatoes. While it is true that lightness of crop in the very early houses makes their production a doubtful economic success, it is nevertheless a fact that both Hambros and Muscats grown for marketing before the outdoor strawberry crop, come less into competition with supplies from other centres, and therefore realise more satisfactory returns than produce marketed later in the year. It is by taking advantage of their favourable climate that the Worthing men can continue to achieve success. Early tomatoes, beans, Hambros, Muscats and cucumbers will enable them to compete with other sources of supply, and, fortunately, nothing can take away from them their climatic advantage.

Cucumbers for Export.—Before the war Worthing did a considerable export business with Germany in winter cucumbers, and, practically had a monopoly of the business, as the cost of carriage beat the Guernseymen, who had to give up growing cucumbers, while the Lea Valley is too cold to compete with Worthing during the winter.

Recent Developments.—In 1921 there has been a development of building in the district, and, as the construction of the new places is on the lines of the most successful Lea Valley establishments, it will be interesting to watch the progress made in these up-to-date nurseries.

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SUGAR BEET GROWING IN HOLLAND AND BELGIUM.

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THE writer has spent several weeks in the Low Countries making a close study of the methods adopted there in the cultivation of sugar beet, and an attempt has been made in the following article to deal with some of the points that may be of service to British growers.

Soil.—Though the sugar beet will grow well in most soils, it does best on the medium and more friable soils. In Belgium and Holland it is grown on soils which have the texture of fine and coarse silts. In the province of Zeeland, *e.g.*, the soil is alluvial and contains a high percentage of calcium carbonate, while in North Brabant the soil is of a distinctly sandy character. Land which produces good crops of mangolds does not necessarily produce good crops of beet, so that farmers should choose the site for cultivation with care, and preference should be given to the lighter portions of the farm.

Careful consideration should be given to the drainage of the land, for land which "lies wet" is in every sense unsatisfactory. In Holland great stress is laid upon the advantages of "thorough" drainage, but many farmers adopt a system of open surface drains. These are 18 inches deep, and are placed from 9 to 25 feet apart according to the texture of the soil, with outlets into a main drain 2 feet 6 inches in depth. Examination of lands so drained during the wet months of the year showed that all surplus water was effectively removed.

Rainfall.—This is an important factor in the cultivation of the beet crop. In Holland it is stated that the best results are obtained when there is plenty of rain during the late spring and early summer to enable the seeds to germinate, and the young plants to make quick growth, followed, when the roots are well formed, by dry conditions for the maturing of the plants and the formation of a high sugar content. This fact has been established also in the laboratories of the sugar factories. Not only is the sugar content higher in a dry summer, but when once the plants have come well away in the spring a dry period does not have an adverse effect on the weight of the crop. In the dry season of 1921, where the beet was planted early, as in Zeeland, the weight of the crop was 20 per cent. above the average, but late planting in parts of Belgium resulted in many cases in great

loss. This emphasises the importance of rainfall during germination and until the plants have formed a well-developed root system.

Place in Rotation.—The beet crop is normally taken after a straw crop, and would in England occupy the place now taken by roots in the rotation. For long there has been dissatisfaction among farmers with the root crop on account of the high cost of production and the relatively low return. Whether sugar beet will assist the farmer in this matter is still a subject for experiment, but it can conceivably take the place of part of the roots now grown, with some financial benefit. The cleaning of the land is as easy under a crop of beet as under swedes or mangolds, and is of just as much importance, so that its introduction would cause no disturbance of present practice.

Tillage.—The land requires very thorough tillage for this crop, and farmers are particularly careful that the operations are carried out so that drilling may be commenced as early in April as the weather will pemit. The sequence of operations adopted in Holland and Belgium is :—

Autumn. 2 ploughings and thorough cleaning.
Spring. Manuring.
Cultivation.
Rolling.
2 harrowings.
Manuring.
Drilling.
Light harrowing.
Rolling.

The two ploughings are carried out with an interval of at least a month between, and the land lies in furrow during the winter. The sub-soiling plough is used once during the rotation, usually when the clover land is being ploughed up.

Manuring.—It is freely recognised that different types of land have different manurial needs, so that hard and fast rules for manuring the beet crop cannot be laid down, but the matter is so important that it should be the subject of careful thought. It must be remembered that the beet responds well to heavy manuring.

The application of farmyard manure to beet land is not favoured in Holland, but a dressing of 10 tons to the acre is frequently given in Belgium. Dutch farmers prefer to give 20 tons of farmyard manure per acre to the land at such a place in the rotation that one or preferably two crops have been removed before the beet crop is planted. They affirm that the highest sugar percentages follow such a practice, and that maturing of the crop is more regular.

Mineral manures are very freely used, and successful growers of beet in the Low Countries give the following applications as suitable for the production of good returns in their respective districts :—

	Superphosphate or Basic slag. cwt. per acre.	*Kainit or Sylvinit.* cwt. per acre.	*Ammonium sulphate or Nitrate of Soda.* cwt. per acre.
Holland : Zeeland ...	5	—	2—4
Belgium : Velm ...	8	8	4

The applications used in Zeeland have been established as the result of controlled experimental work. In these experiments, kainit, at the rate of 3 cwt. per acre, was added to the manures given above, but since this application did not in any way improve the crop, and since the alluvial soil contains sufficient available potash, the practice of using kainit was discontinued in that part of the country. In North Brabant, however, and in Belgium, applications of potash manures are necessary.

The amounts of mineral manures applied in the Belgian district quoted above illustrate the variation of manurial needs according to the type of soil. The applications are higher than those given by farmers in other parts of the country, but it must be admitted that during this dry year such heavy manuring proved advantageous, for the crops there were both early and heavy. A much more general Belgian manuring is :—

10 tons of farmyard manure, applied early in autumn.
5 cwt. superphosphate or basic slag.
3 cwt. kainit or sylvinit.
3 cwt. ammonium sulphate or nitrate of soda.

When the dressings given above are compared with those adopted in England, the outstanding differences are in the amounts of superphosphate and nitrogenous manures. The large dressing of nitrate of soda or of sulphate of ammonia has proved its usefulness. The nitrogen forces the plant into early growth and prevents any check throughout the growing season, but this continued growth does not, as one might expect, delay the time of harvesting. From the results observed in the Low Countries, it appears that an increase in the amount of quick acting nitrogenous manures might be of advantage in England.

The farmyard manure should be applied and spread before the second ploughing in the autumn. The superphosphate or slag, and the kainit, are sown at the end of December or during the early part of January whenever the weather is favourable. The nitrogenous manure is sown in doses, the first just before

drilling and the second immediately after singling. The application of the manures in this way should give the best results, for it allows time for the necessary chemical actions in the soil, and by the time the seeds have germinated the plant food has become available. Continental farmers consider that the early sowing of mineral manures is not associated with loss.

Seeds and Sowing.—Many varieties of sugar beet are available to the grower, but, as a rule, seed that is foreign to the district is planted. Before 1911 most of the seed that was used in both Holland and Belgium was obtained from French growers, but important factors sent the trade into German hands. The German merchants sold their seed with guarantees of minimum germinating capacity, true variety, and minimum sugar percentage, and these guarantees served to capture the trade.

Formerly each farmer cultivated that variety which he fancied most, but recently a different system has been instituted. The farmer purchases his seed from the factory that buys his roots, and this ensures that each factory is dealing with only those varieties which it can most satisfactorily handle, as well as assuring it of a definite supply of roots of uniform character and variety. At the moment great care is needed in the importation of Continental seed, for there is a general complaint among the farmers of the Low Countries of seed adulteration.

Before sowing, the Dutch farmers of Zeeland treat the seed with a 2 per cent. solution of copper sulphate. It is thoroughly wetted on a stone floor, piled in heaps, and covered with a cloth soaked in the solution. It is allowed to remain for 12 or 15 hours, and then spread and air dried. This treatment, it is considered, reduces the loss of seed through attacks by the wireworm.

The drilling of the seed begins as early in April as weather permits, and is usually completed about the middle of May. About 18 or 20 lb. of seed per acre is sown in rows from 14 to 16 inches apart. It is never sown more than $\frac{3}{4}$ inch in depth, and if the ground be damp $\frac{1}{2}$ inch deep is quite sufficient.

Intertillage.—The intertillage of the beet crop differs in nowise from that given to the root crop in Britain. Too much stress cannot be laid upon the necessity of keeping the crop clean, for on this its success is largely dependent. When four leaves appear the singling is commenced, and the plants are left 14 inches apart in the rows. Immediately singling is completed the second dose of nitrogenous manure is applied, and this serves to prevent that check to the growth of the plant which often follows rough usage.

Harvesting.—This begins at the end of September and continues till mid-November. Slight frosts will not harm the roots, and it is better to delay the lifting till the ground is really needed for preparation for the next crop. The late lifting allows the action that follows the application of large dressings of potash

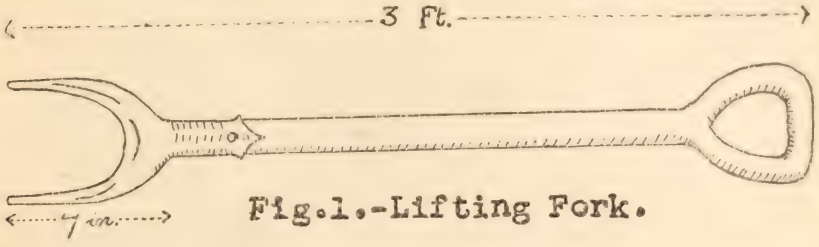

Fig. 1.-Lifting Fork.

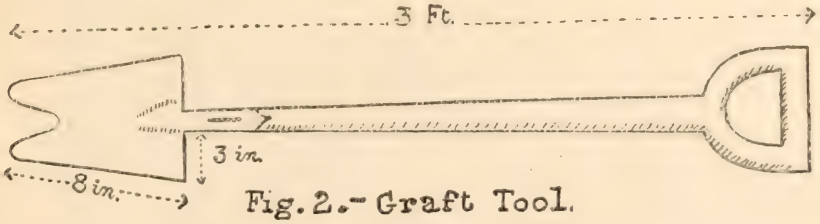

Fig. 2.- Graft Tool.

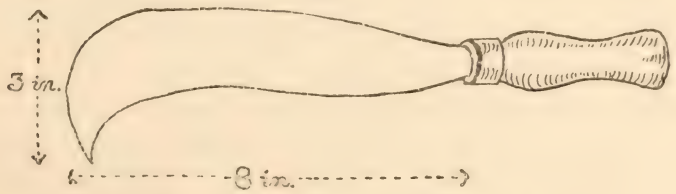

Fig. 3.-Topping Knife.

manures to become completed, and larger quantities of sugar are formed and stored in the roots. The crop can be ploughed out with a special light plough, or a satisfactory substitute for this can be made by removing the mould boards from a common single furrow plough and so adjusting the wheels that the chisel-pointed share cuts to a depth of 9 or 10 inches. This method is not recommended except where the farmer can personally supervise the work, for it increases the possibility of damage to the roots.

The practice usually adopted in Holland and Belgium is lifting by hand. When the soil is dry and friable, the labourer uses a short, stout two-pronged fork as shown in Fig. 1. This fork is about 7 inches long, with the prongs not more than 4 inches

apart. Should the conditions be wet, the fork is replaced by a light graft-like tool illustrated in Fig. 2. Either of these tools will enable the workman to dig or lever the beet from the soil with ease. As the beets are lifted they are placed in rows, with leaves all pointing in one direction. This is important, since it saves labour in topping.

Topping.—Each labourer carries in his belt a topping knife similar to a butcher's chopper weighing about 1 lb. (Fig. 3.).

Having lifted a row of beet, he returns, and, picking up each beet by means of the curved point of his knife, he tops it by a quick straight cut, the cut being made at the level of the lowest leaf scar. The roots are then thrown into heaps.

The topping of the beet in the correct position is a matter that requires strict supervision. If it is topped too near the leaves, the farmer loses part of the crown, which contains valuable cattle food, yet for the extra weight in the roots he receives no credit from the factory manager, for the crown is of little value for sugar extraction. When returning for his lifting tool, the labourer covers the heaps of roots with leaves to prevent drying, or damage by severe frosts before carting is possible.

The lifting, topping, and loading into carts, is usually done by piecework, and gangs of men go from farm to farm for this alone. In loading the beets into the carts, they use a concave five-pronged fork, the points of each prong being enlarged and rounded to prevent the penetration of the roots.

Mechanical Harvesting.—Mechanical lifting is carried out only where the beets are grown on a large scale. Various machines have been devised to do the work quickly and simply. At a demonstration at Gembloux, in Belgium, in September, two machines carried out the work of topping and lifting expeditiously and efficiently. A Belgian machine did the work in two operations. Several rows were first topped by a separate machine drawn by horses, the tops and crowns being mechanically raked into heaps for carting. This machine was followed by a digger drawn by a light tractor. A machine sold by M. Guichard, of Lieusaint, France, is a combined topper and lifter light enough to be drawn by three horses, which will top and lift 2½ acres of beet in a day of 8 hours.

The topper consists of a drum capable of vertical movement, and directly in the rear of this a knife which beheads the beet. When the drum comes into contact with the beet tops, these are drawn in and the knife is forced against the crown of the plant. The severed tops are deposited in rows on one side of the

machine. With this machine the tops are macerated, and will serve best as green manure. Behind the topper is the share which lifts the beets from the soil without damaging them in any way. A set of forks, similar to those in the Martin potato digger, turns at some speed behind the share, and catching the roots, throws them into a large drum, where the adhering earth is removed. The beets are carried by cross bars to the top of the drum and dropped into a hopper which will hold about 440 lb. This hopper can be emptied by the machine mechanic quickly and easily, and it leaves, every 40 or 80 yards, a heap of beets that can be readily removed by the following carts. Harvesting of beets with machines of this type is similar to, but much less expensive than, harvesting potatoes on a large scale.

Use of Tops.—The farmer must decide for himself what will be done with the leaves and crowns, but there are several possibilities. They make excellent green manure and can be profitably ploughed in. They can be fed green to cattle, folded with sheep, or used for silage. They are always marketable, though to sell them is inadvisable, for they seldom fetch a price at all equivalent to their value; for instance the price last season has been as low as £1 10s. 0d. per hectare, *i.e.*, about 12s. 6d. per acre. Leaves recently analysed in Holland were found to contain:—Nitrogen 0.56 per cent., Phosphates 0.24 per cent., Potash 0.8 per cent. This will show that they contain a large percentage of the elements necessary for plant food, and if the Unit Values are taken at, nitrogen 17s., potash 4s. 10d., and phosphoric acid 3s., the value of a ton of tops and crowns as green manure would be approximately 14s.

As a cattle food, Kellner, in the "Scientific Feeding of Animals," gives the following figures:—

	Tops and Crowns of Beet.		
	Wet.	*Silved.*	*Dry.*
Starch equivalent ...	7·2	9·5	27·0

A Dutch Commission of experts placed their feeding value somewhat higher than this.* It can be concluded that when fresh these products have a higher feeding value than mangolds, and when dry the feeding value is about equal to that of clover hay. Therefore the preservation of these by-products is a matter of great importance to the farmer. Continental farmers praise the tops as a food for milch cows, but care should be taken to see that they are fed clean and fresh, for without judicious watching they are liable to cause "scour" in the early part of the season.

* See this *Journal*, Vol. xxii, p. 750, November, 1915.

IMPROVEMENT OF GRASSLAND IN CORNWALL.

SOME interesting results have been obtained from a series of grassland experiments conducted by the Agricultural Committee of the Cornwall County Council. At one centre at Meudon, Mawnan, two fields of temporary pasture were placed at the disposal of the Committee. In Field A., the herbage of which was very thin and poor, five one-acre plots were set out on one half of the field and treated in the winter of 1920-21 as follows:—

Per acre.

Plot 1.—Control. No manure.
,, 2.—1,120 lb. 20 per cent. Basic Slag.
,, 3.—448 lb. 30 per cent. Superphosphate.
,, 4.—448 lb. 30 per cent. Superphosphate and 168 lb. Sulphate of Ammonia.
,, 5.—As No. 4, with 112 lb. Muriate of Potash.

The plots were cross-dressed with lime as follows (per acre):—
(*a*) 4 tons Sea Shell Sand (containing 4 cwt. Lime per ton).
(*b*) 2 tons Ground Limestone.
(*c*) 10 cwt. Ground Lime.
(*d*) No Lime.

At inspections in November, 1921, and March, 1922, the basic slag plot proved to be the best of the series. There was a close bottom of White Clover, and the whole was closely grazed, while there was an absence of inferior grasses. The herbage on the sulphate of ammonia plot (No. 4) was rougher and coarser, with less White Clover, and was not closely grazed. The complete manure plot (No. 5) was almost equal to the slag plot. There was a great contrast between the above plots and the other half of the field which had received farmyard manure only. When the hay crop was weighed green in June, the best results were obtained from slag after lime ($3\frac{6}{7}$ tons per acre), slag after sand ($3\frac{5}{7}$ tons per acre), superphosphate after sand ($3\frac{4}{7}$ tons), superphosphate and sulphate of ammonia after limestone (5 tons per acre). These should be compared with the yield of $1\frac{3}{7}$ tons per acre from the control plot. It is interesting to note that the sea shell sand as a dressing for grassland was at least equal to other forms of lime. Farmers living within a few miles of the coast might well consider the advisability of using lime in this form.

On Field B. the pasture had been laid down two years before the experiment commenced (spring, 1921), and it was then in a

poor condition. The treatment was designed to ascertain whether such a pasture could be so improved as to obviate the necessity of breaking it up for a few years. The field was divided into six one-acre plots and treated with (1) Superphosphate, (2) Superphosphate, Sulphate of Ammonia and Muriate of Potash, (3) Superphosphate and Muriate of Potash, (4) No manure, (5) 33 per cent. solution of Sulphate of Ammonia, and (6) Farmyard Manure.

On 2½ acres across the plots, one half of which had received lime and the other half had not, a renovating mixture consisting of 2 lb. Single-cut Cowgrass, 1 lb. White Clover, 1 lb. Alsike Clover, 1 lb. Timothy, 1 lb. Rough-stalked Meadow-grass, 8 lb. Perennial Rye-grass per acre, was sown in April, 1921, after the surface had been thoroughly harrowed. The field was inspected in November, and the following report made: "The limed portion showed great improvement and was more evenly grazed. The effect of the renovating mixture was excellent, there was a good 'take' of clover, and such weeds as *Prunella* and silver leaf, which were very conspicuous before treatment, were only to be seen in isolated patches. The plots to which superphosphate and potash were applied were all greatly improved, particularly the potash ones."

The success of this experiment in renovating a very poor thin pasture is striking, and should encourage other farmers to try the effect of a good harrowing with a toothed harrow, followed by the application of a few pounds of suitable mixture per acre, rolled in and dressed with superphosphate and potash.

At another centre at Trebilcock, Roche, three experiments were conducted. In Field A. liming was followed by a "seeds" mixture for temporary pasture. The lime applied was at the same rate as in Field A. of the Mawnan centre (ground lime, ground limestone and sea sand). The field was "seeded out" on dredge corn in 1921, four separate mixtures being sown on one-acre plots. A great difference was seen in October, 1921, between the limed and unlimed portion of the field, the sea sand plot especially showing up remarkably well.

Field B., an old rough and coarse pasture, was divided into four one-acre plots and treated with artificials. The plots were then cross-dressed with lime in the three previously mentioned forms. In October, 1921, and again in March, 1922, a great improvement on all the manured plots could be seen, but the most noticeable was on Plot 4, which had received Superphosphate, Sulphate of Ammonia and Muriate of Potash.

Since these notes were written, Mr. W. Borlase, the Agricultural Organiser, has paid a visit to the plots, and states that the improvement noticed at Meudon and also at Roche continues. At the latter centre the quality of the pasture on the part of the field devoted to the experiment is much superior to that on the part seeded and manured by the farmer.

The results of all these experiments are very striking, in spite of the unfavourable season, and they cannot but be useful to the farmers of the district. They seem to emphasise the fact that much pasture is starving for want of either lime or phosphates, in many cases both.

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NOTES ON MANURES FOR APRIL.

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Can Lime be mixed with Sulphate of Ammonia?—Several correspondents have asked whether it would be safe to mix lime or calcium carbonate with sulphate of ammonia and superphosphate in order to counteract the tendency of these substances to induce acidity in the soil. This plan cannot be recommended; it might answer if every condition were favourable, but under ordinary circumstances it is attended with too much risk. Serious loss of ammonia would arise if the mixture became damp or if it were not speedily and sufficiently covered with soil, and there would be danger of serious reversion of the phosphates. It is far better to put on the two substances separately—the lime or calcium carbonate in the autumn or early winter; or, at the present time, to land which is due to come into roots or clover leys; and the sulphate of ammonia for potatoes, barley, etc., and as top dressing for winter corn crops.

Potassic Fertilisers on Pastures: Under what conditions should they be used?—It has been shown that potassic fertilisers give good results on pastures only on certain peaty soils. Professor Somerville quotes an instance in the county of Dumfries of a pasture on 10 ft. of peat where the addition of 8 cwt. of kainit per acre to 10 cwt. slag markedly increased the yield of mutton during the next 7 years and left a substantial profit. Apart from these peat soils it is not usually found that potash is an advantage; neither in the English nor in the Scottish trials did it give more than slight increases and usually not profitable

ones. This remark of course does not apply to hay land, where potash frequently gives good results.

Lime on Pastures: Is it any use?—Considerable diversity of opinion was expressed at the meeting of the Farmers' Club, where Professor Somerville read his paper on the Improvement of Poor Pasture, as to whether lime is of value for this purpose. There is much evidence that lime *alone* will not effect a profitable improvement of such land, but this is only in accordance with old farming experience.

> "Lime, and lime without manure,
> Will make both land and farmer poor."

It is not surprising therefore that neither at Cockle Park, nor in Northamptonshire and Hampshire, did lime alone give any useful result. Indeed, at Cockle Park the continued use of a small dressing of lime at three years intervals appears now to be doing positive harm.

The case, however, is different when lime is used *in conjunction with slag or cake*, and cases were quoted in the discussion where this combination had given useful results.

It is often stated that lime in the slag should suffice for the purpose of pasture land, but as a matter of fact only about 2 per cent. of free lime is usually present, so that a dressing of 10 cwt. of slag per acre would supply only 22½ lb. of lime. While this small quantity would do something, one could not expect it to do much. There is, however, often 35 per cent. or more of combined lime, which might prove useful.

In a number of the Royal Agricultural Society's trials lime proved of value on pasture land, but it is not as certain in its effects as slag, and farmers should try a small scale experiment before embarking on any large expenditure. On hay land lime may be more effective.

Organic Manures v. Artificials.—This question was discussed at some length in a paper in this *Journal* (Vol. XXVI, p. 228, 1920), where it was shown that the experiments up to that date indicated no superiority of organic manures (guano, rape dust, etc.) over a cheaper mixture of artificials, and recent experiments confirm this conclusion. The system of manuring on the Little Hoos field at Rothamsted was somewhat altered in 1919 so as to allow of a strict comparison between artificials and organic manures without detracting from the original scheme of the experiment, and the result has been to show the value of the artificials.

The crop yields are:—

	Barley, 1919. *Grain* bush.	*Straw* cwt.	*Swedes*, 1920. *Roots* tons.	*Barley*, 1921. *Grain* bush.	*Straw* cwt.
Complete artificials only:—					
including Basic Slag ...	31·2	17·4	15·8 ...	34·1	20·1
„ Superphosphate	23·9	16·3	16·3 ...	33·5	17·8
Guano	24·3	17·0	14·4 ...	27·9	17·1
Rape dust	22·4	13·5	13·3 ...	36·1	17·3
Shoddy	23·3	14·5	11·9 ...	30·8	16·0
Bone meal	23·2	14·6	8·6 ...	24·1	14·1

In each case the dressing contains 40 lb. of nitrogen, 100 lb. of calcium phosphate and 50 lb. of potash per acre. Each plot was supplied with as much of its particular manure as possible (shoddy, guano, etc.) without exceeding the receipt in any of the three rationed ingredients. Any deficit in any one of these three was made good by adding the necessary quantity of sulphate of ammonia, superphosphate or sulphate of potash.

Manuring for a Rotation: How long will it last?—The manures ordinarily in use do not deteriorate in the soil but they suffer loss in two ways: (*a*) all fertilisers are taken up by the crop and bodily removed from the soil; (*b*) the nitrogenous manures are liable to be washed out from the soil, but the potash and phosphate are not. It has been shown on an earlier occasion that a moderate sized cereal crop removes from the soil the equivalent of 3 cwt. of sulphate of ammonia, 1½ cwt. of superphosphate and ¾ cwt. of sulphate of potash per acre; a 12-ton crop of potatoes removes the equivalent of 4 cwt. sulphate of ammonia, 3 cwt. of superphosphate and 2½ cwt. of sulphate of potash; and a 30-ton mangold crop the equivalent of 5 cwt. of sulphate of ammonia, 3 cwt. of superphosphate and 5 cwt. of sulphate of potash. It is only when the total dressing of dung and artificials exceeds these amounts that any effect can be expected in the second year.

Bone Meal and Dissolved Bones: Are they useful on Grass Land?—In the past great results were obtained by the use of bone manures on grass land in Cheshire, and a considerable reputation was gained for these substances. It is, however, doubtful whether they really deserve to stand very high in esteem for this purpose. In the Cockle Park experiments they certainly were not as useful as slag on grazing land, as they did not encourage the white clover to anything like the same extent. A number of trials organised by the Royal Agricultural Society and reported by Dr. J. A. Voelcker and Professor Carruthers in 1900 (Journ. Royal Agric. Soc., 1900, Vol. LXI. 116) were quite unfavourable.

NOTES ON FEEDING STUFFS FOR APRIL.

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Vitamines in Feeding Stuffs.—Several correspondents have written within the last few weeks asking for information regarding certain proprietary feeding stuffs which are sold expressly on the guarantee that they are peculiarly rich in vitamines. It appears evident from these inquiries that the farming community would welcome a few notes as to the value of these " vitamines " and the extent to which they are normally present in ordinary farm foods.

" Vitamines " are substances which, although present in small amount in feeding stuffs, exercise a profound effect on the health and well-being of growing and adult animals. Their composition is at present unknown, and their presence in any food or liquid can at present only be detected by the effect they produce on animals when included in a diet known to be free from vitamines.

The origin of the discovery of these mysterious " accessory food factors " forms an interesting story. Some years ago Prof. F. Gowland Hopkins was conducting feeding experiments on rats, in which the substances used consisted of chemically pure protein, fat and carbohydrate, together with ash constituents necessary for normal growth. This constituted in our then state of knowledge a complete diet, but the curious fact was established that, although these rats digested their food satisfactorily, not one of them grew, and if kept on this diet for a sufficiently long time the rats collapsed and died.

On establishing this fact, it was decided to ascertain the result of adding a few drops of raw milk in the diet, with the astonishing result that the rats grew normally. There was evidently some substance present in the raw milk which was essential to normal growth, and without which growth could not take place. This growth-promoting substance was called a " vitamine." Contemporaneous research on the diseases of scurvy and beri-beri showed that these disease conditions were caused by the absence in the diet of some substances present in small amounts in certain fresh foods. All these substances are grouped under the term " vitamines," of which three are recognised, called respectively Fat Soluble A, Water Soluble B,

and Water Soluble C. Most of the common foods have been tested for the presence or absence of these factors and a list compiled which has been published by the Medical Research Committee, and extracts from which appeared in a recent number of this *Journal*.* The chief broad statements that can be safely made are :—(1) Foods in which accessory food-factors

DESCRIPTION.	Price per Qr.		Price per Ton.	Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.	Price per lb. Starch Equiv.
	s.	lb.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	57/–	504	12 13	1 0	11 13	71·6	3/3	1·74
Barley, English Feeding	37/–	400	10 7	0 18	9 9	71	2/8	1·43
„ Canadian „	33/6	400	9 8	0 18	8 10	71	2/6	1·34
Oats, English White „	36/–	336	12 0	0 19	11 1	59·5	3/9	2·01
„ „ Black & Grey	32/6	336	10 17	0 19	9 18	59·5	3/4	1·78
„ Canadian	33/6	320	11 14	0 19	10 15	59·5	3/7	1·92
„ Argentine	31/3	320	10 19	0 19	10 0	59·5	3/4	1·78
Maize, „	45/6	480	10 12	0 17	9 16	81	2/5	1·30
„ South African	38/6	480	9 0	0 17	8 3	81	2/–	1 07
Beans, English Winter	65/-†	532	13 14†	1 15	11 19	67	3/7	1·92
„ Rangoon	—	—	9 0	1 15	7 5	67	2/2	1·16
Buck wheat, Manchurian	59/–	392	16 17	1 6	16 11	53·4	6/2	3·30
Millers' offals—								
Bran	—		9 0	1 16	7 4	45	3/2	1·70
Broad Bran	—	—	9 15	1 16	7 19	45	3/6	1·87
Fine middlings	—	—	9 10	1 7	8 3	72	2/3	1·20
Coarse middlings	—	—	9 5	1 7	7 18	64	2/6	1·34
Pollards (Imported)	—	—	8 0	1 15	6 5	60	2/2	1·16
Barley Meal	—	—	12 0	0 18	11 2	71	3/2	1·70
Maize „	—	—	8 17	0 17	8 0	81	2/–	1·07
„ Germ Meal	—	—	9 15	1 5	8 10	85·3	2/–	1·07
„ Gluten-feed	—	—	10 10	1 11	8 19	75·6	2/4	1·25
Locust Bean Meal	—	—	9 5	0 9	8 14	71·4	2/6	1·34
Bean Meal	—	—	14 0	1 15	12 5	67	3/8	1·96
Fish „	—	—	16 10	5 10	11 0	53	4/2	2·23
Linseed	—	—	20 15	1 16	18 19	119	3/2	1·70
„ Cake, English (9% oil)	—	—	16 0	2 6	13 14	74	3/8	1·96
Cotton seed „ English (5% oil)	—	—	9 7	2 6	7 1	42	3/4	1·78
„ „ Egyptian (5% oil)	—	—	9 2	2 6	6 16	42	3/3	1·74
„ „ decorticated (7% oil)	—	—	14 0†	3 11	10 9	71	2/11	1·56
Coconut Cake (6% oil)	—	—	9 10	1 19	7 11	73	2/1	1·12
Groundnut „ (6% (undecorticated)	—	—	10 0	3 5	15	47	2/10	1·52
Palm kernel Cake (6% oil)	—	—	8 0†	1 9	6 11	75	1/9	0·94
„ Mea (2% oil)	—	—	7 0	1 9	5 11	71·3	1/6	0·80
Feeding Treacle	—	—	6 5	1 1	5 4	51	2/–	1·07
Brewers' grains, dried, ale	—	—	10 5	1 11	8 14	49	3/7	1·92
„ „ „ porter	—	—	9 2	1 11	7 11	49	3/1	1·65
„ „ wet, ale	—	—	2 10	0 8	2 2	15	2/10	1·52
„ „ wet, porter	—	—	2 6	0 8	1 18	15	2/6	1·34
Malt culms	—	—	8 15	2 3	6 12	43	3/1	1·65

* Vol. XXVII, October, 1920, p. 666. † Prices at Liverpool.

FARM VALUES.	—	—	Value per Ton on Farm. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	S.E. per 100 lbs.	Value per s.	Market Value per lb. S.E. d.
Potatoes - - -	—	—	2 9	0 5	2 4	18	2/5	1·30
Swedes - - -	—	—	1 0	0 3	0 17	7	2/5	1·30
Mangolds - - -	—	—	0 17	0 4	0 13	6	2/5	1·30
Good Meadow Hay .	—	—	6 9	0 18	5 11	31	3/7	1·92
Good Oat Straw -	—	—	3 11	0 10	3 1	17	3/7	1·92
Good Clover Hay -	—	—	6 19	1 4	5 15	32	3/7	1·92
Vetch and Oat Silage -	—	—	2 10	0 8	2 2	14	3/0	1·61

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of February and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s. per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

are absent are all fats and oils of vegetable or plant origin, polished rice, tinned meats, and kilned oatmeal and peameal. (2) Fresh animal meat, green foods (particularly cabbage), milk, and root vegetables contain all three "vitamines." Peas, beans, and cereal grains, *after germination*, also contain these vitamines.

Oils of animal origin, particularly butter and codliver oil, are rich in Fat Soluble A (the absence of which causes rickets). Eggs, dried yeast, wheat germ, linseed and millet, are all rich in Water Soluble B (the absence of which causes diseases such as pellagra and beri-beri). Raw cabbage and fresh fruit juices are especially rich in the Water Soluble C vitamine (absence of which causes scurvy).

What is the bearing of these facts on the normal practice of feeding farm animals? In most cases farm animals get at some time or other fresh green foods, which are fairly rich in vitamines. In such cases the inference is obvious: there is no need to provide specially for the animal by supplying proprietary foods guaranteed rich in vitamines. The only case where there is perhaps a possibility of deficiency of vitamines is in the case of sty-fed pigs receiving cereal offals without any addition of green food. In such cases the writer always advocates the addition of a small amount of codliver oil to the diet.

One final point: the amount of vitamine needed is extremely small, and is likely to be provided in excess by any normal dietary.

Ants and Ant-hills.

ANT-HILLS in grass land are not only unsightly but they prevent the use of the mowing machine. To level and distribute ant-hills by hand labour is a tedious and costly proceeding. Ordinary zig-zag and chain harrows make little or no impression on them but a drag harrow behind a tractor does quite efficient work, levelling and distributing the soil evenly in one operation.

On sloping or uneven ground, where the use of a tractor would be difficult, a tractor paring-skim pulled by two horses will cut the hills flush with the ground, but a considerable amount of harrowing is afterwards necessary to disentangle the soil from the turf.

It must be remembered that the levelling of the ant-hill does not destroy the nest underground and there is always the risk of the ants getting to work again. To obviate this, it is advisable to apply some form of manure which will have the effect of encouraging a rapid growth of the grass. If it is possible to mow instead of grazing for two or three years, so much the better, as the ant does not seem to flourish in a heavy growth of grass and is not much met with in fields continually mown for hay.

How far ants may be considered to benefit the soil is a question which still awaits final solution. It is possible that some gratitude is owed to them for more than their proverbial example of industry. It is conceivable that they may serve a good purpose in promoting the aeration and drainage of the soil by their subterranean activities, and in bringing up the lower soil for distribution as a top-dressing. In a chalk country, the surface soil long denuded of lime may be benefited by the addition of the lime thrown up from their workings. At any rate, there is no doubt that the soil from ant-hills is sought after by gardeners for potting and for spreading round transplanted trees and shrubs.

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Goat-keeping.

THE Ministry of Agriculture has recently issued two leaflets on goat-keeping—Leaflet No. 306, The Goat as a Source of Milk, and No. 383, Hints on Goat-keeping.

The Ministry attaches importance to the development of goat-keeping in this country for economic reasons. There is undoubtedly a considerable quantity of waste vegetable material in rural and urban districts which could with very little trouble be converted into valuable human food by means of the goat. Moreover, there are many people living in more or less remote districts who find difficulty in obtaining adequate supplies

of fresh milk for domestic purposes, especially for feeding young children, for whom goat's milk is particularly suitable.

In several foreign countries where agriculture is a prosperous industry, goat-keeping is practised on a very considerable scale. In Holland, for instance, which is a highly cultivated country possessing large herds of valuable milch cows, there were in 1910, according to the official census figures, 224,231 goats. Similar conditions exist in Belgium, and it may be said that goat-keeping is considerably more common in most European countries than in this country, where, however, climatic and economic conditions are by no means unfavourable for goat-keeping.

The goat is, in fact, a hardy animal which thrives well in all European countries. A fairly good nanny goat should produce in one year from 70 to 100 gall. of rich milk at a very low cost, while a first-class milch goat will yield double as much and will probably cost no more to keep than one of poor quality.

It is not essential that goats should have access to grazing. They may be fed largely on cheap or waste greenstuff from the garden or allotment, and on hedge clippings and weeds such as dandelions, sow thistles, docks, young nettles, etc. They are therefore particularly suitable for farm labourers, small holders, allotment holders and cottagers. It is true that goats in milk require a little concentrated food and in the winter some hay, but for the rural dweller who is not able to keep a cow a good milking goat is a most valuable and economical animal, whose merits are at present not sufficiently appreciated.

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THE following experiment has been carried out by Mr. C. H. Oldham, one of the Ministry's inspectors :—

Tarring Posts Infected with Silver Leaf Disease.

Most growers of fruit, both commercial and private, have during the past few years taken an interest in the methods of prevention of the Silver Leaf Disease, and to many the life-history of the causal fungus (*Stereum purpureum*) is now known.

At present it is an undoubted fact that the plum is more susceptible to attack than other types of fruit trees, and in commercial orchards, the varieties Victoria and Czar appear much more liable than others to infection.

While experiments in many directions are being conducted to find some practical method of prevention or cure, up till now it appears that the best method to prevent the spread of the disease is to remove infected wood as early as possible after the appear-

ance of silvered foliage. By this means it is possible to save the life of the tree, providing that the silvered branches are cut back to clean wood.

The fungus causing Silver Leaf spreads in the wood by means of mycelium, which may be traced by the dark stains in the wood. If infected wood—even though in a living condition —is not removed beyond these dark stains the fungus is capable of spreading to other portions of the tree, and if allowed to go on unchecked will ultimately kill the host.

A dead plum or other fruit tree killed by Silver Leaf Disease is a source of danger to any other specimens in the orchard, for the fungus then produces fructifications bearing spores which are capable, after being distributed by wind or other agencies, of infecting healthy trees, providing suitable weather conditions prevail, entrance being afforded by means of cracks in the bark, wounds, or unprotected pruned surfaces.

Since the introduction of the Silver Leaf Order of 1919 especially the cutting out of infected wood has been practised by fruit growers, and there has been a tendency occasionally to use the infected wood for posts, either to stop gaps in the fence around the orchard itself, or elsewhere on the holding or farm. Unfortunately, however, many growers are under the impression that if such wood is painted with tar the fungus will be rendered incapable of producing the incrustations or bracket shaped bodies bearing the spores.

The Ministry therefore conducted experiments to ascertain whether tar really had the power to prevent the fructifications of *Stereum purpureum* from appearing on infected wood. A preliminary trial was made in an orchard formerly severely attacked by Silver Leaf, belonging to Mr. T. Hatley, J.P., of West End, near Southampton. It was particularly desirable that the experiment should be conducted in the district, since the amount of disease present in the area was considerable, and many growers had suffered heavy losses owing to the spread of the disease.

On 11th November, 1920, three posts were selected for the experiment, which were known to be infected and had been sawn from plum trees of the Victoria variety.

The posts were placed in the following order :—

Post No. 1, Bark removed.
Post No. 2, Bark not removed.
Post No. 3, Control.

Owing to bad weather it was impractical to paint with tar until

18th November, 1920, but on this date posts Nos. 1 and 2 were given a good coating. On 20th December, 1920, the site was again visited, and it was observed that on post No. 3, which was used for control purposes the fructifications of *S. purpureum* were appearing, but on the tarred posts, Nos. 1 and 2, none was present. Tar, when in possession of its antiseptic properties, has, therefore, apparently the power to retard the development of the fructification.

The posts have been kept under observation at various intervals and a visit was again paid on 27th January, 1922, when it was noticed that on post No. 2 the fructifications of the disease had developed. It is clear therefore that if growers tar over wood cut from Silver Leaf diseased trees without removing the bark it does not prevent the production of the reproductive bodies of stereum.

It is worth noting that the fructifications did not appear until fifteen months after the post was painted. There is, however, some ground for believing that but for the continued dry period experienced last season these reproductive bodies would have appeared earlier.

Further observations are needed to prove whether tarring after removal of the bark will prevent the production of the fungus. Some authorities are doubtful if it will have a lasting effect, but since for the commercial grower it is hardly practicable to remove bark when any quantity of posts are required, this point is not of much economic value.

The result of this experiment illustrates the importance of the destruction of wood infected with the disease. Such material should not be used for posts under any circumstances, but could be used as fuel for domestic purposes, immediately after pruning, or collected in a heap and burned together with other prunings from the orchard.

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A Metal Plant Bucket.

A description has been received from one of the Ministry's Inspectors of a metal plant bucket intended for use in place of the ordinary flower pot. The inventor constantly noticed that certain plants appeared to give better results when grown in old pails and buckets. After experiments extending over several years he produced a bucket which has now been tested in the production of crops on a commercial basis for over six years with apparently satisfactory results. The bucket, which is approximately 12 in. in height and 9 in. in diameter, is constructed

of pure zinc and is practically indestructible. A special feature is a false or moveable bottom with a single hole underneath for drainage.

The chief reason for the superiority of the bucket over clay pots is that considerably less watering is required. This makes for the maintenance of a more equable root temperature especially during periods of rapid evaporation. The saving of labour in watering is also considerable. Its advantage over clay pots in the matter of breakage is obvious.

The disadvantage of the appliance is its cost. It is patented and at the moment is manufactured in a spasmodic way without special plant at a cost of 2s. 10d. each. The patentee has found, however, that while it is extremely desirable to cheapen the bucket, the present cost is not prohibitive for the purpose for which it is used.

One of the most striking purposes for which the plant bucket is employed at Hassocks is the cultivation of high quality dessert pears under glass. The method followed is very simple. Cordon pear trees of choice dessert varieties are propagated on the premises and permitted to attain a bearing age outside. They are then lifted, planted in the plant bucket and brought into the houses. At the conclusion of the fruiting period the trees are taken outside again, the culture, once the trees are in the buckets, being that usually accorded to orchard house trees. The writer inspected a house of pears grown in this manner and was considerably impressed with their appearance. A crop of from one dozen to two dozen fruits is allowed to each tree and these are matured without any trouble. No artificial heat is employed and pests are not severe, the few caterpillars which appear in the spring being removed by hand-picking.

Tomatoes are also successfully grown in the bucket and this crop affords a satisfactory basis for comparison with flower pot culture. In every case the buckets give much better results, the plants being healthier generally and yielding heavier crops of fruit. The tomato plants are obviously supplied with a steadier supply of water in the buckets, a factor in the development of fruit which all growers will appreciate.

Chrysanthemums also exhibit a marked difference in the general growth and quality of the bloom when grown in the bucket as compared with pots.

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Appointment of Guide Demonstrator to the Rothamsted Experimental Station.

For many years past parties of farmers have visited the experimental fields at Rothamsted and every season since the Armistice the numbers of visitors have further increased. The authorities at Rothamsted desire to encourage these visits and they endeavour by all means in their power to make them useful and interesting to farmers.

The generosity of the Fertiliser Manufacturers' Association and of the British Sulphate of Ammonia Federation has enabled a great step forward to be made. Funds have been placed at the disposal of the Rothamsted Committee which have permitted them to appoint a special member of the staff for the purpose of explaining the plots to farmers and others. Mr. H. V. Garner, B.A., of the School of Agriculture, Cambridge, has accepted the post, and it now becomes possible, therefore, to accommodate more parties, and, it is hoped, with even better results, than could be done before. Dr. Russell will be happy to arrange with the Secretaries of Farmers' Clubs, Chambers of Agriculture, and other bodies interested, for visits to the plots. Among other important items of interest are: experiments on the manuring of arable crops, especially wheat, barley, mangolds, and potatoes; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land, hay land, and arable crops; crop diseases and pests; demonstration of good types of tillage implements, tractors, etc. At any convenient time between 1st May and 1st October there is sufficient to occupy a full day, and alternative arrangements are being completed; even if the weather turns out too bad to allow for close inspection of the fields, which will ensure that the time will not be lost.

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Care in Purchase of Copper Sulphate.

In September, 1921, the Ministry's Inspectors were instructed to obtain some samples of Blue Vitriol (Sulphate of Copper) as sold for wheat dressing. The Inspectors were instructed to ask for "a pound of Blue Vitriol for wheat dressing." Sixty-nine samples were purchased and submitted to the Government Laboratory.

Fifty-five of these contained 98 per cent. or more of Copper Sulphate, and 7 contained 96 per cent. or more of Copper Sulphate, together with small proportions of impurities, mainly Green Vitriol (Sulphate of Iron). The remaining samples con-

tained a low percentage of Copper Sulphate and gave the following results :—

Copper Sulphate. per cent.	*Iron Sulphate.* per cent.	*Insoluble in Water.* per cent.	*Lime.* per cent.	*Tar Acids.* per cent.
15·8	81·0	1·2	—	—
13·1	84·8	0·9	—	—
42·3	49·2	0·8	0·8	0·18
23·0	72·5	1·3	0·5	0·57
26·5	69·0	1·2	Trace	0·12
28·8	70·3	0·2	Trace	0·17
51·2	46·6	—	—	—

In these 7 cases the article would be quite valueless for wheat dressing, potato spraying, or any other agricultural or horticultural purpose for which Blue Vitriol is generally employed, and the result of the inquiry shows that farmers and gardeners should exercise care in the purchase of Copper Sulphate. The following points are of value :—

(1) The deep blue colour of unadulterated Blue Vitriol is quite distinctive, and when it has once been seen no mixture is likely to be mistaken for it.

(2) The label on the package should be noticed. If it is labelled "Blue Vitriol" or "Copper Sulphate" and this description is incorrect the seller is liable to a prosecution under the Merchandise Marks Act. If, however, the package is labelled "Powdered Vitriol" or by a fancy name the contents may not be Blue Vitriol.

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Royal Patronage for Poultry Keepers.

THE fact that His Majesty the King has consented to become Patron of the National Utility Poultry Society will be noted with satisfaction by all who are interested in the development of the poultry industry in this country. This mark of Royal approval may be read as a sign that poultry farming, which has hitherto been regarded as the "Cinderella of Agriculture," is now beginning to emerge from its lowly estate, and to claim a more prominent position. Progressive farmers all over the country are paying more attention to poultry than ever before. They realise that, in view of the huge imports of eggs and poultry from abroad, there must be a strong and steady demand for the home-produced article. They also know that the ordinary farmer, whose normal cultivations produce a variety of food suitable for poultry feeding, can engage in poultry farming more economically and on a larger scale than anyone

else. Nevertheless it should not be forgotten that the great progress which has been made in improving the productivity of British breeds of poultry is almost entirely due to the efforts of specialist poultry breeders, the majority of whom are not farmers at all in the ordinary sense of the word, and are usually quite "small men."

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Blindness in Strawberries.

The term "blindness" has been somewhat loosely applied by growers, and has been wrongly used to describe failure of plants to produce fruit from causes such as frost, eelworm, red-plant, and other forms of insect attack and fungoid disease. There is, however, a well-known form of blindness in strawberries, and it is to be found to a greater or less extent in all varieties. It is easily recognisable to those who carefully examine their crops, by the presence of strong growing luxuriant foliage-producing plants which do not flower. These plants in turn produce strong healthy runners, which are, as a rule, more robust than those produced by plants bearing a normal crop of fruit. The runners of such blind or barren plants seldom produce fruitful stools, but show a marked tendency in turn to produce abnormal foliage and no flower. A small percentage of blind plants in a large area does not seriously affect the crop, but when they appear in a small plot they materially decrease it.

The small grower, cottager and allotment holder are very apt to select strong runners from these barren plants to renew the strawberry patch, and in cases where only a few rows are grown for home consumption, it is a very easy matter under such a process of selection for the patch to become quite barren in a few years. This often occurs in small gardens, and the only safe course is to mark barren plants during the fruiting season and exercise the greatest care that runners are not taken from them later to extend the plantation.

Where strawberries are specially selected for forcing purposes, it is best to isolate stock plants which have been observed to be healthy and heavy bearers and only propagate from such. Stock plants should be selected the first season as soon as they have bloomed and the fruit set; they should receive special cultural attention to enable them to throw strong healthy runners, which should produce strong crowns before any attempt is made to force them in pots or frames. The larger growers should mark blind plants and after the fruiting season destroy them.

It is generally agreed that certain varieties of strawberries have a tendency to throw more barren plants than others, and although they appear under the best soil and manurial conditions, it is also possible that poor cultural conditions have some effect in their production.

Blindness in strawberries is apparently on the increase and therefore only runners from fruitful plants, no matter what the variety, should be selected.

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Wart Disease: Immunity Trials of Potatoes, 1922.

THE Ministry has arranged to continue the testing of new varieties of potatoes during the coming season at the Testing Station of the National Institute of Agricultural Botany, with a view to the establishment or otherwise of their immunity from wart disease. Entries for the trials closed on 15th February.

Thirty-five seed-size tubers are required of any stock which has not before been tested at the Station; in other cases, 70 seed-size tubers are required. The Ministry accepts no responsibility for the failure of the growth of any stock. All reasonable precautions are taken to secure that none of the potatoes on the trial plots shall leave the Station except for exhibition or scientific purposes authorised by the Ministry. At the close of the season a report on each stock forwarded will be furnished to the grower.

When the Ministry has decided, as a result of the trial, that a variety is immune from wart disease, it will formally approve the variety and issue an official certificate of immunity. A certificate will not be issued for any variety until it has passed at least two consecutive years' tests without contracting the disease, nor will a certificate be issued for a variety which is declared by theSynonym Committee of the National Institute of Agricultural Botany to be synonymous with an existing variety.

With regard to the testing of seedlings, the Ministry desires to encourage the breeding of new varieties of potatoes, and is prepared to accept from 5 to 10 tubers of any seedling for growing for one season on the trial plots, and to furnish a report on the results. These tests, however, wil l not be reckoned in the minimum period of two years required for a variety to pass the full test before approval.

* * * * * *

AGRICULTURE ABROAD.

AGRICULTURAL PLOTS FOR RURAL SCHOOLS IN SPAIN—PLANT IMPROVEMENT LAW IN CZECHO-SLOVAKIA.

Agricultural Plots for Rural Schools in Spain.

WITH the object of checking the growing exodus of population from country to town, and reducing the emigration of land-workers whose means and lack of instruction do not allow them successfully to compete with other countries under modern conditions, a Spanish Royal Order has been made establishing a scheme of agricultural instruction in rural schools.

Provision is made for plots of land to be obtained by schools to enable teachers to instil into their pupils a love of nature and of country life and to develop their powers of observation. As there are insufficient teachers having the necessary knowledge and training, not more than a trial of the scheme can be made at present. The subjects to be taught are :—use of fertilisers, especially chemical manures; influence of selected seed on the harvest; rotation of crops; preparation of the land and the use of machinery, especially the type of plough most suitable for local soils; use of insecticides; study of local climate as it affects crops; and the use of a simple system of book-keeping.

A request for the addition of a plot to a school may be made by municipalities, teachers, agricultural syndicates, or associations of experts, with the concurrence of the master of the school concerned, provided that they can obtain land to the extent of 1 hectare (nearly 2½ acres) which can be devoted to the objects of the scheme for at least six years. Various specified instruments must be kept for obtaining records of local climatic occurrences, and the books will be open to the public for the better training of the latter. One day each week the school children will be taken to the plot to see the work being performed and to have it explained to them; and the teacher is recommended to arrange similar lessons for adults on public holidays.

After paying all expenses of the plot, the net profit will be disposed of as follows :—50 per cent. to improvements of the plot, 25 per cent. to the School Mutual Benefit Society, or, failing that, to the canteen, wardrobe, holiday fund, or other special institution connected with the school, and the remaining 25 per cent. to the manager or foreman of the plot. Each plot will have a national subsidy of 1,000 pesetas (nominally about £40) annually to defray rent and other necessary expenses. This

subsidy may be doubled if the plot comprises 2 hectares of land. The Director General of Elementary Schools is to draw up rules for conducting and inspecting the school plots, and for holding competitions to award prizes to teachers who obtain the best results.

* * * * * *

Plant Improvement Law in Czecho-Slovakia.

WITH the object of improving plant cultivation, the new State of Czecho-Slovakia has introduced a law providing for the registration of varieties of plants as "original" varieties, and, after protracted trials, as "guaranteed" varieties, and for the examination of seeds and plants for variety.

The administration of the Act is vested in the Czecho-Slovakian Ministry of Agriculture, who have delegated their powers of inspection to Commissioners. In applying for a certificate to register a variety as an "original" variety, the grower must prove, to the satisfaction of the Commissioners, that the variety in question has been obtained by means of a systematic process. He must agree to an inspection of his trial grounds and laboratories, but the Commissions are bound to observe strict secrecy with regard to any special methods or installations.

A register is maintained at the Ministry of Agriculture of all "original" varieties recognised by the Commissions, showing the name of the producer, a short description and essential qualities of the variety, the method of production, the terms of the label issued to the grower for the purposes of sale, etc. A certificate of "original" variety holds good only for three years, unless renewed.

"Original" varieties, which prove satisfactory during comparative tests made over a period of years on selected areas by the Institutes and Stations set up for controlling the trade in seeds and plants, may be recognised as "guaranteed" varieties, a register of which is also maintained at the Ministry of Agriculture. With both registers are kept samples of the seeds, ears, or fruit of the "original" or "guaranteed" varieties. The registers and samples are open to public inspection.

* * * * * *

Foot-and-Mouth Disease.

SINCE 19th February, the date referred to in the Note contained in the *Journal* for March, 1922, 242 further outbreaks of foot-and-mouth disease have been confirmed in Great Britain, making a total up to Sunday, 19th March, of 1,029. This number is distributed throughout England, Scotland and Wales as follows:—England, 936; Scotland, 91; Wales, 2.

The counties which have been the most heavily infected are Cheshire, Durham, Lancashire, Lindsey (Lincs), Norfolk, Northumberland, Nottingham, Westmorland and York. Those in Scotland are Forfarshire and Renfrewshire. Out of the 936 outbreaks in England, 533 occurred in Yorkshire. The number of animals slaughtered by the Ministry in connection with all outbreaks up to 19th March is 21,510 cattle; 17,971 sheep; 8,575 pigs and 41 goats; totalling 48,097 animals. The percentage of the animals slaughtered to the total livestock population is shown in the following table:—

	Infected Counties only.		*Whole of Great Britain.*	
	No. of Livestock.	*Percentage slaughtered.*	*No. of Livestock*	*Percentage slaughtered.*
Cattle	3,352,630	0·64	6,659,859	0·32
Sheep	9,859,532	0·18	20,490,024	0·09
Pigs	1,568,041	0·55	2,650,964	0·33

The estimated net cost of compensation for animals so slaughtered will amount approximately to £65,000 after deducting the estimated receipts for the salvage of carcasses passed as fit for human consumption.

In each outbreak the local circumstances are considered by the Ministry with a view to determining whether they are specially favourable to the adoption of isolation in lieu of slaughter. The policy of slaughter, however, has not been superseded, and isolation is only decided upon where the situation of the farm and arrangements for housing the stock are peculiarly suited to such a course. The question of isolation assumes more importance where valuable pedigree herds are concerned. Moreover, the expenditure of a large amount of public money on slaughtering is not justified in cases in which proper arrangements can be made for isolating affected animals with practically no risk of the spread of infection. This course had been followed with respect to 43 outbreaks in England and 8 in Scotland up to 19th March.

An important Order was issued on 9th March revising the rules to be observed on foot-and-mouth disease infected places, with the principal object of securing a more thorough disinfection both of the premises and also of the clothing of persons entering or leaving infected places.

Restrictions on Movement. The restrictions on the movement of animals which, as stated in the *Journal* for March, 1922, were applied on 5th February to the whole of Great Britain, were modified on 27th February by releasing altogether the whole of the Northern counties of Scotland down to, but not including, Forfarshire, Perthshire, Dumbartonshire and the portion of Argyllshire south-east of Loch Fine; the Isle of Arran was also included in the released district. The effect of this Order was to allow the free movement, and the holding of markets and sales, of all classes of stock within the released part of Scotland, and the movement of animals out of such part into any other part of Great Britain subject to obtaining the necessary licences from the Local Authority of the place of destination. No movement, however, into the released area from any other part of the country was allowed.

On 6th March a new Order came into operation revising the restrictions generally. This Order released from restrictions altogether the South-western counties of England and South Wales, as well as the Northern half of Scotland. The remainder of Great Britain was divided into 4 scheduled districts within which movement was allowed for all necessary purposes with a licence of the Local Authority of the place of destination, which licence was required to be endorsed by the Local Authority of the place from which the animals were moved. Within these 4 scheduled districts certain infected areas surrounding outbreaks or groups of outbreaks were declared. Out of these infected areas no movement was allowed to take place except direct to a slaughterhouse in one of the 4 scheduled districts for slaughter within 48 hours of arrival thereat, and no farm dispersal sales were allowed to be held within those infected areas. Throughout the scheduled districts store stock sales continued to be prohibited, but fat stock markets could be held by licence of the Local Authorities subject to veterinary inspection. No animals could be moved from the scheduled districts to any of the released areas for any purpose whatever.

On 17th March the last-mentioned Order was amended so as to add the whole of North Wales and Berkshire, Hampshire and the Isle of Wight to the released areas and also for the purpose of empowering Local Authorities to license the holding of farm dispersal sales in infected areas, subject to the conditions that (*a*) no such sale was to be held within two miles of an infected place; and (*b*) that licences should be obtained for movements from such sales to the places of destination, but that no movements should be allowed from such sales to premises within a radius of two miles from an infected place.

The following is an extract from a circular letter sent by the Ministry on 15th March to Local Authorities when issuing this Order:—

> "The Ministry considers that the risk of the spread of disease by the holding of dispersal sales on any premises within a radius of 2 miles from any existing infected place renders it inadvisable to allow such sales on premises so situated at the present time, and has accordingly provided that no licences shall be issued in these cases. It may also happen that although a licence for the holding of a sale has been issued by the Local Authority, the removal of all or some of the animals therefrom to the intended places of destination by their purchasers may be prevented by prohibitive regulations of Local Authorities of the receiving districts. In all such cases both the incoming and outgoing tenants will be placed in a position of considerable difficulty as regards the keep of the animals on the premises where they are detained. With a view to minimising these difficulties as far as practicable, the Minister made the Order entitled the 'Foot-and-Mouth Disease (Change of Occupation) Order of 1922,' dated the 13th instant. This Order provides that where, owing to the termination of his right of occupation of any land, the owner of livestock kept thereon is unable to remove the same by reason of the foot-and-mouth disease restrictions, the incoming occupier shall afford the owner of the livestock all such facilities for tending, feeding or using the stock, or for the sale of the stock (where the sale is licensed) as he may reasonably require; and that where the owner is unable to avail himself of such facilities the incoming occupier

shall take reasonable steps for the proper feeding, tending or otherwise using of the stock, the owner of the stock being liable to pay to the person affording such facilities or services such remuneration or expenses as may be reasonable and just, the amount of which, in default of agreement, is to be determined by arbitration in accordance with the provisions of the Second Schedule to the Agricultural Holdings Act, 1908."

Up to 19th March the restrictions which prevented the landing of animals from Ireland otherwise than for the purpose of immediate slaughter continued in operation, but the Ministry has under consideration certain proposals for the landing of store stock subject to conditions which would prevent the aggregation of such stock in markets in this country.

* * * * * *

Conciliation Committees in Agriculture.

THE division of the Lincoln Interim Conciliation Committee into two Committees, one for Holland and the other for Lindsey and Kesteven, and the separation of Loughborough from Leicester and the subsequent formation of separate Committees for those areas, has increased the total number of Conciliation Committees to 61. This number will be further increased on the sub-division of the West Sussex area into three separate districts, which it is understood will take place on the 1st April.

Details of the 42 agreements in operation on the 20th March are given below. In many areas where the current agreements are due to expire at an early date, the Committees have already arrived at further agreements. Particulars of these additional agreements are not included in the subjoined table, but detailed information as to the rates applicable in any area will be furnished on application to the Ministry.

Current Agreements.

Area.	*Period.*	*Wages.*	*Hours per week.*
Beds and Hunts	Up to 22nd July, 1922	32/-. Overtime, 8d. per hour.	52
Cambridge - -	Until such time that one side gives notice of alteration.	8d. per h. for week of 50 h. Overtime 8d. per h. up to 54 h.; 10d. on Sundays.	
Cheshire - -	Up to 30th April, 1922	36/-. Guaranteed week of 54 hours. Overtime, 9d. per hour on weekdays, 10d. per hour on Sundays.	
Cumberland and Westmorland	„ 3rd June, „	32/6. Overtime, 10d. per hour. Skilled workers, 45/-	54 in Summer. 48 in Winter. 63
Derby - -	„ 31st March, „	36/-. Overtime, 8d. per hour on weekdays, 11d. per hour on Sundays.	54
Devon - -	„ 25th March, „	34/-	50
„ - -	„ 29th Sep. „	32/-	50
Dorset - -	„ 29th April, „	32/-. Carters, cowmen and shepherds, 7½d. per h. up to 60 h. 9½d. per h. over 60 h.	51

Area.	*Period.*	*Wages.*	*Hours per week.*
Durham -	- Up to 13th May, 1922	42/-.	50
*Ely, Isle of -	„ 31st May, „	31/-. Overtime, 8½d. per hour. Horsemen and milkmen, 40/6.	51 Customary
Hampshire -	„ 31st March, „	32/- guaranteed week of 48 hours. Overtime, 8d. per hour.	48
Hereford - -	„ 30th Sep., „	30/-. Proportionate rate per hour for all weekday overtime. Sundays, 9d. per hour.	50
Hertford - -	„ 6th Oct., „	7½d. per hour. Guaranteed week of 50 hours.	
Lincoln :—			
Holland -	„ 30th June. „	8d. per hour for all hours worked.	
Kesteven and Lindsey	„ 31st Oct. „	7½d. per hour. Guaranteed week of 50 hours.	
Lancashire :—			
Southern area	.. 31st March. ..	45/- Tramsmen and stockmen. Rates for other workers in proportion.	Customary.
Northern area	„ 31st „ „	42/6	Customary.
Eastern area	.. 31st „ „	50/-	Customary.
Leicester :—			
Ashby Bosworth, Hinckley and Atherstone	„ 31st .. „	35/-. Overtime, 10d. per hour on weekdays, 1/- Sundays.	50
Market Harborough and Lutterworth	„ 30th Sep., „	31/-. Overtime, 8d. per hour on weekdays, 10d. per hour on Sundays.	51
Middlesex S. -	„ 2nd Sep., „	35/5. Guaranteed week of 48 hours. Weekday overtime, 10d. per hour. Sunday employment, 11d. per hour. Carters, stockmen, &c., 8½d. per hour up to 60 hours. Weekday overtime, 10d, Sunday employment, 11d. per h.	
Northants - -	„ 6th Oct., ..	31/-. Overtime, 8d. per hour.	50
Northumberland, S. ..	13th May, „	44/6. Overtime, 1/1½d. per hour on weekdays. Sundays, 1/4d. per hour.	50 in Summer 48 in Winter.
Nottingham -	„ 30th Sep., ..	34 -	53

Area.	*Period.*	*Wages.*	*Hours per week*
Norfolk -	- Until beginning of Harvest.	30/-	50½
Oxford -	- Up to 29th Sep., 1922	30/-. Overtime, 8d. per hour on week-days. Sundays, 10d. per hour.	50
Peterborough, Soke of	„ 6th Oct., „	31/-. Overtime up to 54 hours, 8d. per hour; over 54 hours, 9d. per hour. Sunday employment, 10d. per hour. Horsekeepers and milkmen, 7/- plus cottage, and stockmen 5/- per week extra for performance of their customary duties.	51
Rutland - -	„ 28th Oct., „	32/-. Rates to vary 1/- for every change of 6 points in cost of living. Overtime 8d. per hour week days. 10d. Sundays.	50
Shropshire -	„ 30th Sep., „	7½d. per hour. Guaranteed week of 50 h. Sunday employment, 10d. per h.	
Somerset - -	„ 30th April, „	32/-	50
Stafford - -	„ 29th „ „	8d. per hour. Guaranteed week of 50 h. Sunday employment, 10d. per h.	
Surrey* - -	„ 25th March, „ (Male workers of 21 to 65 years).	33/4. Overtime, 9d. per hour. Carters, cowmen and shepherds, all time worked between 50 and 60 hours per week 8d. per hour, and all time worked by these classes in excess of 60 hours, 9d. per hour.	50
Sussex, E. -	- Up to 31st March, 1922	31/-. Overtime, 8d. per hour.	52
Suffolk - -	„ 31st Oct., „	7½d. per hour up to 50 hours per week. Between 50 and 54 hours, 8d. per hour. In excess of 54 hours, 9d. Sunday employment, 10d. per h.	
Warwick* -	- „ „ 6th Oct., „ (able-bodied adult male workers).	31/-. Guaranteed week of 50 hours. Overtime, 8d. per hour.	

* Confirmed agreement.

Area.	*Period.*	*Wages.*	*Hours per week.*
Wight, Isle of -	Date of next meeting, or such other date as may be agreed.	32/-	Ordinary.
Worcester -	Up to 6th Oct., 1922	7¼d. up to 60 h. Guaranteed week of 50 h. Overtime beyond 60 h. 9d. per h.	
Yorkshire, North Riding	„ 31st Oct., „	35/-. Overtime at proportionate rates	52½
West Riding -	„ „ „	36/-. Overtime at 9d. on weekdays and 10d. on Sundays.	54
Brecon and Radnor	„ 30th April „	34/-. Overtime, proportionate rates up to 60 hours. In excess of 60 hours, at time and a quarter.	52
Carnarvon - - -	„ 13th May „	35/-. Special classes workers, 38/-. Overtime, all classes 10d. per hour.	50 61
Cardigan - -	„ 31st Oct. „	36/-	54
Merioneth and Montgomery	„ 30th April „	33/- 36/-	50 56
Monmouth - -	„ „ „ „	35/-	54
Pembroke - -	„ 4th Oct. „	34/-. Overtime at equivalent rate up to 60 hours. In excess of 60 hours, time and a quarter.	54

The North Northumberland Committee, which was delayed in its initial negotiations pending the division of the original Northumberland Interim Committee, decided that as the November hirings had already taken place it was unnecessary to deal with the wages question for the period up to May next. An agreement has now been arrived at by that Committee over the period 12th May, 1922, to the 12th May, 1923, for the payment of adult male workers at the rate of 32/- for a week of 50 hours in summer and 48 hours in winter.

The Surrey Conciliation Committee has agreed to extend their present agreement, which would otherwise expire on the 25th March. In accordance with the Committee's application, this agreement has been confirmed by the Minister and provides as follows :—

(a) A wage rate for all male workers between the ages of 21 and 65 years of 33/4 for a working week of 50 hours.

(b) All time worked between 50 and 60 hours per week by carters, cowmen and shepherds between 21 and 65 years of age to be paid for at the rate of 9d. per hour ; in the case of all other male workers between the ages of 21 and 65 years any time worked in excess of 50 hours per week to be paid for at the rate of 9d. per hour.

(c) All the rates specified to apply only to workers whose employment is terminable by a week or longer notice, and to operate until one calendar month after notice of any proposal to cancel is received by the Minister from either section of the Conciliation Committee.

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MACAINSH, JOHN, Congash, Grantown-on-Spey, N.B. —Pure-bred Aberdeen-Angus Cattle.—Particulars on application.

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STANTON, HARWICH.—REGISTERED HERD RED DEVON DAIRY CATTLE. Devons are the best English Dairy Cattle under all conditions and in any climate.

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CHIVERS & SONS, LTD., HISTON, CAMBS.—Pedigree Dairy Shorthorns. Over 100 head, mainly fashionably bred Bates Families. Milk recorded daily and checked by Ministry of Agriculture recorder. Champion Cow, reserve champion Bull, 100 Guinea Challenge Cup, R.A.S.E., Derby, 1921, etc. Bulls and Bull calves always for sale.

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The Journal of the Ministry of Agriculture.

Net Sale Certificate.

I hereby certify that the average monthly net sales of *The Journal of the Ministry of Agriculture*, all editions carrying advertisements, after deducting all free vouchers, complimentary and advertising copies, and all returns, for the half year ending 30th September, 1921, were **9,687** copies per issue.

In addition to sales, the average number of copies distributed to Officials of the Ministry, County Inspectors, Agricultural Committees, Agricultural Societies, and agricultural experts and writers, was 1,187 monthly, which, while not being a sale circulation, is nevertheless effective and guaranteed.

(Signed) F. L. C. FLOUD,
Secretary and Accounting Officer.

7th November, 1921.