The Scottish Journal of Agriculture

VOLUME X

1927

EDINBURGH

PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
120 George Street, Edinburgh; Adastral House, Kingsway, London, W.C. 2;
York Street, Manchester; 1 St. Andrew's Crescent, Cardiff;
15 Donegall Square West, Belfast;
or through any Bookseller.

INDEX TO VOL. X—1927

The Scottish Journal of Agriculture.

VOL. X.—NO. 1.] JANUARY 1927. PRICE 1s. NET.

MARKETING OF EGGS ACTS, 1924 and 1926 (Northern Ireland).

J. S. GORDON, C.B.E., D.Sc.,
Ministry of Agriculture for Northern Ireland.

THE Department of Agriculture for Ireland was established in 1900, and during the ensuing twenty-one years devoted considerable attention to the marketing in Great Britain of Irish agricultural produce, viz. butter, eggs, potatoes, &c.

In particular, marketing of eggs received special consideration, every effort being made to induce exporters voluntarily to have their eggs properly packed, in suitable boxes, in a fresh and clean condition. The Department's work undoubtedly produced some improvement in the conduct of the Irish egg trade, but this disappeared in 1916, when prices were controlled by regulations made under D.O.R.A. The effect of these regulations was that people became quite careless and indifferent as to the appearance of their eggs and the manner in which they were packed for market. Indeed there was no inducement for them to do otherwise since the controlled price disregarded quality to such an extent that practically the same price could be obtained for all classes of eggs—good, bad and indifferent. The regulations were withdrawn after 1918, and those foreign countries which had before the War exported eggs to Great Britain realised that the then unsatisfactory condition of the home trade afforded them a unique opportunity of recapturing the United Kingdom markets. By the adoption of improved methods in the grading and packing of their eggs the countries in question succeeded in securing a very large volume of the trade —Irish eggs being relegated to a very inferior position. This state of affairs continued up to 1921, when a separate Government for the six northern counties was established.

The Ministry of Agriculture for Northern Ireland began to function on 1st January, 1922 at a time when Irish eggs had practically disappeared from the London market, and occupied only a third or fourth place on the British market generally as compared with the produce of competing foreign countries and the Dominions. One of the Ministry's earliest actions was to investigate the conditions of the Northern Ireland egg trade, and in this connection it sent its Marketing Inspector to London to interview a number of the leading wholesale egg merchants at Smithfield Market. He was informed that no Irish eggs had been sold in London since 1916-17, whereas before the War Irish eggs held a good position on that market. When asked the reason why Irish eggs were not then bought by them, these merchants stated that their experience was that they could rely on the best foreign eggs because they were well packed, graded, and tested, and true to guarantee or invoice, whereas Irish eggs had become so unsatisfactory and so unsuitable in respect of quality, packing and grading that they had to be unpacked, re-sorted, tested and graded before they could be sent out to retail customers—a process which entailed an unremunerative outlay. He also ascertained that the demand for Irish eggs in other English cities was falling off, and that most Irish egg merchants were having considerable difficulty in disposing of their shipments.

Realising that the attempt to improve the industry by voluntary effort was ineffective, the Ministry decided that legislation was necessary, and an Advisory Committee, representing all interests, viz. producers, collectors, retail merchants and wholesale merchants or shippers, was accordingly appointed by the Ministry.

This Committee met on a number of occasions to discuss the matter, and eventually, with the assistance of the Ministry's officials, a Bill was drafted. Before presentation to Parliament the Bill so drafted was submitted to the Farmers' Union, Co-operative Societies and Egg Merchants' Associations, and in the end an agreed Bill was introduced and became law in May 1924.

Owing to certain difficulties arising from the provisions of the Government of Ireland Act, 1920, the Marketing of Eggs Act was much more complicated than otherwise would have been necessary, and a very much wider field had to be covered. As these difficulties, however, are disappearing, consequent on the settlement of the boundary question between Northern Ireland and the Irish Free State, and of the matter of the Council Services, an amending Bill was presented to the Parliament of Northern Ireland in October and became law in November 1926.

The original Act became operative on 1st January 1925, and its chief points are as follows :—

A. All wholesale dealers in eggs must have a licence.

"The Ministry shall grant a licence to carry on business in Northern Ireland as a wholesale dealer in eggs to any person applying for such a licence who complies, or undertakes to comply, with such conditions in relation to the preparation for sale and the consignment of eggs as may be prescribed from time to time by the Ministry with respect to any class of such business in order to secure—

"(*a*) the proper testing, grading and packing of such eggs, and their freshness and fitness for the food of man; and "(b) compliance with the requirements of this Act relating to any such eggs."

By wholesale dealer is meant any person who carries on the business of purchasing eggs for re-sale *otherwise than by retail.* Therefore wholesale dealers include : (a) merchants who ship or export eggs; (b) local dealers in small towns or villages who sell otherwise than by retail; (c) those who buy eggs throughout the country, that is, who gather or collect eggs from the producers.

The extent of the task of getting all these classes to apply for licences will be realised when it is mentioned that during the first year of the operation of the Act no less than 1,734 licences were issued. A licence—the fee charged is 20*s.*—remains in force until suspended or revoked by the Ministry, and up to the present the Ministry has suspended only 25 licences for periods varying from one to six months.

Licences were given automatically to all wholesale merchants who made formal application and gave an undertaking that, if their premises were not suitable or did not comply with the regulations, they would put them in order on being given a reasonable time to do so. By adopting this course, which did not inconvenience or disturb the trade, the Ministry was able to induce practically all the wholesale merchants in Northern Ireland to take out licences during the first year. If the Ministry had first insisted upon premises being put in order before licences were granted, considerable trade difficulties would have been created, and the Ministry could not have received that loyal co-operation which the trade has given it in carrying out the provisions of the Act.

B. Premises where eggs are *preserved, cold-stored* or *pickled* must be registered :—

(a) The owners of such registered premises must keep records and furnish to the Ministry returns showing the delivery, despatch and ownership of eggs dealt with on the registered premises. These records must be open to inspection by the Ministry's officers.

(b) Every package, whether open or closed, which contains any such eggs must be branded with the words "Preserved Eggs," "Cold-stored Eggs" or "Pickled Eggs," as the case required.

(c) If any such eggs are exposed for *sale by retail* there must be attached to, or exhibited with, each lot thereof so exposed, in such manner as to be clearly visible to the purchaser, a label marked, in printed capital block letters not less than one and a half inches square, with the words "Preserved Eggs," "Cold-stored Eggs" or "Pickled Eggs," as the case requires.

C. Certain market authorities must provide covered accommodation for packing :—

"The market authority of every market, in which tolls are for the time being authorised to be taken, and actually are taken, in respect of eggs, shall provide and maintain such covered sheds or other accommodation for the packing of eggs brought for sale at the market as the Ministry considers suitable."

If the market authority fails to comply it is debarred from charging toll in respect of eggs brought for sale at that market.

D. The Act brings into force in every urban and rural district in Northern Ireland, as regards eggs, certain permissive provisions of the Public Health Acts, 1870 and 1890, in relation to articles intended for the food of man. This enables a local authority to prosecute any person who sells or attempts to sell unsound eggs, and already 50 local authorities, out of a total of 64, have appointed trained inspectors to see that these provisions of the Act are carried out.

The regulations made under the 1924 Act prescribe the kinds, sizes, &c. of boxes to be used, as well as the quality of timber and the material for packing.

A question arose as to whether either straw or wood-wool should be used exclusively for packing. Some merchants advocated home-grown straw, while others urged that wood-wool only should be permitted, since this was the material invariably used by our foreign competitors. Ultimately the Ministry recommended the use of wood-wool, but agreed that wheat or oat straw could be used provided it was thoroughly dry, clean and sound.

Another point which caused some little difficulty was whether home-grown or foreign timber should be used for making cases. In rural districts the manufacture of egg cases is a local industry, both seasoned and unseasoned home timber of all kinds being used for this purpose. Most of the hardwood timbers are unsuitable. It has been found that boxes made of unseasoned oak weighed 70 lb. and boxes made of unseasoned beech weighed 60 lb., while boxes of well-seasoned home-grown spruce weighed 33 lb. only. The Ministry in its Regulations prescribes that home-grown timber may be used for egg cases, provided that the wood is well-seasoned, dry, clean and free from bark. The same conditions apply to foreign timber.

E. Eggs must be graded.—The old system was to sort eggs according to different sizes. They were divided into *smalls*, those below 14 lb. per great hundred; *selected*, those not less than 14 lb., with an average weight of not less than 15 lb. per great hundred, and *extra selected*, for eggs not less than 15 lb., with an average weight of not less than 16 lb. per great hundred. It was, however, customary, if a case of selected or extra selected exceeded the nominal weight, to adjust the weight by taking out some of the large eggs and substituting small eggs; so that a case of "selected" eggs could contain 14 lb., 15 lb., 16 lb., and even

17 lb. eggs. This, however, was merely "sorting" not "grading," but it was popular amongst certain merchants in Great Britain since it enabled them to re-grade these eggs into 14 lb., 15 lb., 16 lb. and 17 lb., and thereby to obtain a handsome profit on the higher grades.

It transpired that on an average the percentages of the different grades of eggs passing through the hands of Northern Ireland egg merchants were as follows :—

70 per cent.	15½ lb. grade.
20 to 25 per cent.	below 15½ lb.
5 per cent. (approximately)	17 lb. and over.
2 per cent. ,, ...	smalls.

Accordingly, as it was considered desirable that uniform standard grades with guaranteed weights should be provided, the Ministry, with the approval of the trade, decided to prescribe the following grades in the Regulations made by it under the Act :—

Grade 18 lb.—For eggs of uniform size weighing 18 lb. per 120. No twelve eggs in any 120 shall weigh less than 28 oz.

Grade 17 lb.—For eggs of uniform size weighing 17 lb. per 120. No twelve eggs in any 120 shall weigh less than 26½ oz.

Grade 15½ lb.—For eggs of uniform size weighing 15½ lb. per 120. No twelve eggs in any 120 shall weigh less than 24 oz.

Grade 14 lb.—For eggs of uniform size weighing 14 lb. per 120. No twelve eggs in any 120 shall weigh less than 21½ oz.

Grade "Smalls."—For eggs too small for inclusion in the 14 lb. grade and weighing less than 21½ oz. per dozen.

The principal merits of this system are that graded eggs carry better; that each grade represents a definite guaranteed weight per 1 hhd. (10 doz.); and that the eggs in each grade are of uniform size.

The other system of offering "selected" eggs, to which reference has been made, consists in merely selecting the eggs and guaranteeing the *average* weight in each selection. This method, however, does not provide uniformity in size, and for the better class trade, for which uniformity is demanded, necessitates re-handling and proper grading by the purchaser.

The first of these grades was included at the request of the representatives of certain districts where it is claimed that a high proportion of very large eggs was produced. As the Ministry does not encourage the despatch of the last grade (Smalls) to markets in Great Britain, there are in effect only three main grades for export, viz. 17 lb., 15½ lb., and 14 lb.

Each egg in a case must approximate closely to the general average of the eggs in that case, and the top layer must be fairly representative of the bulk in size, colour and appearance. Apart from the special provisions for preserved, cold-stored and pickled eggs, only "Fresh" or "New Laid" eggs may be included, and to this end it is prescribed that, amongst other characteristics which must be present in a "Fresh" or "New Laid" egg on being tested, the air space may not exceed a quarter inch.

The Regulations also require that an egg shall be rejected on test if :—

(*a*) It is opaque or black;

(*b*) The white is dull, cloudy or streaky, or the yolk cannot be distinguished—this condition usually indicates a broken or spread yolk, and the egg is known as "spent."

(*c*) The yolk is distinctly darkened in appearance, flattened in shape and floating near to the shell;

(*d*) The yolk is anywhere in contact with the shell, under which conditions the egg is known as "sided." Contact is denoted by a spot on the inner side of the shell, and also by the fact that, when the egg is turned quickly, it is observed that the yolk adheres to the shell;

(*e*) It contains blood spots or has dark or mould spots under the shell.

Their experience of the working of the 1924 Act impelled the principal egg exporters in Northern Ireland early in the present year to make representations to the Ministry as to the desirability of bringing in an amending Bill to deal more particularly with :—

1. the compulsory purchase of eggs by weight;
2. the prohibition of the sale of dirty, soiled, stale or unsound eggs by producers; and
3. the application to persons purchasing eggs for re-sale by retail of the same conditions as apply to wholesale merchants.

Practically the whole of the trade pressed the Ministry to make compulsory the purchase of eggs by weight, which it was contended would be fairer to both producer and exporter than the customary sale by count. It was pointed out that one of the chief difficulties of the trade was the disposal of the small egg (14 lb. or less per great hundred of 120 eggs), inasmuch as the egg in greatest demand in Great Britain is (as a minimum) the 2 oz. egg or 15 lb. per great hundred.

In certain districts of Northern Ireland eggs are purchased by weight from the producer instead of as elsewhere by the dozen or by count. When purchased by the latter method practically the same price is given for large eggs as for small eggs, so that there is no inducement for poultry keepers to produce large eggs—in fact it has had the other effect, viz. to produce quantity at the expense of size. Producers, therefore, sold their small eggs and used the large eggs at home.

In one district where eggs have been purchased by weight for many years it was observed that in the beginning the number of small eggs offered for sale was very high, but in a short time this grade represented only 17½ per cent. of the eggs offered for sale—more than 82 per cent. being 15½ lb. and over per long hundred. The average weight per 120 of the eggs purchased by one of the principal wholesale dealers operating in the district in question increased until it was 16¼ lb. from one year's end to another. Producers in that district found that it paid them to sell the large eggs, and they increased the size of the eggs for sale by consuming the small eggs at home and by paying more attention to breeding poultry which lay large eggs.

If eggs are bought by weight, breeders of poultry will pay more attention to the production of large eggs, and laying competitions will have far greater effect than they can possibly have at present. So long as eggs are purchased by count, laying competitions can have little influence in encouraging the production of larger sized eggs.

The 1924 Act applied to wholesale merchants only, producers and retail merchants being unaffected by it, except as regards preserved eggs. The trade, however, put forward a claim, which the Ministry considered reasonable, that the Regulations for wholesalers as laid down under the original Act should apply also—so far as appropriate—to producers and retailers because, unless poultry keepers were compelled to market only clean, fresh eggs, it would not be possible for wholesale merchants to comply with the Regulations. Further, if retail merchants were permitted to purchase in the same market as the wholesale merchants and not be bound by the same Regulations a considerable dislocation of trade would result, and wholesale merchants would inevitably lose many of their regular suppliers.

The Ministry gave very careful consideration to these several representations, and having conferred with its Advisory Committee and consulted the agricultural bodies referred to above, decided to take action on the lines suggested. The necessary provisions were accordingly inserted in the amending Bill which has just become law.

The results achieved in the short period that has elapsed since the Act of 1924 came into operation have far exceeded the Ministry's anticipations. It is a fact that a most gratifying improvement in the methods of marketing Northern Ireland eggs generally has been effected. The best graded eggs from our small area are now securing across the Channel prices equal to those for foreign eggs of the best quality, and in some instances, indeed, they are quoted higher. It is the intention of the Ministry not to relax its efforts until the desired object has been attained of placing Northern Ireland eggs in the premier position on the markets of Great Britain.

SOME OBSERVATIONS ON THE CAUSE OF LANARKSHIRE STRAWBERRY DISEASE.

C. W. WARDLAW, Ph.D.,

Botany Department, University of Glasgow.

THE "Lanarkshire Strawberry Disease," which is now regarded as being something in the nature of an epidemic, began to be noticed by growers sometime about 1920. Since then it has increased in some areas to a disastrous extent, 1922 and 1926 being conspicuously bad years. A strawberry disease has also been reported in the south of England during this period, but there is reason to believe that the disease there is not the same as that in Lanarkshire. There is also the further point that the conditions of cultivation in Scotland and in England are not quite comparable. Both share two characters in common, however, namely, the disease presents many different aspects in the field, and also the diagnosis and cure of the disease have proved to be problems of a puzzling and difficult nature. In drawing up this preliminary report, therefore, the author wishes to point out that the observations set forth regarding the cause of the disease do not necessarily cover all the aspects of the problem encountered in the field. The observations, rather, represent a study of what appears to be the most pronounced features of the "Lanarkshire Strawberry Disease." The observations recorded here refer to the variety "John Ruskin," which has a wide cultivation in Lanarkshire, and which appears to be particularly susceptible to disease in this district.

In the field the disease presents many aspects of a varied and, at first, baffling nature. Two features are particularly noticeable, namely, the rapid spread of the disease through the strawberry beds, and the obviously diseased condition of individual plants. From the point of view of diagnosis the disease presents many difficulties, and a satisfactory understanding has only been reached by a consideration at all seasons of the year of the soil, the plants, and the activity of possible parasites. A system of research of this kind was conducted during 1926, the results of which are tentatively summarised as follows.

Appearance of Diseased Plants (Figs. 1 and 2).—In general the diseased plants are of squat stature, with discoloured leaves (often with red margins); they fail to form fruit, and there is a decline in the formation of runners. Young plants in a diseased condition have a stunted sickly appearance with yellowish leaves. In short the plant shows many symptoms like those due to starvation. Examination of the root-system shows that the roots may be partially or completely rotted. This is true of any kind of root. In the case of very young roots and rootlets the disease may first appear as blemishes or discolorations, which in a more advanced condition resemble the "damping-off" effect familiar to growers. In the stouter roots there is a somewhat similar state as the dying-back takes place. When a diseased plant is lifted

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 1.

A typical diseased plant, showing squat stature, smallish procumbent leaves, and the insignificant root-system. Note how the primary roots have been deprived of their fine fibrous rootlets.

FIG. 2.

A more accentuated example of the disease. Note the general stunted appearance of the plant and the demolished root-system. This is quite a typical example taken from a stiff soil. The clay adhered so closely to the roots and root-stock of the plant that it could be washed off only with difficulty.

FIG. 3.

A healthy plant grown in free garden soil, showing the erect habit of the leaves, the general vigour of the plant, and the well developed root-system. Such a root-system compares favourably with strawberry roots growing in the English soils.

one is struck by the insignificance of the root-system. The diseased plant may have roots extending into the soil to the depth of two, three or four inches only. These are mostly brown or black and rotted. The stout primary roots are found to be rotted at the tips, and they are denuded of practically all their fine fibrous rootlets. Microscopic investigation revealed the presence of fungal filaments in the diseased portion of the roots. Above the diseased portion, however, and also in the root-stock, petioles and leaves, no fungal filaments were observed. Young blemished roots and rootlets were found to have fungal filaments associated with them.

Observations such as these lead to the examination of three possible causes of disease :—

1. The condition of the soil.

2. The general health of the plant, with special reference to favourable root development.

3. Presence of possible parasites.

The Soil. — The soil in the infected fields is for the most part heavy and close, sometimes almost a clay, and seldom sufficiently free for healthy root development. It is acid, though not to an excessive degree.[1] The significance of soil acidity in relation to the growth of the strawberry is as yet not fully understood. It is probable that the strawberry tolerates or thrives on a slightly acid soil, but accurate knowledge on this point is desirable. Acidity of the soil, however, usually leads to an increase in the fungal flora, and competition with the root-hairs for the food materials in the soil is thereby introduced.

Further, the soil lacks humus, and it has not the proper coherence and openness. Where the disease is worst the drainage is bad; the soil is water-logged in wet weather and practically hard-pan in dry. It must be pointed out here that the natural drainage should be good, since many of the strawberry fields are situated on steeply sloping hillsides, hillocks and mounds. In actual practice it is found that the drainage is not what it should be. This is due to the physical condition of the soil. The soil particles are of very fine texture and run together with moisture, so as to give a sticky mass which is almost a clay. This soil, with its close texture and colloidal nature, is very retentive of water. When a mass of it is allowed to dry it shrinks and forms a very firm, heavy and hard coherent block. When crumbled in the hand it goes into a fine powder. When shaken up with water the particles remain in suspension for a very long time. It is clear that a careful study of the soil is required. For the present it is enough to note that the soil in the diseased fields presents to the growing plant those same difficulties now associated with soils of fine texture, where considerable quantities of fine silt and

[1] "pH" varying between 6·0 and 6·8, with an average about 6·4. In some fields "pH" of 5·6 and 5·8 have been recorded. Fertile soils have "pH" close to the neutral point, 7·0.

clay are present. There is thus a lack of humus and a probable need of lime.

Cases of disease have also been noted in fields where the soil is comparatively free and open. In such cases, which are being kept under observation, there is reason to believe that the soil is in an impoverished condition. This therefore would be another source of weakening of the root-system, thereby making it more susceptible to parasitic organisms.

Such soil conditions necessarily tell against the vigorous healthy growth of the strawberry plants. For the most part in the areas where the disease is prevalent it cannot be said that they are growing under the most favourable conditions. When lifted, the roots of many of the plants, though not actually diseased, are in a weak and lax condition, consequent on the excessive stiffness of the soil, combined with lack of adequate ventilation. In short the field observations all tend to indicate that the state of the plant itself, and not the causative organism of the disease, is of first importance. It would thus appear that the poor root-system with its soft and limp roots, and the starved condition of the plant, are due to unfavourable soil conditions plus fungal competition. These general conditions, which tell against the plant, favour the fungal flora of the soil, and thus the plants are rendered very susceptible to fungal and other diseases.

The Plants. — Many difficulties have been made clear by studying the development of the root-system in conjunction with the soil conditions described in the previous section. It is unnecessary to do more than call attention to the unhealthy condition of roots in general in waterlogged or stiff soil. There the root-system tends to be poorly developed, limp and lax, and with only a slight development of lateral rootlets. As a whole there is a marked absence of the extensive and bushy development of roots and rootlets found in free open soil (fig. 3). This, however, is only one of the difficulties of rooting under adverse soil conditions. During the summer runners are thrown profusely and the young offshoots begin to root. When the soil is in the hard-pan condition (noticed in many cases during this year), the young roots have the greatest difficulty in penetrating into the soil at all. The result is that the runner fails to root and simply sits on the surface of the soil. As a result the young roots which are developing are either damaged at the tips or become splayed out along the surface of the soil, and while dry weather continues rooting is unsuccessful. The results of these conditions are very important in the subsequent development of the young plants. In the first place the development of the root-system as a whole is delayed till the soil is moistened by rain. Owing to injury of the root-tips of the primary roots, growth is then very often carried on by thin lateral rootlets (growing out behind the damaged root-tip), whose power of penetrating into the stiff soil is by no means comparable with that of the stout primary roots. Once in the soil the bushy root development seen in healthy plants does not take place. There is the further point that the delay in penetrating, coupled with the stiffness of the soil, prevents deep rooting, and thereby leaves the plants more liable to frost, drought, and other sources of injury.

In fig. 3 a healthy root grown in a large pot of free garden soil is shown. This indicates the extent of healthy root development, and shows how far behind the ordinary field roots are in active root formation. Such a root though grown in a pot is not to be regarded as unusual. Pot culture certainly does favour strong root development, but it is found that such roots are comparable with typical roots grown in field conditions in English soils. Such roots indeed may be seen in the various published works on the strawberry plant.[1] In conclusion, the evidence from the plant itself is found to bear out the contention stated in a previous section, namely, that the state of the plant itself and not the causative organism of the disease is of first importance.

Organisms causing the Disease.—Without prejudging the evidence in any way, the observer is struck by the absence in a diseased plant of those fine roots and rootlets which play the chief part in the actual absorption of the mineral salts and water from the soil. It is concluded that the destruction wrought on the fine absorbing roots is responsible for the various signs of starvation perceptible in the green aerial part of the plant and for its final decline and death, in fact for all the symptoms usually associated with "Lanarkshire Strawberry Disease."

Wounding organisms of various kinds, such as eelworm, cannot at this stage be ruled out altogether as first causes in the attack; the general evidence, however, points to the fact that the ultimate and rapid decline in the vitality of the strawberry plant is due to the exploitation of the root-system (especially of the fine absorbing roots) by fungal hyphæ.

Attempts were made to isolate, by the usual mycological methods, the fungus or fungi concerned in the decay. For this purpose diseased roots of all kinds were used, and from these a species of *Pythium* was isolated a large number of times, and was shown by inoculation experiments to be capable of producing the disease. The general evidence to hand demonstrates that the *Pythium* is capable of producing the disease as it occurs in field conditions. These observations, however, do not necessarily rule out other causes of disease. Some inoculation experiments were also carried out with another of the isolated fungi, and this also proved capable of attacking the strawberry roots. Under conditions unfavourable to the plant it is probable that a number of the soil fungi will prove capable of attacking the roots. It is also probable that under special conditions a great many of the soil saprophytes, ordinarily harmless, may develop parasitic tendencies. This tendency will be furthered by any reduced vigour of the crop plants. Further experiments along these lines are in progress. In the field it has been found that there are

[1] As an example of well-rooted plants grown in English soils, reference should be made to the illustrations in *Research and the Land*, Ministry of Agriculture and Fisheries, 1926, p. 128.

two periods of fungal attack, namely spring and autumn. The fungi referred to were isolated from the spring infection. It is possible that isolations from the autumn infection will reveal some additional parasites.

Without stressing such evidence as there is to hand at the present time, it appears to the author that whether *Pythium* is or is not the primary agent causing the disease, there can be no doubt that it has, under certain conditions, the power of exploiting the root-system on which the general health of the plant depends. Further, it is to be noted that *Pythium* is a fungus which exploits quickly and spreads very rapidly, both of which features are in accordance with the striking aspects of the disease as seen in the field.

In the light of these observations it is clear that the problem is probably an agricultural rather than a mycological one; that is, curative treatment is to be sought along lines where the sanitation of the soil and general healthy rooting of the plants are the main objects in view. The main factor involved in the strawberry disease appears to be the general health of the plant. The fungal attack is to be regarded as an important accessory to the main factor. It is, however, a factor which has become increasingly aggressive owing to the accentuation of certain soil conditions. If the roots reach a sufficient state of laxness and ill-health they are liable to be attacked by any of the parasitic soil fungi. Thus the disease may be due to fungal agency without necessarily being referable to one parasite in all cases.

In view of this finding, experimental work with the soil and observations on the rooting of the strawberry plant are being carried out side by side with the mycological studies.

The author wishes, in conclusion, to express his thanks to Professor J. M. F. Drummond for much helpful criticism and advice during the progress of these researches.

AGRICULTURAL RESEARCH IN THE BRITISH EMPIRE.

J. S. Thomson, M.A., B.Sc., and J. B. Orr, D.S.O.,

The Rowett Research Institute.

III. Agricultural Research in New Zealand.

In two previous articles in this Journal accounts were given of the development and organisation of research in South Africa and in Canada. It was shown that in both of these Dominions workers were engaged in problems of essentially the same nature as those engaging the attention of research workers in this country. It was further shown that the results, in addition to being of great economic value to the countries in which the work was done, were also throwing light upon similar problems in different parts of the Empire, and the desirability of team work for a united attack on problems affecting different parts of the Empire was discussed. The desirability of co-operation in research effort throughout the Empire is now being fully recognised. It is a noteworthy fact that the recent Imperial Conference devoted a special sub-committee to the discussion of ways and means of developing Empire Research.

In the present article an attempt is made to give some idea of research activities in New Zealand. This Dominion is certain to take a very prominent place in connection with the future development of agricultural research within the Empire. The work being done there is of special interest to this country, because Britain receives 85 per cent. of the total agricultural products exported from the Dominion.

New Zealand is a country specially favoured by climatic and soil conditions for both stock farming and fruit growing. In recent years very rapid developments have taken place in dairying, sheep farming and fruit growing. Amongst our Dominions and Colonies, New Zealand has become the largest exporter of both butter and dried milk. Her sheep are famous throughout the world, and New Zealand frozen mutton forms a substantial part of the meat consumed in Britain. Fruit growing is developing very rapidly. The future of the industry, however, depends upon improvements in methods of transport. A very extensive investigation on the methods of handling and storing fruit for transport is being undertaken. As the difficulties of transporting this perishable commodity are overcome, there is certain to be a great increase in the amount of New Zealand fruit put upon the British market.

The success of agriculture in New Zealand is shown by the steady increase in the export of agricultural products. In 1913 the total exports amounted in value to nineteen and a half million pounds, and in 1923 the total reached forty-one and a half million. An even more marked increase is likely to be shown in the present decade.

Organisation of Research.—The Department of Agriculture, which is under the control of the Minister of Agriculture, is a service mainly concerned in the advancement of the interests of primary production. Under a Director-General of Agriculture there are divisions for Live Stock, Dairying and Horticulture, and in addition two separate sections for Chemistry and Biology. The service is mainly educative, though it also carries out important inspection work. The research work of the past has been done chiefly by men whose time was largely occupied with educational, administrative or other duties.

There are several State Experimental Farms and Horticultural Stations which carry out experiments and demonstrations of national as well as local importance, and farmers are encouraged to visit these farms and see the experiments in operation.

In addition to the above work carried out by the Department of Agriculture, teaching and research is done by the colleges affiliated to the New Zealand Universities.

By an Act of Parliament passed in 1913 provision was made for the establishment of a Board of Agriculture, consisting of representatives from the Agricultural and Pastoral Societies of both Islands, whose function was to advise the Minister on matters relating to agriculture; in particular to give advice in the aiding and improving of agriculture and rural industries, the prevention and control of diseases in stock, the control of noxious weeds, the establishment of agricultural colleges, and the facilitating of the carriage and distribution of produce.

In 1925 a further attempt was made to organise all scientific activities, including agricultural research, by the setting up of a Committee of Scientific and Industrial Research. It is intended that the Committee will suggest means for co-operation and co-ordination of research work carried out by University Colleges, other Institutes, or even private workers. It is too early to predict what influence this ambitious scheme will have upon the development of agricultural research.

Of the research work not controlled by the Government the most important is that carried out by the Cawthron Institute, which is named after the late Mr. Thomas Cawthron, an Englishman who migrated to New Zealand in early life. He bequeathed £240,000 for the establishment of this Institute. It consists of a commodious building with well equipped laboratories, a museum and a library. The entomological section of the library is considered to be one of the finest in the world. The chief work of the Institute is research in agriculture and fruit growing. It was opened by Lord Jellicoe in 1919.

Nature of Research Work.—The following reference to some of the main lines of investigation which are being carried out will give an idea of the nature of the work.

Wheat Breeding.—The varieties of wheat used in New Zealand were imported from England between the years 1850 and 1880. They were cultivated for thirty or forty years without any selection, and consequently crops were of mixed varieties. In 1910 there were fields of wheat where even a wheat breeder could not tell the variety the farmer had intended to sow. The uneven ripening caused severe losses, and the Board of Canterbury College undertook the work of raising pure strains of the best varieties. Hilgendorf and his co-workers, after several years' work, succeeded in producing pure strains. It is estimated that in general these yield 4 bushels per acre more than the mixed strains they replaced.

The quality of the wheat for bread-making is almost as important as the yield. The staff of the Chemistry Section has been investigating the baking qualities of different strains in producing a good loaf, and certain important correlations between the chemical composition and the results of experimental baking tests have been discovered. Further work in breeding and selection is being done to obtain new strains which will combine heavy yields with good quality.

Control of Noxious Weeds.—One of the agricultural problems with which New Zealand is faced is the eradication of weeds. There are large tracts of country, both cultivated and uncultivated, which are more or less weed infested. Indeed, in some parts fertile land is being put out of cultivation by the steady encroachment of these pests. One of the most troublesome is the blackberry or bramble. The extent of the spreading of this plant may be judged by a saying current in the West Coast of the South Island that they have only one blackberry bush, but it is 200 miles long. Chemical control by spraying is expensive, and at best is only a temporary expedient. A new method of eradication is being attempted by what is known as "biological control." This consists in adjusting the "balance of nature" in such a way that the pest becomes eliminated by natural processes through the activities of either insects, animals or plants which destroy the noxious weed, as, for example, is being done in the case of the prickly pear in New South Wales. This plant was spreading at the rate of about a million acres per annum. Through the efforts of the entomologists a species of insect was discovered which feeds upon the plant and destroys it. This insect has been introduced to New South Wales, and the formidable problem of the prickly pear looks to be on the way to solution. Tillyard, head of the Entomological Department of the Cawthron Institute, has undertaken an investigation into the means of the "biological control" of the blackberry. The problem is one of great difficulty, as there is a danger in introducing any insect which is known to feed on plants other than the blackberry. The Cawthron Institute, however, is in touch with all the important work on "biological control" that is being done throughout the world, and there is reason to hope that success will attend the efforts in this new and highly important line of research. It is thought that the same method of "biological control" may be applicable to other noxious weeds, such as Gorse and St. John's Wort.

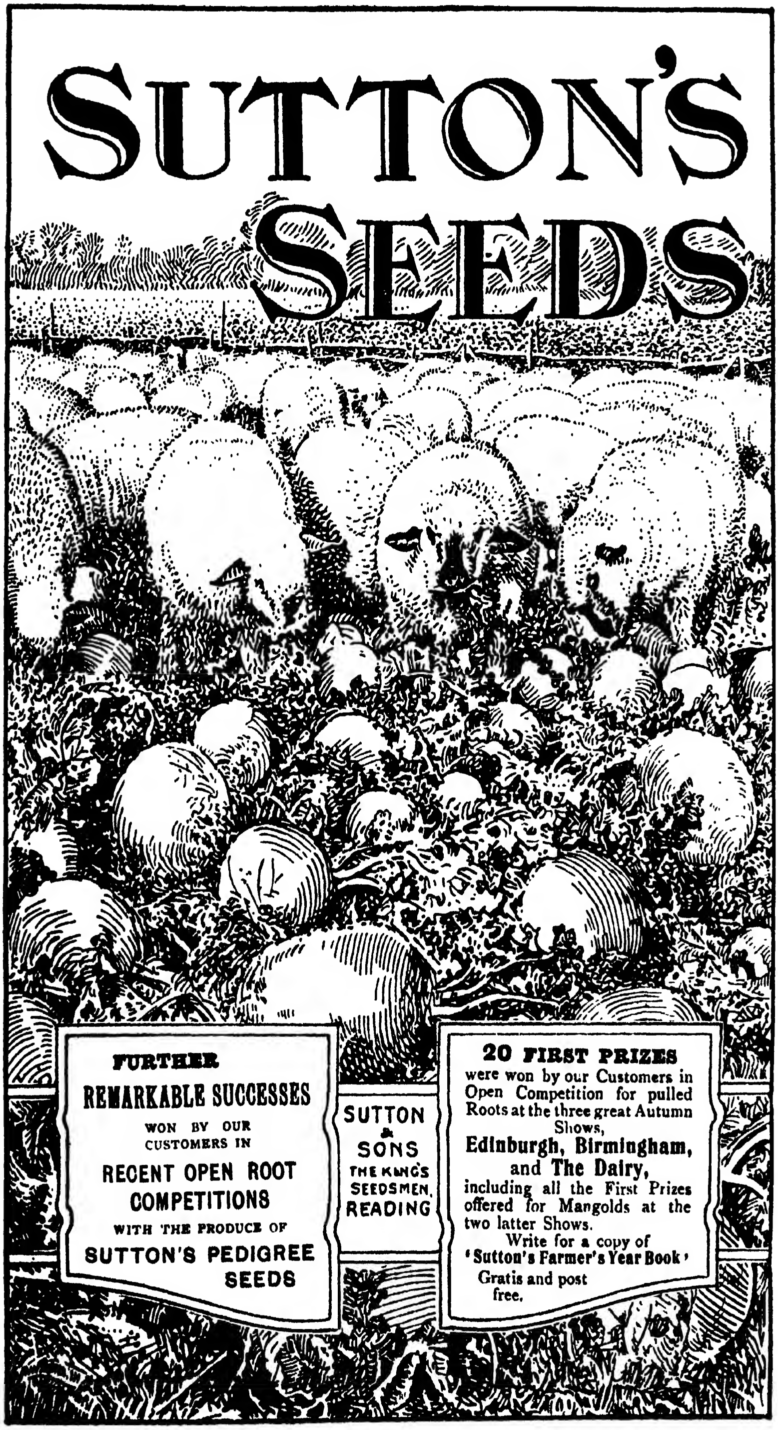
Fruit Growing.—One of the most interesting investigations in connection with fruit growing is that of the control of injurious insects. One of these injurious insects is the woolly aphis. This pest originated in North America, and in many countries is known as "American Blight." In New Zealand, probably owing to the equable climate, the pest became very virulent, and indeed threatened the continuation of the apple growing industry. Six years ago the Cawthron Institute, which had only then been established, was asked to undertake the task of finding means of eliminating this pest. After two or three years' study, involving some failures and disappointments, which, indeed, are usually associated with research on new lines, a suitable insect was obtained from America through the Bureau of Entomology at Washington. This insect was acclimatized and multiplied in insectaries. It was then distributed in large numbers to apple orchards. The result has been that the woolly aphis is now under satisfactory control and is no longer regarded as a serious pest in New Zealand.

Malnutrition in Stock.—Though New Zealand is in many ways such an excellent stock country, deficiency diseases occur in some districts. A disease in the bones was noticed some time ago amongst sheep which had been moved from one pasture to another. They ceased to thrive, and when made to walk they were seen to be lame. Fractures of the bones were frequent. Postmortem examination showed that in well marked cases the bones had become thin and shell-like. An investigation into the cause of this condition revealed the fact that the land on which this condition occurred was deficient in lime and phosphorus. The appropriate measures have been taken to prevent this disease in sheep. It is still, however, prevalent among cattle, especially in heavy milking cows. These are treated by the administration of substances deficient in the pastures, but there is urgent need for further work in determining the nature of the deficiencies in the various pastures and fodder plants.

A specially interesting case of deficiency disease, known as "bush-sickness," occurred in a district in North Island. The researches of Aston, head of the Chemical Division, have established the nature of this disease, and what is more important a successful method of treatment. The chief symptoms are extreme anæmia and emaciation. The administration of iron salts leads to a cure.

Economic Importance of Research.—The above notes, scrappy though they are, are sufficient to show that the agricultural research being carried out in New Zealand is yielding results which are increasing the wealth of the country. It has been stated above that it is estimated that the work in the selection and breeding of wheat has increased the yield by about 4 bushels per acre—a result of considerable importance in a country which produces eight million bushels per annum. The work recently begun on the "biological control" of noxious weeds and injurious insects has already, as indicated above, been of great value to the apple growing industry, and its developments are full of possibilities. It is estimated that 20 per cent. of the total value of crops throughout the Empire is lost through the depredation of insects and the growth of noxious weeds. Owing to the great importance of the dairying and sheep raising industries, the work being done on deficiencies in the pastures is at least as important as these other lines of research.

In view of the attempts being made at the present time to secure co-operation in research within the Empire, it is of special interest to note that all the main lines of research being carried out in New Zealand have a direct bearing on problems in other parts of the Empire. Thus the problems on mineral deficiencies in the pasture are of the same nature as those to which reference has been made in the two previous articles as occurring in South Africa and Canada, and the work on these problems in New Zealand is throwing light upon similar problems elsewhere. Aston's work on "bush-sickness" has proved of value in connection with a somewhat similar disease occurring in limited


SUTTON'S
SEEDS
FURTHER
REMARKABLE SUCCESSES
WON BY OUR
CUSTOMERS IN
RECENT OPEN ROOT
COMPETITIONS
WITH THE PRODUCE OF
SUTTON'S PEDIGREE
SEEDS
SUTTON
&
SONS
THE KING'S
SEEDSMEN,
READING
20 FIRST PRIZES
were won by our Customers in Open Competition for pulled Roots at the three great Autumn Shows,
Edinburgh, Birmingham, and The Dairy,
including all the First Prizes offered for Mangolds at the two latter Shows.
Write for a copy of
'Sutton's Farmer's Year Book'
Gratis and post free.

areas in Kenya Colony and in the South of Scotland. In the same way the work on "biological control" of injurious insects and noxious weeds is of general Empire interest. Indeed some of the work referred to above has already been applied successfully in Australia.

In recognition of the value to the whole Empire of the work in New Zealand on deficiencies in the soils and pastures, a special grant has been made by the Empire Marketing Board Research Committee for an extension of the work now proceeding on the mineral content of pastures. This extended work is to be carried out as part of a general scheme which connects up the work on mineral metabolism at the Rowett Institute, phosphorus deficiency in South Africa, mineral deficiencies in pastures in East Africa, and indeed all the important work of this nature throughout the Empire.

A grant from the Empire Marketing Board has also been received by the Cawthron Institute for an extension of the work on the "biological control" of insects. This investigation will be linked up with work being carried out at the Imperial Bureau of Entomology in London.

By means of this correlation of effort, whereby all available information bearing on the problem can be pooled, it is hoped that the solution of many of these problems which are of Empire importance will be reached in a shorter time, and with less expenditure of money than if each centre had been isolated and working independently.

THE CAUSES OF VARIATION IN THE PROPORTION OF BUTTER FAT IN MILK.

J. F. TOCHER, D.Sc., F.I.C.

Introductory.—In my last contribution to this Journal [1] I discussed the proportion of water in milk, and showed that it was not possible for a public analyst to state from the results of his analysis the *amount* of water added to milk. The reason given was that milk was extremely variable in composition, and therefore, unless the analyst knew the composition of the milk prior to adulteration, it would not be possible for him to state the extent to which water had been added. The highest proportion of water found in any sample of milk from healthy cows is about 90 per cent. There would therefore be a strong presumption that water had been added if a higher proportion of water than 90 per cent. were found on analysis to be present. The *amount* of water added, however, could not be stated unless the actual proportion in the original sample had been previously determined. Bound up in this problem of the amount of water in milk is the problem of the total solids in milk. Since the proportion of

[1] *Scottish Journal of Agriculture*, vol. ix., No. 4, pp. 351-56.

water varies from 82 to 90 per cent. in milk the proportion of solids must vary from 18 to 10 per cent. Total solids as such, however, are not subject to any Regulations by the Board of Agriculture.

Water not the only probable adulterant of milk.—The constituents named by the Board in their Regulations are "milk solids other than milk fat" on the one hand and "milk fat" on the other hand. I propose in this article to discuss a few of the causes of variation in "milk fat," or "butter fat," as I prefer to call it. In a future article I hope to deal with solids-not-fat in a similar manner. It is presumed for the purposes of the Sale of Food and Drugs Acts until the contrary is proved that, if a sample of milk contains less than 3 per cent. butter fat, it is not genuine by reason of the abstraction therefrom of butter fat or the addition thereto of water. It is now obvious that one of the reasons given for the presumption (namely, the addition of water) is not sound, because skimmed milk containing no butter fat could be added to genuine milk, thus reducing the proportion of butter fat in the original sample, just as water would do. In other words, skimmed milk and not water could be the medium of adulteration. In my opinion the words "skimmed milk or other fluid" should have been added to the paragraph constituting Regulation No. I, so that the end of the paragraph may read, "or the addition thereto of water, skimmed milk or other fluid." Many instances of adulteration have occurred by the addition of skimmed milk to genuine milk.

The reasons why milk may be of poor quality—the analyst's position. — In the case of a sample containing less than 3 per cent. butter fat the public analyst is not required to state on his certificate his opinion as to the cause of the poor quality of the milk. All he is required to do is to give the results of his analysis. He is not required to state on his certificate his view that there has been abstraction of butter fat or addition of skimmed milk or water or other fluid. The reasons for this are very obvious and include the following :—(1) The sample may be a sample of milk properly taken from a small herd of cows, and it is known that, owing to the operation of various factors which I shall later enumerate, small and even moderately large herds frequently give bulked milk containing less than 3 per cent. butter fat. (2) The sample may have been improperly taken. For example, the sample may be in a pint bottle which has stood for some time, thus allowing for the accumulation of butter fat in the neck of the bottle and necessitating the emptying of the contents into another vessel in order to secure proper mixing of the butter fat before dividing the sample into the three parts required by the Act. The official sampler, however, may have divided the sample into three parts without properly mixing the contents of the bottle, and the analyst may have no knowledge of this fact. (3) The poor quality may arise from the fact that the sample was taken from the bulked milk of cows after a long interval; say 12 to 15 hours after the previous milking. It has been proved many times that, with a short interval between two milkings, the proportion of butter fat is high, and, with a long interval between two milkings, the proportion of butter fat is low, when compared with the per cent. obtained from the same cows when the intervals between the milkings are equal. These reasons are sufficient, and they are not all the reasons, why an analyst should not state on his certificate, from the results of his determination of butter fat, that the sample is a sample of adulterated milk. (4) Butter fat may have been abstracted by the seller prior to sampling. (5) Skimmed milk or other fluid may have been added to the milk prior to sampling. If Nos. 4 and 5 had been practised by the dairyman they would of course be distinct proofs of adulteration, but the public analyst, as analyst, can have no knowledge of such tampering with the milk. He cannot tell which of the five above or other reasons is the cause of the poor quality of the milk.

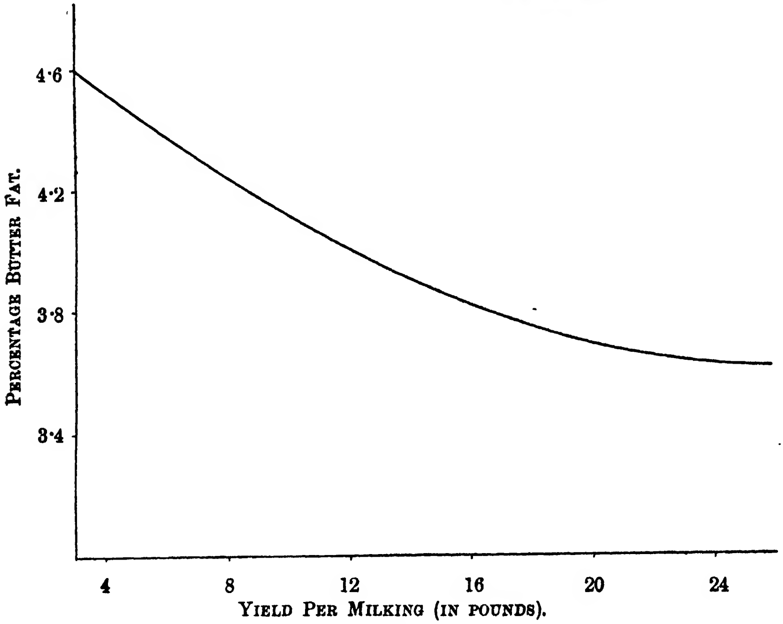
The analyst and evidence in Court.—In Court the public analyst can state his experience of the composition of milk, and this certainly is an aid to the Court, after the Judge had heard the evidence of the seller's witnesses in defence of his contention that the milk was genuine and had not been interfered with by him or his staff in any way. The public analyst, however, must be very cautious in giving his evidence, in order not to mislead the Court as to the facts of variation in the composition of milk. A few examples may be given as to how this caution is exercised. It is well known that many dairymen select certain cows because of their inherited characteristic of giving milk rich in butter fat. There are other dairymen, however, who are careless in this respect, and the law does not at present require dairymen to purchase cows giving a high percentage of butter fat. The tendency of many dairymen is indeed in the direction of purchasing cows with a high milk yield. It is known, however, that cows with a high milk yield generally give milk with a lower percentage of butter fat than the average. The following diagram (Diagram I) shows the general relationship between percentage of butter fat and yield in milk. Now the public analyst is furnished with no information whatever as to the milk-giving and butter-fat-giving qualities of the herds of cows, the bulked milk of which is sent in to him for analysis. Even if he had this information it cannot have an absolute value with regard to the sample analysed, because the quality of milk obtained from a herd of cows on any one day is not necessarily the same as the quality found on a succeeding day or on succeeding days. In order to emphasise this fact, one example can be given of the composition of milk on succeeding days of a herd of 24 cows. A herd of 24 is not a small herd, and yet one finds daily variations of considerable magnitude in the proportions of butter fat. It must also be remembered that the smaller the herd, the greater will be the daily variations. The milk from one cow certainly does show wide daily variations compared with the milk from a herd of 24 cows. The undernoted diagram

(Diagram II) shows the daily variations in the percentage of butter fat of 24 cows over a period of 39 days.

Do byre samples really help in detecting adulteration?—This raises the question as to whether it is scientifically sound to recommend that byre samples should be taken in cases where samples of milk have been found to be below 3 per cent. in butter fat. My personal view is that such byre samples do not help the Court very much, because there is no constancy in the proportions of butter fat found in the bulked milk of the same cows day after day. The public analyst should not mislead the Court into thinking that because a byre sample was found on analysis to give a higher proportion of butter fat than the original sample, therefore the original sample was adulterated. Before

DIAGRAM I.

Regression of Butter Fat on Yield per Milking.



an opinion can be given by an expert as to the probability of the original sample being adulterated from the result of analysis of the byre sample one must know the daily variations found at random in herds of 1, 2, 3...... n cows, and compare the variations in the bulked milk from n cows with the variation actually found in the herd of the particular size n.

The role and limitations of random samples.—The public analyst can lay before the Court facts bearing on the variations found in butter fat from samples of milk properly drawn from a large number of cows taken at random throughout the country. Under the auspices of the Inter-departmental Committee on Milk (Scotland), 1922, such samples were analysed and the variation in butter fat from individual cows actually determined. The following diagram (Diagram III) shows that the

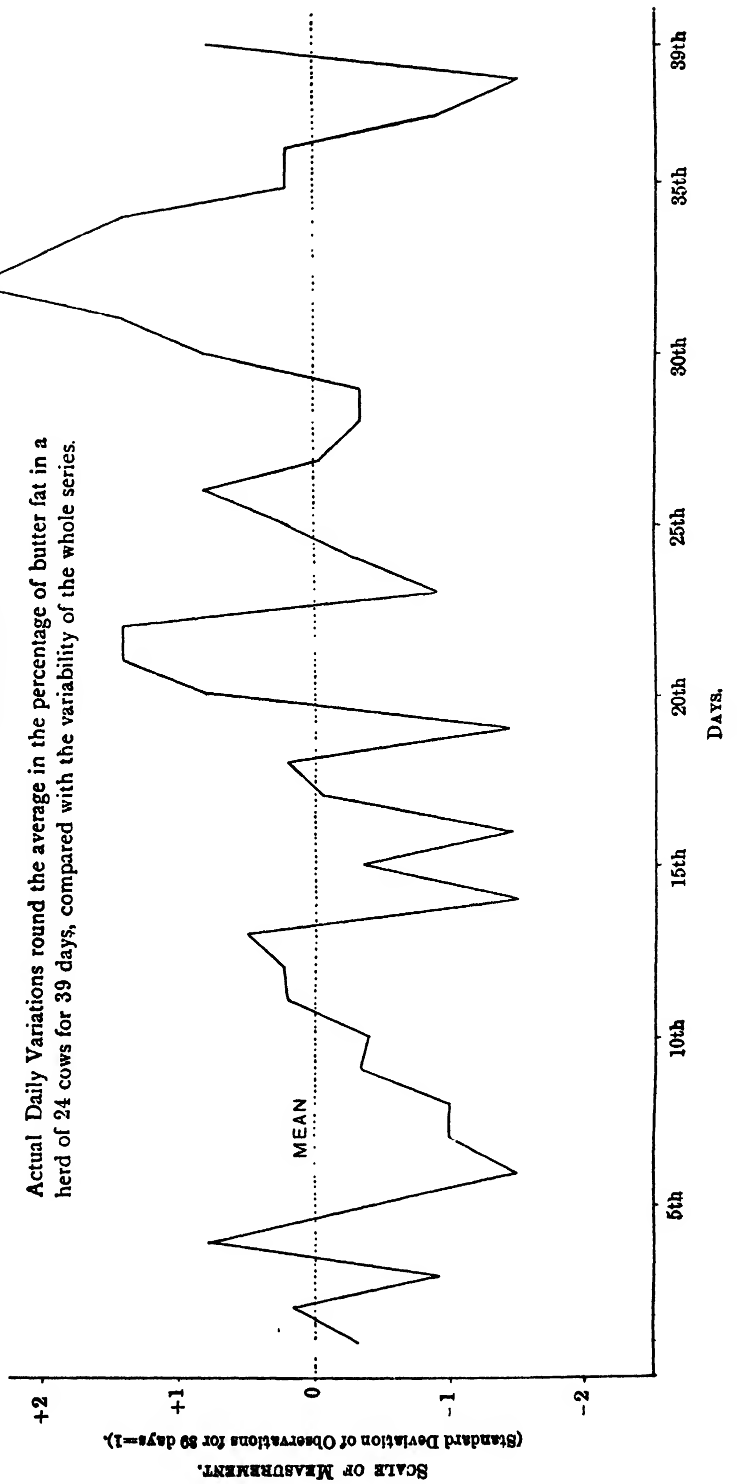


DIAGRAM II.

Actual Daily Variations round the average in the percentage of butter fat in a herd of 24 cows for 39 days, compared with the variability of the whole series.

lowest per cent. of butter fat found from a large random group of cows is 1·63 per cent. (see also Table I).

DIAGRAM III.

Percentage Butter Fat Distribution.

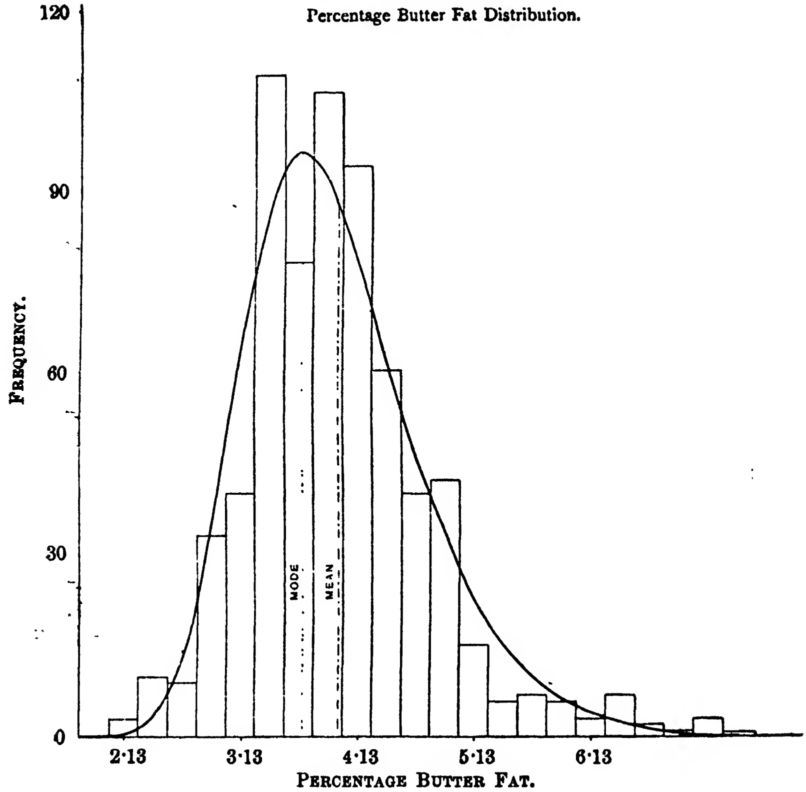


TABLE I.

Distribution of Butter Fat Percentages.

(All the cows were completely milked in each case.)

Butter Fat per cent.	*Frequency Distribution.*
1·63	1
1·88	—
2·13	3
2·38	10
2·63	9
2·88	33
3·13	40
3·38	109
3·63	78
3·88	106
4·13	94
4·38	60
4·63	40
Forward...	583

Butter Fat per cent.	*Frequency Distribution.*
Forward...	583
4·88	42
5·13	15
5·38	6
5·63	7
5·88	6
6·13	3
6·38	7
6·63	2
6·88	11
7·13	3
7·38	1
Total...	676

There would therefore be a strong presumption that the *bulked* milk of a herd of cows was adulterated if it was found to contain less than 1·63 per cent. of butter fat. This deduction, however, would be based upon the presumption that the herd of cows was a *random* herd in every respect and not a herd specially selected by the milk producer. One cannot readily get random conditions with respect to feeding, weather, stage of lactation period or age in a herd selected by a milk producer. The composition of milk is affected by all these and by other factors, and thus the evidence with regard to the minimum percentage of butter fat in random herds is not strictly relevant. It would be necessary to establish in each case how far all these factors affected the composition of the milk sample before it could be proved without doubt that such milk was adulterated. The poor quality may have arisen from the joint operation of these factors, and therefore a special enquiry should be made to ascertain the direction in which the factors are operating.

Partial milking a cause of poor milk.—One of the reasons why the bulked milk of a herd of cows could have as low a percentage of butter fat as 1·63 per cent. is that the cows have been *partially milked*. Cases are known where even experts have gone to the byre to take samples of milk for the purpose of furnishing byre samples as evidence as to composition in Court, and these experts have merely taken the *fore milk* of the cow and not the *whole* contents of the udder in each case. It would therefore be necessary to know in every case of prosecution whether or not the cows were properly milked when the results of analysis of byre samples are stated in Court.

Average percentages valueless in Court.—It would be quite a wrong argument—it is sometimes advanced in Court—for a public analyst or any other expert to state average results from a herd and argue, simply because the sample was below the average, that the milk had been adulterated. Such reasoning is not valid, because it overlooks the fact that every average is made up of a series of individual values above and below the average and all varying round the average. It is in the nature of an average to have values above and below it. It is wrong also because it assumes that the conditions under which these averages were obtained were the conditions for the particular herd the bulked milk of which was found to be poor in quality. In many cases it would be difficult, and in all cases it would be costly, to reproduce in byre samples the conditions existing when the official sample was taken.

Butter fat percentage varies with age of cow.—I have mentioned various factors which affect the composition of milk of herds of cows. I propose now to show the extent to which some of these factors individually affect the proportions of butter fat in milk.[1] It is quite a mistake to leave out of account in any discussion on milk the factor of age. The same cow at

[1] See "Variations in the Composition of Milk," H.M. Stationery Office, 1925; and *The Analyst*, vol. li, No. 609, December 1926.

different ages gives different proportions of butter fat. The following diagram (Diagram IV) shows the average proportion of butter fat given by cows at various ages. These are average figures, and there is considerable variation round the average values for each year of age.

Butter fat percentage varies with stage of lactation period.—Another factor of importance is the number of weeks the cow has been in milk. It is well known that the proportion of butter fat varies for the same cow during a lactation period. The undernoted diagram (Diagram V) shows the average proportions of butter fat found in cows during various stages of lactation period.

Butter fat percentage varies with breed.—An important factor in butter fat production is the breed of cow. I have shown that the *average* percentage of butter fat varies widely for different breeds of cows taken at random without respect to age. The following table (Table II) shows these average values :—

TABLE II.

Averages from Large Numbers of each Breed.

Breed.	*Butter Fat.*
British Friesians	3·63 per cent.
Various Crosses	3·82 ,, ,,
Shorthorns	3·91 ,, ,,
Ayrshires	4·09 ,, ,,
Welsh	4·40 ,, ,,
Kerry	4·67 ,, ,,
Guernsey	5·16 ,, ,,
Jersey	5·43 ,, ,,

This is a very incomplete statement of variation with respect to breed. The data we ought to have in our possession are the data showing the average percentages of butter fat for various breeds of cows of the same age, at the same stage of lactation period, and under the same conditions with respect to feeding, weather and other factors. Until such data have been analysed by modern statistical methods, one cannot state precisely in figures the relative differences in butter fat percentages among different breeds of cows.

The relationship of butter fat to solids-not-fat.—I have shown in a previous issue of this Journal [1] and in a recent publication [2] that when *different* herds are considered, a high proportion of butter fat is accompanied on an average with a high proportion of solids-not-fat and *vice versa*. In other words a good butter fat producer is a good solids-not-fat producer. If, however, the bulked milk of the *same* herd is analysed every day, it is found that, when the proportion of butter fat is higher than the average, the proportion of solids-not-fat is lower than the average and *vice versa*. This means that the herd tends daily

[1] *Scottish Journal of Agriculture*, vol. ii, No. 3, 1919.
[2] "Variations in the Composition of Milk," H.M. Stationery Office, 1925.

DIAGRAM IV.

Interdepartmental Investigation—All Cows (676).

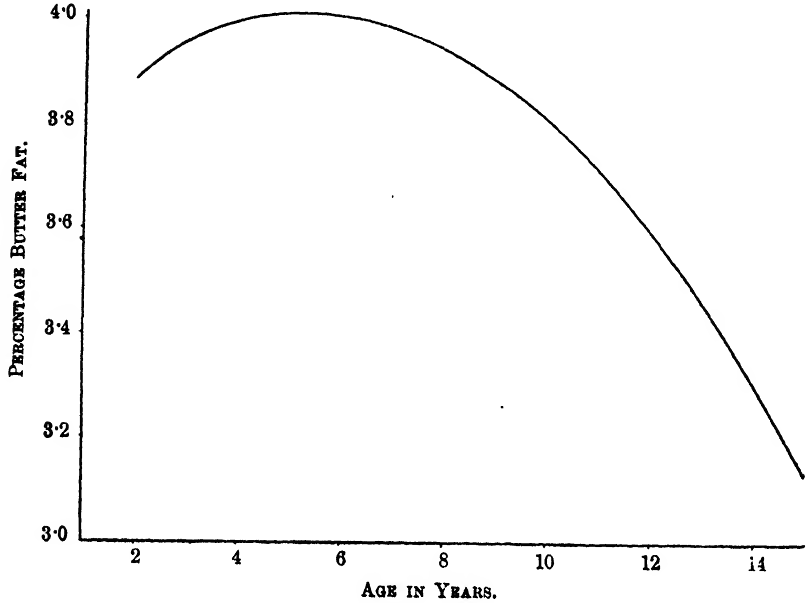


DIAGRAM V.

Regression of Butter Fat on Weeks in Milk.

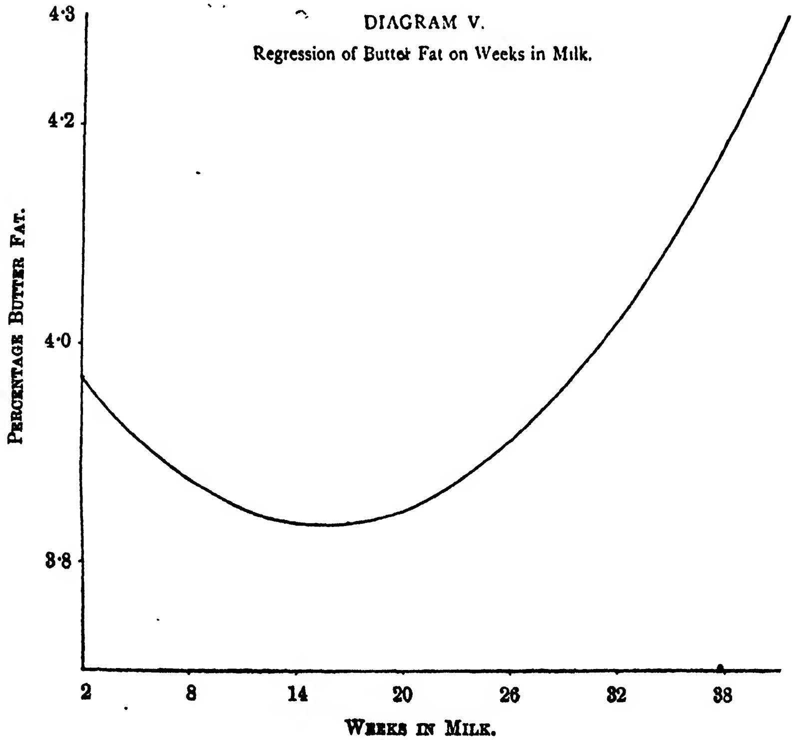
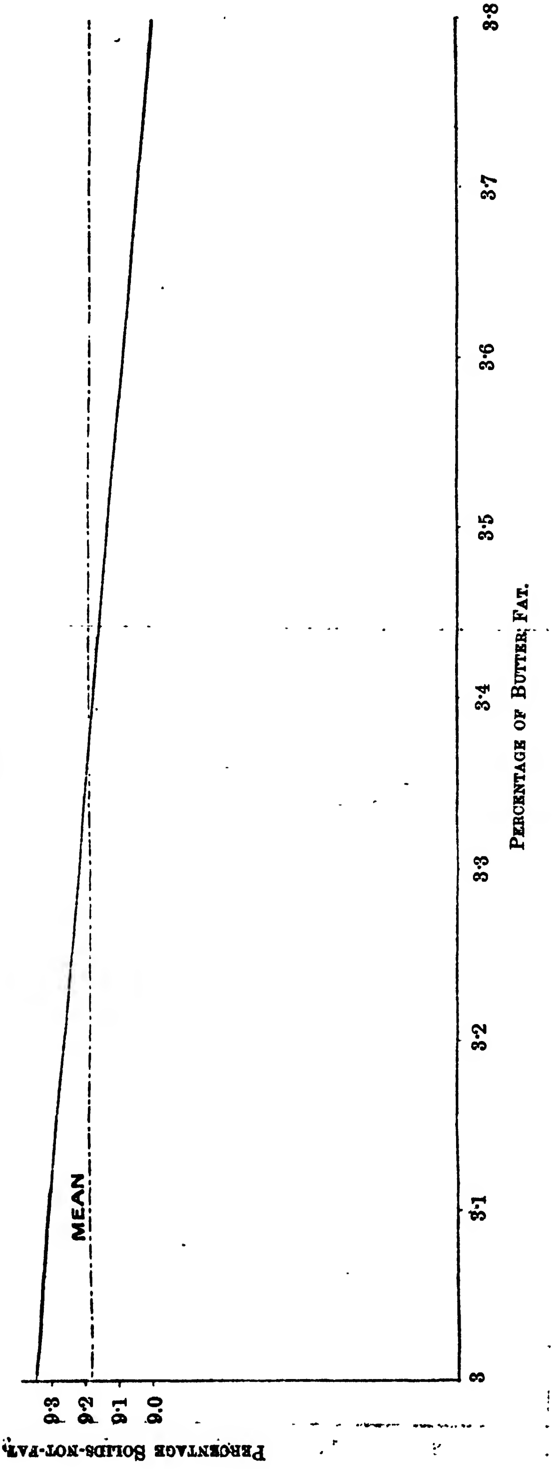


DIAGRAM VI.

Regression Line of Solids-not-fat on Butter Fat.

Hanley's Data.



to give practically the same proportion of total solids. The diagram opposite (Diagram VI) shows graphically the nature of the relationship between the percentages of butter fat and solids-not-fat in the daily samples of the same herd. It means that in general should there be a fall in butter fat percentage from the previous day there is a proportional increase in the solids-not-fat percentage. There are of course exceptional cases, but this is the general rule.

Summary.—It is now known that the percentage of butter fat in milk depends on (1) breed of cow, (2) age of cow, (3) number of weeks in milk, (4) percentage of solids-not-fat, (5) percentage of lactose, (6) yield per milking, (7) hereditary qualities due to selection within the breed, (8) number of cows in herd, (9) incomplete mixing of sample when drawn for analysis, (10) unequal intervals between two milkings, (11) variations in weather conditions, (12) insufficient feeding, (13) pathological factors, (14) partial milking. All the foregoing factors can influence the proportion of butter fat in genuine milk. The adulteration in milk usually takes the form of (1) the abstraction of butter fat, (2) addition of skimmed or separated milk, (3) addition of water. There are other possible modes of adulteration which need not here be enumerated. The following factors are at the choice of the milk producer:—breed, age, hereditary qualities, number of cows in herd, intervals between milkings, feeding, partial milking, and freedom from adulteration. There are three methods at least by which the milk producer can ensure that milk for sale contains butter fat above the prescribed presumptive limit of 3 per cent. [I] To keep a large herd. By doing this, the influence of small numbers of cows is excluded and the operation of factors (3), (4), (5) and (6) will not have sufficient influence to reduce the butter fat below 3 per cent. It should be noted that, when a large number of samples were taken from all over Scotland, the butter fat in the bulked milk of 676 cows was 4 per cent., or 1 per cent. above the prescribed presumptive limit of the Board. [II] To get frequent analyses made of the milk for sale. The Gerber method is available for the dairyman and the milk producer. The information gained from the results will guide the producer regarding the composition of the milk of his herd. [III] To purchase a strain of dairy cow which is known to give a high percentage of fat when tested at various times during the lactation period.

This article is written, not for the purpose of excusing or defending the sellers of poor milk, but for the purpose of pointing out to the producer the factors influencing the quality of milk so that he may use the information in the direction of improving the quality of the milk he sells to the public. So long as the law stands as it is at present, it is the milk-producer's duty, and it is to his interest and to that of the milk-seller, to take every practical means of producing milk of good quality.

RURAL EDUCATION.

JOSEPH F. DUNCAN,
Secretary, Scottish Farm Servants' Union.

ONE may have little sympathy with the motives which have inspired much of the criticism of education in rural schools, and yet be glad that their methods and achievements are being discussed. Our rural schools have been neglected, because the main stream of effort in this country during the two generations in which we have been building up a national system of education has been directed to industrial development, and our educational activities have taken their colour from the dominating purpose.

Naturally too, in building up a national system of education, emphasis was placed on uniformity, and codes were designed and applied with that object, and the rural school had to conform as best it could to the national system. It was not recognised that it presented a distinct problem. The reaction has now set in, and the rural school is claiming its fair share of the attention of educationists and others.

As usual, there is danger that the reaction may lead to excess on the other side. The rural school has its own problems; they are distinct but not separate, and any attempt to create a system of rural education which did not flow naturally into the main stream of national education would be even more disastrous than the neglect from which we are passing away. Our aim ought to be to give to the people in rural Scotland as good facilities for education as are to be found in our cities, and equal opportunities to the rural child to pass through the various grades for which he proves fitted. The object of any system of education ought to be to enable people to develop their faculties so as to lead to fuller lives for themselves, and to fit them better as members of society.

I make no apology for stating those platitudes, because the main stream of criticism of our rural schools has flowed from other springs. Rural education has been condemned because it is alleged to have made young people dissatisfied with rural life. A large share of blame for what the Germans call the "land flight" has been laid at the door of the rural school, and much of the advocacy of that elusive thing called "rural bias" has its origin in a desire to use the schools for directing the desires of rural children to agriculture as an occupation. One would have more respect for the critics who adopt this attitude if they applied their criticism impartially, but we find that there is no desire to discourage any of the young people in rural districts from leaving the land except those who can only remain as wage-earners in agriculture. Most of the advocates of "rural bias" have no qualms about sending their own young folks into professions, commerce or industry.

The flight from the land is as old as the cities, and is not peculiar to any age or country. The causes are many, and most of them were in existence and active before the rural school passed through its doors more than a fraction of the children reared in the country. It is the conditions of life for the young folks after they leave school that determine whether they will remain in rural occupations or seek other avenues of employment. Some of these conditions are within the power of those engaged in agriculture to remedy themselves; some are matters of social and political adjustment, and some are inherent human impulses difficult to influence or control.

Any attempt, therefore, to form a ring fence round our rural schools to preserve the young folk for wage-earning employment in agriculture would be a distinct dis-service to the industry and unfair to the young people. It would merely direct attention away from the true causes of the flight from the land and delay the endeavour to deal with the problem, an endeavour long overdue. It would be unfair to the young people to cut them off from equal opportunities with the children of the cities to match themselves for any career for which they might qualify. So long as agriculture and rural life prove less attractive to the wage-earner than industry and city life, we shall have to submit to seeing the most vigorous and enterprising of our young people leaving rural Scotland, and, if we are wise, will bend our energies to making agriculture and rural society more attractive.

Nor must we lose sight of the fact that in a country such as Scotland, where intensive agriculture has reached a comparatively advanced stage, we are likely to continue to rear many more people in country parishes than we employ on the land. That fact in itself makes any early specialisation in our rural schools impracticable, even if it were desirable. That does not mean, however, that the curriculum in our rural schools should be the same as that in the cities, as it has been more or less for the last two generations. On educational grounds the claim for giving to the teaching in rural schools a direction more in touch with the everyday life of the rural child is a sound one, but the aim must be educational and not vocational in the early years.

It is curious, when we come to think of it, that no attempt has been made to encourage vocational education for the wage-earners employed in agriculture. All the effort has been directed toward the primary schools, in the hope that more children would be given a taste for rural life. Yet the difficulty does not lie in getting sufficient young people to enter agricultural employment, but to remain in it once they have begun. There is seldom a scarcity of learners, but quite often there are more young folks offering themselves for employment than the farmers can employ. The great complaint is that the best of the young people leave agricultural employment after a few years' experience, leaving a dearth of competent men and women. It would appear, therefore, to be better worth while to consider whether anything could be done to develop an educational system which might reach the young people, and help to reduce the handicap on the industry and enable it to retain more of the workers whose loss it regrets.

We have made great strides in the development of technical education in agriculture in recent years, but with the exception of the dairy school at Kilmarnock and its extension courses, the wage-earner has been left completely outside the scheme. Here and there an odd farm worker who is exceptionally keen has been able to attend extension lectures, and one or two schoolmasters have devised continuation courses and by outstanding personal qualifications have done fine work, but, taking Scotland as a whole, it is true to say that the great body of farm workers has not been touched. Even when the scheme for scholarships of sons and daughters of farm workers, and farm workers qualified in their own right, was introduced five years ago, the number of actual wage-earners who attempted to qualify for these was disappointing. The shorter courses which might have suited them did not coincide with their terms of employment, and they would have had to risk a six months' unemployment to enable them to attend a short course of six or twelve weeks. Even so, the short courses are designed for farmers and those who are likely to be in a position to practice what they have been taught. For the great mass of wage-earners that opportunity is not likely to occur, and hence there is little to encourage them to seek to qualify.

The great strides which have been made in agricultural education and research in recent years have not made the industry more interesting to the farm worker. There is a wide gulf between the modern farmer who is keen to apply the results of modern research and the workers on his farm, which did not exist a generation ago between the farmers and their workers. The old farmer practising the customary methods had little advantage over his workers, many of whom were as skilful in cultivation or in handling stock as any farmer. Such skill is still to be found amongst the workers, but more than skill and experience are necessary to understand the scientific principles upon which modern practice is based. For that a groundwork of good general education is necessary and a training in scientific methods, both of which are exceedingly rare amongst the workers. They are not as widespread as they ought to be amongst farmers, but the number of farmers who can bring a better trained mind to bear on the work of agricultural research is steadily increasing. Unless something is done to enable the worker to follow intelligently the new methods, his work will become less and less interesting. He will be less useful while he remains in agriculture, and readier to leave it because it makes no claim on his interest.

I am well aware that the view of education I am putting forward runs directly contrary to the accepted idea of education held by the majority of people in rural Scotland, including the workers themselves. The commonly accepted idea is that education is necessary only for those who wish to escape from manual labour. Those who are likely to " get on in the world " should be kept at school, but those who are to become wage-earners are better not to have too much schooling, because it tends to make them discontented and unfits them for regular work. Hence the opposition to raising the school-leaving age, and to any proposals for continued education during adolescence. It is a suicidal attitude for the agricultural industry to adopt. In every other industry the drive is all towards continued education leading up to vocational and technical education for the workers. In some occupations arrangements are now made to enable young people to attend continuation classes during working hours; in practically all industries, employers' associations help to organise technical classes and encourage the workers to attend, and stimulate interest by giving scholarships and prizes. If agriculture is to continue to give it forth that it can carry on with workers less well educated and trained than other industries, it ought not to complain that the workers look upon it as the least desirable occupation. Status counts for a great deal, particularly with the young, and agricultural workers have unfortunately felt in the past that they occupied a lower status than other workers. It will be fatal to any progress for the future if a lower standard in education for agricultural workers is to be established. To-day they are the only skilled workmen for whom no workable scheme of continued education has been organised, and for whom no provision has been made of vocational and technical education.

So far I have been discussing the question as it affects the industry and the position of the worker, but there is a social problem in rural Scotland that is even more important. The agricultural industry is only a means to an end, and not an end in itself. It is the means whereby we produce our daily bread that the human family may live, but the human being demands something more than daily bread. Man has spiritual, intellectual and social needs, and will not be satisfied with a life which does not give him outlet for his energies in these directions. For the young in particular the greatest need is for fellowship with their kind, and it is because it is more difficult to find the society they demand in the country that it is so difficult to get the young people to remain at rural occupations. In Scotland the problem is particularly acute, because for the past hundred years we have been suffering from a steady decay of social life. The disappearance of the small farms, the introduction of labour-saving machinery, the decay of the villages, which were never numerous, and the disappearance of the small craftsmen have all drained rural society of its vital elements. Concurrently the growth of the large farms has led to a division of classes between which there is little social contact. The building of cottages on the farms leads to greater isolation, and the mobility of the farm workers makes it difficult to create a community spirit. All this bears with greater force on the young, and we need not be surprised that they desert the country.

The problem is a complex one and there are many causes contributing to the unhappy result, and only a very superficial observer would propose a simple cure. We are not likely to find agreement as to the relative effects of certain causes; we are not likely to find agreement as to what the causes are, and we are even less likely to agree as to the methods to be adopted to cure the evil. I am sanguine enough to believe that we shall find a greater measure of agreement if we tackle the problem from the educational side than from any other, because there is no other ground which will provide a common meeting place for all. There people of all creeds can meet; statutory bodies and voluntary associations can co-operate; employers and workers can find common vocational and technical interests, and cultural associations can find stimulus and recreation. The problem is nothing less than the creation of a rural society, and it cannot be created by any others than the people living in rural Scotland. The first essential is a common centre round which all the activities can revolve, and I cannot conceive of any other agency that would serve as well as the school.

There have been many attempts to arrest the decay of rural life in Scotland. Clubs and Institutes for men have been tried, and nearly all have had a short and disappointing life. Mutual Improvement Associations have done useful work in many districts, but generally they have had a precarious existence. Women's Rural Institutes show more promise than any other effort. But all suffer from the fact that they are partial in their scope and have not been linked up with any permanent centre of rural life. There is such a centre in the school, and if we developed it properly it could provide the link which would help to keep all the other activities in touch, and out of which a rural society with its own life and purpose could evolve.

Over the greater part of rural Scotland the largest number of people living in rural parishes are engaged as wage-earners in agriculture. The problem is how to bring them into any effort to re-create rural society, and the crux of the problem is to carry them through the formative years of adolescence so that they may develop interests which will lead them to seek the life they desire in rural Scotland. These are the years of unrest, and if youth cannot find answers to the questions which life then presents to them, in the life they know, they will seek elsewhere. We may never hope to set bounds to the roving blood of youth, but we ought to be able to give direction and scope to their desires in such a way as to enable us to keep more of them at home.

Our system of compulsory education to-day is largely effort wasted. We keep the children at school until they are carried to the point at which they have mastered the tools which they could use to educate themselves. They have accumulated a respectable body of knowledge, much more than they are generally credited with, and they can read and express themselves in speech and writing. Then we turn them out to work and leave them to their own resources, whether they shall go on to use the education they have received or let it be forgotten for want of use. In agricultural work little call is made upon the capacities they have cultivated at great expense to the community, and in a few years' time most of them have ceased to read anything except the tawdriest newspaper, and will do anything rather than face the labour of writing the simplest note. One has only to compare

the lively interest of a class of children of say twelve years in any rural school with the mental dulness of a feeing market of young folks, to measure the loss during the years of adolescence.

We cannot blame the young people because they do not take advantage of the opportunities of attending continuation classes. Some of them make a gallant attempt, but it requires quite exceptional zeal and unusual perseverance to attend evening classes after a day at farm work. The physical effort to keep awake is task enough for most, and few can concentrate their minds for the hour or two necessary to gain any advantage from attendance. The working day on the farm, even in winter, is too long to leave the young worker the necessary energy to engage in serious educational effort. Unless, therefore, we are to give up the attempt to continue the education of the farm worker during the years of adolescence, some method will have to be devised of setting them free at certain times for day continuation classes. I can see no insuperable difficulty if the will is there to have a more alert and educated people in rural Scotland. It would be a dismal reflection on our demand for scientific research and education in agriculture if we were to shut out from any share in its stimulus the large class of workers on whom the industry rests. And in the long run it would not pay, considered from the narrow standpoint of commercial results. The skill and interest of the workers in any industry is a factor of considerable economic importance, and any industry satisfied to be shunned by the better educated and more enterprising workers cannot become efficient. In a community in which manufacturing industry predominates, agriculture will always be seriously handicapped in the competition for capital and ability, and it cannot afford to raise other hurdles against itself.

What is required is a system of continued education that will keep in view the social and vocational needs of the wage-earners in agriculture. We have been too prone in the past to look upon any system of continued education as a makeshift substitute for the higher education which more fortunate pupils receive in intermediate or secondary schools. No one will desire to close any door which will give an opening to the keen student to strike out for the best training available. The scholarships scheme I have already referred to shows that there are always a few ambitious young people ready for such opportunities, but that is no reason why our system of education should be so much concerned about helping forward the exceptional pupils. Under any system of education they will always forge ahead. Nor is there any dearth in rural Scotland of people qualified to fill the higher positions. Our universities and colleges turn out many more trained scientists, technicians and teachers than the industry absorbs. What we require is a higher level of general intelligence, and a rural community mentally alert and active enough to assimilate the results of the scientific work of the last twenty years.

The endeavour should be to give a broad foundation of general education. Too much cannot be expected from the limited time

the lively interest of a class of children of say twelve years in any rural school with the mental dulness of a feeing market of young folks, to measure the loss during the years of adolescence.

We cannot blame the young people because they do not take advantage of the opportunities of attending continuation classes. Some of them make a gallant attempt, but it requires quite exceptional zeal and unusual perseverance to attend evening classes after a day at farm work. The physical effort to keep awake is task enough for most, and few can concentrate their minds for the hour or two necessary to gain any advantage from attendance. The working day on the farm, even in winter, is too long to leave the young worker the necessary energy to engage in serious educational effort. Unless, therefore, we are to give up the attempt to continue the education of the farm worker during the years of adolescence, some method will have to be devised of setting them free at certain times for day continuation classes. I can see no insuperable difficulty if the will is there to have a more alert and educated people in rural Scotland. It would be a dismal reflection on our demand for scientific research and education in agriculture if we were to shut out from any share in its stimulus the large class of workers on whom the industry rests. And in the long run it would not pay, considered from the narrow standpoint of commercial results. The skill and interest of the workers in any industry is a factor of considerable economic importance, and any industry satisfied to be shunned by the better educated and more enterprising workers cannot become efficient. In a community in which manufacturing industry predominates, agriculture will always be seriously handicapped in the competition for capital and ability, and it cannot afford to raise other hurdles against itself.

What is required is a system of continued education that will keep in view the social and vocational needs of the wage-earners in agriculture. We have been too prone in the past to look upon any system of continued education as a makeshift substitute for the higher education which more fortunate pupils receive in intermediate or secondary schools. No one will desire to close any door which will give an opening to the keen student to strike out for the best training available. The scholarships scheme I have already referred to shows that there are always a few ambitious young people ready for such opportunities, but that is no reason why our system of education should be so much concerned about helping forward the exceptional pupils. Under any system of education they will always forge ahead. Nor is there any dearth in rural Scotland of people qualified to fill the higher positions. Our universities and colleges turn out many more trained scientists, technicians and teachers than the industry absorbs. What we require is a higher level of general intelligence, and a rural community mentally alert and active enough to assimilate the results of the scientific work of the last twenty years.

The endeavour should be to give a broad foundation of general education. Too much cannot be expected from the limited time given to continued education. When the Education (Scotland) Act, 1918, is put fully into operation, the total number of hours of compulsory attendance at continuation classes will be 320 in the year. Unless we can make the definite work of continuation classes fit into a more general scheme of social and vocational activities which will attract and retain the interest of the young people, we are not likely to make much success even of compulsory continuation classes. The Advisory Council of the Scottish Education Department reported four years ago upon a curriculum for such continuation classes. They suggested that 240 hours in winter and 80 hours in summer would be the most suitable division of the time, and that attendance should be for the whole day, possibly twice weekly or five days a fortnight. The division of the time for different subjects was roughly one half for cultural and recreative subjects, and the other half for vocational subjects during the first two years, and about two-thirds for vocational subjects in the third year. Cultural subjects were grouped under English, history and geography, and recreational subjects under physical training, music and drama. The vocational subjects ranged over rural arithmetic, handicraft, farm mechanics and agricultural science for boys, with domestic science, handicrafts, dairying, poultry-keeping, &c. for girls.

The problem is how to link this up with the social and vocational life of a rural community. Unless that can be done the continuation classes will become as much of a dead end as the rural school is to-day for the great mass of the boys and girls who pass through it. Merely to raise from fourteen to eighteen the age of escape will make matters worse. There is no reason why the school should be regarded as the place of penance. When we think of the place school and college occupy in the lives of those who are fortunate enough to continue their education through adolescence, there is no reason why we should despair of the rural school if we can bring it into as intimate relation with the life of the rural community as our secondary and high schools bear to their communities.

It will probably be easiest to work from the recreational side at the beginning. A certain amount of prejudice requires to be broken down. The common conception of education as a training for " getting on " has narrowed the educational outlook, and the cultivation of the graces of life has been ruled outside the purview of the school. The musical festivals have done something to bring back the old Scots " country " dances to the children, and in time we may hope the adults will return to them also. Now it is in singing, dancing and dramatic representation that the best field is offered for associated effort by the adolescents. They should be encouraged to organise their own games, competitions, exhibitions and so on, inside the school as well as outside. The endeavour ought to be to make as little distinction as possible between the running of the recreational side of educational work and the ordinary social activities. There should be a development from the day school, through the continuation school, on to the social activities of adult life with as little break as possible, but an increasing reliance on the initiative and organisation of the young people, so that they can pass out to adult activities with the habit and capacity for associated effort.

It should be possible also to link up the work of vocational education during the years of adolescence with the everyday work of agriculture. There would, of course, be a definite relation between the school and the agricultural colleges. There would be a new field for extension work by the colleges, following on the vocational teaching of the continuation classes, and we might hope for a more fruitful result when the colleges did plan their extension courses. But even during the earlier years much more might be made of the class excursion, during class hours, and also as a means of retaining interest in the work between the school periods. I do not want to suggest anything so definitely technical as the visits to well-known herds, and the demonstrations and judging competitions arranged for students of agricultural colleges, though there is no reason why the older pupils should not be present at these when they occur in the neighbourhood. Something much more simple, but more varied, would suit the needs of the farm worker. It must be remembered that his craft touches many crafts and includes not a few. What he ought to have is an intelligent understanding of the reasons for doing many things. He handles the soil, animals, plants, machinery, chemicals and the varied products of the farm. It is with the handling of these things that his vocational education will concern itself, and he will be much more interested if he is brought to think about them for himself by handling the real things. A demonstration at the smithy would be as important educationally as a crop experiment.

In the later years, when vocational training would occupy more of the time of the teachers, the work should be definitely tutorial. Much of the dislike of the young folks to classes is the feeling of being at school. We may agree that it is a foolish idea, but young people between sixteen and eighteen who are at work are very sensitive. They like to think they have grown up, and they cannot bear to be classed with those at school. It is different when they are treated as adults and encouraged to take their share in the work of the class by allotting a definite time for questions and discussions by the students. This is particularly important for young people who have entered employment. Their outlook is different from that of the student who has always been in the atmosphere of the class-room. One of the most successful continuation schools I ever saw set aside one night a week for a debating society. The teacher assured me it was the making of his school.

Even on the more directly cultural side, I believe a great deal more could be made of rural Scotland. I see no reason why we should not relate the teaching of geography to the actual development of the country lying around the school, and make much more use of regional surveys than we do. There ought to be no difficulty in giving history a more definitely social and industrial background from the history of the parish and the county. There is no dearth of material. The introduction of the rural libraries scheme has solved one of the difficulties, and there is a valuable link there between the school and those who are interested in the things of the mind. If the habit of reading, which most of the children are acquiring to-day, can be carried over those difficult years of adolescence, then we may look more confidently for a keener intellectual interest in rural Scotland.

If work such as I have suggested is to be carried out it means that the country school will require to be extended. Up to the present every advance in education has told against the country school. On grounds of expense the tendency has all been towards centralisation for higher work, leaving the country school to decay. A certain amount of centralisation is unavoidable, but there are good social reasons for maintaining the country schools wherever they can be made to serve as natural centres of social life. Where the school does serve as such a centre it ought to be equipped with such buildings as will enable it to serve the whole community. There ought to be a suitable hall attached to the school, so that the adult activities can be kept in touch with the school life. If that is done then the school may give the impetus from which the creative forces in rural social life may be set to work.

THE BIOLOGIST ON THE FARM.—No. XXIV.

By Prof. J. ARTHUR THOMSON, M.A., LL.D.,

University of Aberdeen.

Boar's Head.—Long before there were any farms in Great Britain there were herds of wild boars in the forests, and they meant much to our forefathers. A wild boar, killed by a spear after it had been caught in a pitfall, was a treasure trove. It meant feasting, and so the boar's head remains to-day in the forefront of holiday fare—a sort of symbol of unstinted hospitality, besides being a very palatable dish in itself. But the wild boar was also part of the sieve that sifted our ancestors, eliminating the foolhardy and the timid. An old boar at bay is a very formidable antagonist to man and dog, but man hunted the boar for ages before he had a dog in his service. When agriculture began, it was more necessary than ever to keep the dangerous wild boars in check, for they did much harm in rooting in the fields among the crops. We read of a great boar hunt in Germany as late as the eighteenth century that over two thousand were killed before the chase was over. This would make it possible to have a Gargantuan feast, and there can be no doubt that similar events on a smaller scale occurred in Britain. The number of places with names like Boar's Hill or like Swinton shows how widespread the vigorous creature once was, but there is not much evidence of big boar hunts after the end of the sixteenth century. Considerable rewards were offered from time to time for the destruction of a savage old solitary who became more than usually aggressive and the terror of the countryside.

An interesting feature in the boar's history is that it seems to have submitted repeatedly to domestication, first in one country and then in another. So that whereas man seems to have brought to Britain already domesticated races of dog and sheep, cattle and horses, he seems to have domesticated British wild boars, just as others had domesticated French or German, Italian or Spanish wild boars. It comes to this, that the domestication of the wild boar is not difficult. So long as the young boar got plenty to eat and plenty to root up, he did not trouble himself over restricted range and man's eugenic control. It is of the nature of swine to be much pre-occupied with their bellies, though it must be remembered that the wild races are quick, strong, and courageous. There is a pleasant custom of keeping the young ones more or less in the centre of the wild herd so that there is less risk of their being carried off by wolves. An old solitary has almost no formidable enemies except a pack of wolves, and even before them he dies game, with ripped up corpses around him, marking an honourable end. The domesticated pigs of Europe are mostly the descendants of the European wild boar, *Sus scrofa*, still holding its own well in remoter parts of central and southern Europe; but there seems to have been mingling with another race, the domesticated descendants of an Oriental wild boar, called *Sus vittatus*.

Man and his Dog. —The origin of the European domestic pigs (chiefly from *Sus scrofa*) seems relatively clear, but the pedigree of man's trusty partner, the dog, is full of uncertainties. As we mentioned once before, the probability is that the oldest known domestic dog, Studer's Stone-Age dog (*Canis putiatini*), was the ancestor of *most* of the domestic dogs of to-day. But Studer's dingo-like Neolithic dog was probably derived from a small southern wolf, and its descendants, like the "peat-dog" of the Swiss lake-dwellings, may have been crossed from time to time with wolf and even with jackal.

But what brought this difficult problem to mind was the reflection that man was so long without his partner. The dog was the first animal to be domesticated, but there is no secure evidence that this had happened before the Neolithic Period when man began to use well-fashioned stone implements. For long ages Palæolithic man was hunting without a dog. The first use of the half-tamed wolf, doubtless taken to the cave as a cub, was to help man on hunting expeditions. For how many generations must it have been kept on leash,—in a primitive partnership which began perhaps ten thousand years ago. Later on it became a watch-dog! After four or five thousand years had sped, in the Full Neolithic Period, when man had domesticated cattle, swine, sheep and goats, the dog, freed from its leash, became man's responsible partner. This co-operation evoked latent qualities of great value, and the pastoral people were able to breed from these dogs that were most controlled, alert, and loyal. No Neolithic shepherd would breed from a dog that worried the sheep!

No doubt the dog belongs to a fine-brained stock, but we attach great importance to its sharing of responsibilities with man, as is true also of the horse, but not for instance of cat or sheep. We do not look on the discipline of co-operation as engendering qualities which were entailed; we think that the co-operation evoked latent qualities or new variations in individual types, which were subsequently bred from. But another important idea, as it seems to us, is that the dog sprang from a stock which packs during at least part of the year. For many wolves live alone in summer. Thus there was what we might call a dual inheritance, that of the habit of self-subordination in the team-work of a pack, and that of living independently and trusting in self alone. The dog is loyal by inheritance, but it is also independent by inheritance. As Benjamin Kidd suggested in one of his essays, very shrewdly as it seems to us, the dog in process of domestication probably accepted man not as "master" —a far-fetched idea—but as the head of the pack, as a remarkable super-dog in fact. Reversions to running amok and worrying sheep are in part due, we believe, to strayed dogs or to badly handled dogs, which not unnaturally return to wolfish ways when the control of man is awanting. For the master stands for the leader of the pack, or, to put it in another way, man and his co-operation have come to take the place of the pack itself. Without man to keep the herd-instinct living, the trusty guardian of the flocks may revert to the predatory ways of the solitary summer wolf.

Cocksfoot and Butterflies. —The great fact of inter-linkages, with which Darwin impressed the world in his "cats and clover" story, and in many other instances, though few so dramatic, is always being demonstrated afresh, and we have been able in these pages to give case after case of these wheels within wheels. In these "Biologist on the Farm" studies, we have made, so to speak, a special feature of these endless inter-relations, since we are convinced that the Darwinian idea of "the web of life" is central to all ecology, which amounts to the old-fashioned Natural History,—the study of the life of living creatures as it is lived in wild nature.

It seems at first sight a far cry from cocksfoot grass, *Dactylis glomerata*, to butterflies, but Mr. David Landsborough Thomson has recently shown that a pigment from the wings of the Marbled White Butterfly, *Melanargia galatea,* is identical with a substance in the cocksfoot on which the caterpillar feeds. The substance in question is a flavone or flavonol, and it occurs in the grass not only free, but in a glucosidic combination. A flavone has been previously found in the maize, and it probably occurs in other grasses besides cocksfoot. It is satisfactory to have this adornment of the butterfly's wing traced back to its origin. Some of the other pigments of the animal body are known to be derivable from food-stuffs, but others are waste-products formed in the animal's body, or the results of the breaking down of amino-acids. In rare cases, like the cochineal insect, they seem to be reserve products.

Do Horses laugh?—As with so many other questions, the answer depends on the definition of terms. There is no doubt that horses often have a neigh that indicates gratification and welcome. But this seems a dubious kind of laughter. In human laughter there is (1) a sudden change in the breathing movements,—a deep inspiration and then an interrupted release, (2) a broadening of the mouth and raising of the upper lip, (3) a movement of various other muscles of the face, e.g. of the lower jaw and around the eyes, and (4) the reiterated sound which varies considerably in different races and individuals. In this sense there is, as Darwin showed, a quite distinct laughter in monkeys; but we doubt if it occurs in any other creatures,—not even in the "laughing jackass." Yet the distinguished physcologist Pavlov has given evidence of the occurrence of hysteria in dogs. There have been many theories of laughter, and we wish to add to the number. For it appears to us that the essential feature in the simplest forms of laughter, such as that produced by tickling, is a brief lack of control over the normal movements or over the resting phase of the muscles concerned in breathing, vocalisation, mouth-closure and facial expression. The disturbance of the normal controls and inhibitions may be due to a very strong emotional excitement (perhaps liberating a hormone) or to some very sudden and unexpected stimulus, which need not be pleasurable or ludicrous, or to something from which there is no easy escape, as with the tickled child. But it must be understood that this physiological theory is not in the least inconsistent with the subsequent utilisation of laughter in human life. Laughter which begins in the tittering of the monkeys, as a sort of tax on an emotional nature with greatly extended powers of expression, has been humanised and moralised with fine results.

The Bite of an Adder.—Snake-bite does not count for much in Britain, for there is only one poisonous snake, the adder or viper. We saw a large one last summer, basking in the sun on the top of a boulder by the side of a narrow road in a Highland glen. The boulder was big enough to carry some heather, blaeberry bushes and grass, and the adder was lying picturesquely on a shelf, evidently enjoying its sun-bath. It seemed to be nearly two feet long, but the biggest adders are those which are not caught. And why should one catch them? As the beautiful creature pulled itself together and slipped away, rowing on the ground with its ribs, a nullipede become a multipede, we realised that what we had been staring at as unusual was one of the commonest sights in warm countries. One of the amenities of Britain is not having to think about snake-bite.

Yet the rare casualty of an adder's bite is full of interest.

The instruments are two sharp-pointed fangs or teeth, carried by the maxillary bones. Each has been folded on itself so that a canal is formed down the centre, and this opens by a minute pore near the tip. When the excited adder opens its mouth to strike, the maxilla is moved by a system of levers, and switches the fangs from a horizontal to a vertical position. In a sheath at the root of each fang there lie about ten reserve and developing fangs. If the functioning pair are injured there are other two lying ready to take their place; and, as a matter of fact, the fangs periodically fall out and are replaced after they have done duty for a considerable time.

Just as a fang is simply a highly specialised tooth, so the poison-making organ is derived from one of the salivary glands. When the adder's mouth is opened to strike, there is an automatic compression of the poison-gland on each side of the back of the mouth, and a minute quantity of the venomous secretion is squeezed forward to the root of the fang. It is then forced up the central canal and injected into the wound. As one of the greatest authorities on reptiles well says: "This is a perfectly devilish contrivance, ensuring the conveyance of the poison into the very deepest part of the wound." The poison acts rapidly on some kinds of animals, such as mice, and it must be an advantage to the adder, which has a delicately built skull, to have this method of putting an end to the violent struggles of its booty. But Mr. Norman Morrison, of Campbeltown, who has had a long experience of adders, maintains that the frog, which is a common victim, is quite immune to the venom. Others hold that the frog's nervous system is poisoned, though the blood cells are not dissolved as they are in the mouse. Mr. Morrison also points out that an adder can bite and discharge poison six times in rapid succession, after which the supply is exhausted, till the gland has had time to make more.

The poison of the adder is of a protein nature, evidently very complex. It has a paralysing effect on the nervous system of the bitten animal, and that is naturally followed by a slowing or fatal stoppage of the breathing movements, and by a great diminution of the blood-pressure. In other words, in man's case, the breathing is heavy and the pulse is feeble. There is burning pain around the bitten part, and discoloured swelling sets in. The patient is depressed and sickish, with cold, clammy perspiration. But the severe symptoms usually pass off in twelve to twenty-four hours, and really serious cases are rare. Out of over two hundred bad cases in Germany in the course of ten years, only fourteen ended fatally; and much depends on the patient's state of health at the time.

The commonest place for an adder to strike a human being is above the ankle. A string should be tied tightly above the bite, to keep the poison from passing into the general circulation. The wound should be widened, bathed and pressed, and bleaching powder or Condy's fluid should be applied. The ligature must not be kept tight for more than half an hour, but after the circulation has returned it may be applied again. The best internal stimulant is a little ammonia. The best antidote, apart from artificially-produced serum, is the adder's own bile.

The hedgehog is an inveterate enemy of the adder, and it is not a very easy creature to bite. But even if the hedgehog were bitten, nothing would happen, for the hedgehog has somehow become immune to the adder's poison. This probably means that the blood of the hedgehog contains a counteractive or anti-body which neutralizes the poison. The pig is another creature that enjoys immunity, and the same seems to be true of the honey buzzard. If one adder bites another, nothing happens; in natural conditions it is immune to its own kind of poison. Yet a very heavy injection of adder poison into an adder will kill it! This is a very intricate subject, requiring further study. Thus, although a cobra does not poison another cobra, its bite may be fatal to another kind of snake. Here we get into the deep waters of bio-chemistry.

CHEESE STANDARDS.

R. A. Berry, Ph.D., F.I.C.,

Professor of Agricultural Chemistry, West of Scotland College of Agriculture, Glasgow.

No legal standard of purity for cheese is in force in this country, yet as far back as 1901 regulations fixing the minimum percentage composition of whole and of skim milk and of butter were incorporated in the Sale of Food and Drugs Amendment Act of 1879. For the purpose of the Act an article of food is deemed to be adulterated if it has been mixed with any other substance or if any part of it has been abstracted, so as in either case to affect injuriously its quality, substance or nature. Cheese is defined as the substance known as cheese containing no fat derived otherwise than from milk, but no standard of purity for cheese is fixed as in the case of milk and butter. Since cheese is made from milk its composition is determined by that of the milk from which it is made. In other words the composition of cheese solids follows that of milk as indicated in the following table :—

Fat.		Fat : Casein.
In Milk Percentage.	In Dry Cheese Percentage.	
4·5	57·0	1 : 0·62
4·0	55·5	1 : 0·65
3·5	53·0	1 : 0·74
3·0	49·5	1 : 0·86
2·0	40·0	1 : 1·30
1·0	25·5	1 : 2·60
0·1	3·6	1 : 24·0

For the purpose of comparison, and owing to the variable degree of moisture in cheese, the fat in the above table is calculated as a percentage of the water-free substance. The figures illustrate the connection between the fat content of milk and that of cheese. The ratio of fat to casein given in the last column shows that as the fat in cheese decreases the proportion of casein increases. To calculate the percentage of casein in a dry cheese multiply the percentage of fat by the corresponding fat-casein figure.

Cheeses made from whole, half skim and skim milk are put on the market in this country unlabelled, and it is left to the judgment of the dealer and the consumer to distinguish between them. Under the circumstances it is unfair to the home producer of whole milk cheese to have to compete in the open market with produce of inferior composition, more particularly as much of the half skim milk is imported from foreign sources. The adoption of a minimum cheese standard would remove this drawback, and the consumer would gain by knowing that the article supplied would require to be not lower than a certain specified quality. Considering that the State has laid down a minimum standard of purity for milk and butter, it is surprising that the public have not sought a similar protection against the sale of impoverished or adulterated cheese. The consumption of cheese, though less than that of milk, is considerable. For the year 1925 the total consumption in the British Isles is estimated at 154,935 tons, of which 31 per cent. was home made, 60 per cent. was from the Overseas Dominions, and 9 per cent. was from foreign countries. It is equal to a consumption of 9¾ lbs. per head per annum of the population. So long as cheese satisfies the palate, the consumer appears to be indifferent as to what it contains. The indifference is not due to a want of appreciation of the importance of cheese as an article of diet, but to ignorance of the fact that separate lots of cheese alike in appearance, flavour, &c. may differ widely in their value as food and should have a different market value.

Cheese Standards are based upon (*a*) purity, and (*b*) characters such as flavour, aroma, texture, colour, finish, &c. In reality the one embraces and is dependent upon the other. Purity, when once a standard defining it is fixed, can be determined by chemical analysis, but quality, as judged by characters which appeal to the sense of taste and smell, is more difficult to define or to determine. In cheese, as well as in vegetable and animal products, quality is a property which is assessed mainly in accordance with personal taste and fancy, a fact which is borne out by the preference shown in different parts of the country for different types of cheese or for different characters in the same variety of cheese, such as whether it is hard or soft, pale or highly coloured, mild or sharp to the taste, &c. These characters are given a scale of points which is used as a basis for judging cheese. The values assigned to each character indicate perfection and the totals aggregate 100. As an example, the

Ayrshire Agricultural Association at their annual Produce Show at Kilmarnock direct that the basis for judging cheese shall be in accordance with a standard of points given below. On the same principle a scale of points for cheese was fixed by the Highland and Agricultural Society some years ago.

	Kilmarnock.	Highland Agricultural Society.
Flavour	40	45
Body and Texture	40	25
Colour	12	15
Finish	8	15

The points are awarded to hard pressed cheese of the Cheddar and Dunlop type, made from whole milk. At the London Dairy Show no ruling as regards points is laid down in the judging of cheese. For the purpose of comparison a number of 1st and 2nd prize cheeses, awarded at the Kilmarnock Shows in the years 1924, 1925 and 1926, were sampled and analysed. The following is the average result in percentages :—

	Cheese.			Dry Cheese Solids.	
	Moisture.	Fat.	Casein.	Fat.	Casein.
1st Prize (8) ...	34·0	32·8	26·1	49·7	39·6
2nd Prize (8) ...	34·3	32·7	26·0	49·8	39·6

On the basis of the chemical composition the figures show that there is little to choose between a 1st and 2nd prize cheese. To meet the requirements of different cheese markets slightly different values are assigned to cheese characters. Below are examples of different scales of points in use in the United States of America.

	Export Cheese.	Home Trade Cheese.	British Market.
Flavour	45	50	35
Texture	15	25 (Texture and Body)	15
Body	15		25
Colour	15	15	15
Appearance and Finish ...	10	10	10

These scales apply to hard pressed cheese of the Cheddar type. For other varieties the scale is adjusted in accordance with the relative importance attached to each of the characters.

Grading of Cheese on points is adopted in most countries by the exporters of cheese, and the grading is confined to cheese which conforms to a minimum standard of purity. As an illustration of the scale of points assigned by different countries to hard pressed cheese for exportation, the following examples are taken :—

	American.	Canadian.	Australian.
Flavour	45	40	50
Body and texture	30	30	30
Colour	15	15	} 20
Finish	10	15	

In accordance with the above method of scoring, cheese is separated into different grades, one example of which will suffice. The Commonwealth of Australia fixes four grades of cheese, namely :—

Superfine,	cheese	scoring	95-100	points	inclusive.
First grade,	,,	,,	90- 94	,,	,,
Second grade,	,,	,,	84- 89	,,	,,
Third grade,	,,	,,	73- 83	,,	,,

Standards of Purity.—As already remarked, the British Dominions and foreign countries in their Health or Food and Drugs Acts have incorporated legal standards of purity for whole milk cheese to be exported. Little uniformity exists in the standards adopted, which are summarised below.

WHOLE MILK CHEESE.

Minimum percentage of Fat in Dry Cheese.

50	45	40	30
Australia.	Canada.	South Africa.	California.
New Zealand.	Netherlands.		
United States.	Denmark.		
	Switzerland.		
	Minnesota.		

The standards are based upon the results of the examination of data obtained over a number of years on the composition of cheese made under common conditions of manufacture and from milk of known quality. The standards adopted must be low enough to protect the genuine manufacturer of whole milk cheese from prosecution, but high enough to act as a reasonable safeguard against the substitution of skim milk cheese for whole milk cheese. When a minimum of 45 per cent. of fat in the dry solid is fixed, cheese as low in fat as that would represent exceptional cases. The average would more likely lie between 48 and 50 per cent. The only provision made in some cases is that the milk from which cheese is made must contain a minimum of 3 per cent. of fat.

Some countries have fixed a minimum standard for partly skimmed and for skim milk cheese. Switzerland may be taken as an example of this.

For a full fat cheese a minimum of 45 per cent. fat in dry cheese.
¾ ,, ,, ,, 35 ,, ,, ,,
½ ,, ,, ,, 25 ,, ,, ,,
¼ ,, ,, ,, 15 ,, ,, ,,
Skim milk cheese less than 15 ,, ,, ,,

A minimum standard of fat of 10 per cent. of the dry solid for skim milk cheese is adopted by Australia and South Africa and a maximum of 20 per cent. by Tasmania. For cream cheese calculated on the same basis a minimum of 60 per cent. of fat is adopted by South Africa, Australia and Tasmania, and of 58 per cent. by Switzerland.

The minimum percentage of fat is based not on the whole cheese, but on the percentage of fat in the dry cheese solids. Cheeses differ greatly in their content of moisture, and the amount of water present affects the amount of fat in the whole cheese. By eliminating the water, cheese of any degree of moisture is brought to a common basis of comparison. The proportion of fat in the whole cheese to that in the dry cheese may be calculated as follows :—

Moisture in whole cheese = 35·4 per cent.
Fat in whole cheese = 33·8 per cent.
Then 100 − 35·4 = 64·6 per cent. dry solids.

$$\frac{33\cdot8}{64\cdot6} \times \frac{100}{1} = 52\cdot3 \text{ per cent. fat in dry cheese.}$$

It is recognised that different markets call for cheese with different degrees of moisture, and by basing the cheese standard on the water free substance of the cheese this condition is not interfered with. At the same time it is clear that the greater the moisture content of cheese the less is the percentage of cheese solids. Although in two lots of cheese one lot may contain 29 per cent. of water and the other 39 per cent., yet the amount of fat in the dry cheese might be exactly the same in each case. The only difference between them would be that one lot contained 10 lbs. of water in 100 lbs. of cheese more than the other. It seems desirable therefore to fix a limit to the water content of cheese. In Minnesota the maximum amount of water in cheese is fixed at 40 per cent. The aim in view in adopting cheese standards, however, is not so much to control the amount of water present, although that is important, but to prevent the sale of skim or partly skimmed milk cheese as whole milk cheese. The difference in composition between the two is shown in the following figures, given in percentages :—

	Cheese.		Dry Cheese Solids.	
	Water.	Fat.	Fat.	Fat : Casein.
Whole Milk Cheese ...	33·6	34·1	51·3	1 : 0·74
Skim " " ...	37·2	22·8	36·0	1 : 1·5

Adulteration of Cheese.—The usual forms of fraud consist in the substitution of skim milk cheese for whole milk cheese, or by the addition of fat not derived from milk to skim milk before making it into cheese. Partial skimming of the milk or excessive losses of fat in the whey, due to carelessness or by intention, in the treatment of the curd will lower the proportion of fat in the cheese, and must be regarded in either case as a form of adulteration. It is not difficult in cheese-making to increase the amount of fat in whey to as much as 1 per cent. or even 1·5 per cent. Whether the fat is removed by skimming of the milk or by producing a whey which contains too much fat is immaterial, as in either case the cheese is robbed of its normal amount of fat.

Legal Definition of Cheese.—The following three examples should suffice. *Canada* :—" Cheese is the sound, solid and ripened product made from milk or cream by coagulating the casein thereof with rennet or lactic acid with or without the addition of ripening ferments or seasoning, and contains in the water-free substance not less than 45 per cent. of milk fat. Cheese may also contain added colouring of a harmless character." *Netherlands* :—" Cheese bearing the Government mark for whole milk cheese is made from whole cow's milk without any addition of foreign fats. That the cheese contains at least 45 per cent. of fat in the dry matter, and that the amount of water remains within normal limits." *New South Wales* :—" Whole milk cheese shall be the product obtained from milk by coagulating with rennet, pepsin or acid with or without the addition of ripening ferments, seasoning, salt or harmless colouring matter. It shall not contain less than 50 per cent. of milk fat in its water-free substance and shall not contain any foreign fats or added fats, and shall be such as to secure at least 75 points out of 100 as decided by an inspector."

Government Control of cheese standards operates in different ways. In the Netherlands it acts through cheese control stations, members of which must comply with regulations laid down by the State in connection with the manufacture of cheese. Want of space prevents the inclusion of these regulations. Officials appointed by the Government have free access at all times to buildings for inspection of books, of the process of manufacture of cheese, and for the purpose of taking samples for analysis. Each cheese made is marked by a stamp which is placed by the maker on the cheese at the time it is made to guarantee its quality. The stamp is supplied by the Government, and the cost is borne by members of the Control Station. In the Australian Commonwealth the control operates at the port of shipment or at any other approved place, where the cheese is examined and graded by Government inspectors and export permits are granted thereon. The Government stamps are fixed on the crate containing the article and not on the cheese. For the purpose of defraying the expenses of putting the control into effect fees are charged for granting certificates of quality at the rate of one penny for every hundred packages or part thereof in a consignment. Fees for analysts' certificates range from one to five shillings according to the cost of making the analysis. Other small nominal fees are also charged, such as for licenses to sell or to manufacture dairy produce.

In Canada the country is divided into districts, each under a food inspector. The control operates through the cheese factories, which are open to inspection at all times. Records are kept of each vat, which is numbered along with that of the cheese. The grading and the stamp affixed are in accordance with Government regulations. The stamp is put on to the crate or box containing the article and not on the cheese. Nominal fees are charged for grading and for analysis, &c.

Cheese Standards in this Country.—In the Reports of the Departmental Committee on the Distribution of Agricultural Produce published in 1924 and of the Economic Imperial Committee, Part 4, on Dairy Produce published in 1926, the question of the imposition of a legal minimum standard of purity for cheese in this country was referred to as a subject worthy of careful examination. It might be argued that the effect of a minimum standard for cheese would be for makers to lower the quality of cheese to just above the minimum fixed. But since rich milk is known to give cheese of better quality, which commands a higher price than that made from poor milk, there is little danger of this happening. Only in exceptional cases does it appear to be profitable first to remove part of the fat from milk before making it into cheese. Exporting countries have benefited greatly in wholesale markets through the operation of cheese standards, inasmuch as the effect has been to level up the standard of quality. There is reason to assume that a similar result would be achieved in this country. The present market price for Cheddar cheese varies from 50*s.* to 90*s.* a cwt., due to differences in quality as judged by flavour, body, texture, colour and finish. There would therefore appear to be room for improvement in the direction indicated. A standard would not greatly benefit the skilled cheese maker except to bring into greater prominence the superiority of his article. Legal standards would apply to whole milk cheese as a class and to skim milk cheese as a class, and would not be in any way detrimental to the manufacture of different makes of cheese, of which there are at least seventeen in this country, namely, eleven of the hard pressed cheese type, three of the blue-veined lightly pressed cheese, and three of the soft cheese type. The bulk of the imported cheese is of the Cheddar type. The retailer of cheese is not compelled to label cheese for sale, and the general public are left in ignorance as to whether they are purchasing home made or imported cheese, skim milk or whole milk cheese. Compulsory designation of cheese, which should form part of the regulations in connection with cheese standards, would remove this unsatisfactory state of affairs and it would enlighten the public of the existence of the different British makes and help to advertise and to improve the sale and output.

In the event of the State fixing a minimum standard of quality for whole milk cheese, the question as to what the minimum standard should be is one of the first matters to decide. Except for the fact that there are more breeds of cows each giving a distinct quality of milk, and a number of varieties of cheese peculiar to Britain, the considerations which require to be taken into account in fixing a minimum standard are much the same here as elsewhere.

Since the spring of 1923 analyses of home made and imported cheese of the Cheddar type have been carried out in the chemistry department of the Dairy School, Kilmarnock, and the results obtained provide useful data bearing upon the question of fixing a minimum standard of purity for whole milk cheese of the hard pressed type.

In order first to show the variation in composition of cheese during the cheese-making season, analyses of milk and of the cheese made therefrom were carried out each month from May to September inclusive over a period of three seasons. Two analyses each of milk and of cheese were made monthly, and the results are summarised in the following table :—

Percentage Composition of Milk and of Green Cheese.

	Milk.		Dry Cheese Solids.		Cheese.
	Fat	Fat : Protein.	Fat.	Fat : Casein.	Moisture.
May	3·5	1 : 0·93	50·2	1 : 0·79	34·8
June	3·5	1 : 0·95	49·9	1 : 0·80	35·2
July	3·6	1 : 0·91	51·5	1 : 0·76	34·5
August ...	3·6	1 : 0·92	51·3	1 : 0·76	35·5
September ...	3·7	1 : 0·91	51·0	1 : 0·77	35·5
Average ...	3·6	1 : 0·92	50·8	1 : 0·78	35·1

The figures show that cheese in the fresh or green state made from milk with an average percentage of fat of 3·6 contained 50·8 per cent. of fat in the dry cheese solids and a ratio of fat to casein of 1 : 0·78. The range of variation over all the cheese samples analysed (31) is as follows :—

	Minimum.	Maximum.	Mean.
Water	33·3	37·1	35·1
Fat in Cheese	31·6	34·7	32·9
Fat in Dry Cheese	48·5	53·2	50·8
Casein in Cheese	24·0	27·1	25·7
Casein in Dry Cheese	37·3	41·1	39·5

One of the differences between green and ripe cheese is in

the amount of water; the total amounts of the other constituents remain the same, although changes affecting their digestibility, flavour and texture occur during the process of ripening. The shrinkage or loss in weight which takes place during storage is stated to be at the rate of 1 lb. a week for the first four weeks and 1 lb. every two weeks afterwards for 100 lbs. by weight of cheese. In an experiment at the Dairy School, Kilmarnock, the loss in weight was found to amount to about 7 per cent. during a period of from five to six months' storage. The loss, however, will vary according to the richness or otherwise of the cheese in fat, to its size, to the humidity and temperature of the air, &c.

The composition of cheese representative of what is placed on the market is shown in the following two tables.

COMPOSITION OF PRIZE CHEESE, CHEDDAR AND DUNLOP.

Kilmarnock Show.

	Moisture.			Dry Cheese.			
				Fat.			Fat : Casein.
	Lowest.	Highest	Average.	Lowest.	Highest.	Average.	Average.
1924 (9)	32·4	36·2	34·5	47·6	50·8	49·9	0·78
1925 (12)	32·5	34·7	33·7	46·8	52·6	50·2	0·78
1926 (14)	30·6	36·7	33·1	48·8	51·8	50·5	0·75
Miscellaneous (11)	28·7	38·7	34·1	47·6	50·4	49·0	0·83

Miscellaneous cheese consists of samples taken from cheese made at factories and cheese made at farms in the West of Scotland.

New Zealand and Canadian Cheese.

	Moisture.			Dry Cheese.			
				Fat.			Fat : Casein.
	Lowest.	Highest.	Average	Lowest.	Highest.	Average.	Average.
New Zealand (10)...	31·1	35·2	32·9	51·7	55·1	53·4	0·70
Canadian (6) ...	28·2	34·4	32·5	49·8	52·2	51·1	0·77

Examination of the figures in the foregoing tables point to the conclusion that a minimum standard for fat in whole milk cheese should not be fixed at a higher figure than 45 per cent. of the dry cheese solids. From what has been said earlier in this paper the Governments of New Zealand, of the United States of America and of the Commonwealth of Australia have fixed a minimum of 50 per cent. of the dry cheese. The two principal factors concerned in fixing upon a standard are (1) the composition of the milk, and (2) the loss of fat in the whey. In respect to the latter a large number of analyses of whey obtained from factories and cheese-making farms have been made; the minimum percentage of fat found was 0·12, the maximum being 0·3 and the mean 0·23, which denotes a skill in cheese-making at least equal to that shown in any other country. As regards the effect of the composition of milk on the cheese, it was pointed out in table on page 48 that cheese made with a fat content of 3·6 per cent. contained 50·8 per cent. of fat in the dry solids, and had a fat-casein ratio in milk of 0·93 and in cheese of 0·78. The corresponding fat-casein figures for milk and cheese in other countries is under 0·9 and below 0·78 respectively. In New Zealand the ratio is 0·7. The table on page 49 shows that the richer the milk is in fat the higher in proportion will be the amount of fat in the cheese solids and the lower the proportion of casein. The inference is that cheese imported from New Zealand is made from milk richer in fat than the milk used for cheese-making in the West of Scotland. But it must be remembered that the best quality of cheese is exported.

To summarise : Changes in the conditions of sale of cheese in this country which seem desirable are :—

(*a*) The introduction of a legal minimum standard of purity of fat for whole milk cheese expressed on the dry cheese solids.

(*b*) Grading of cheese on points into 1st, 2nd and 3rd grades.

(*c*) A maximum water content expressed on the whole cheese.

(*d*) Designation of cheese with name of variety and country of origin.

Government control could operate by modelling the regulations on the basis of those in use in the Oversea Dominions and in the Netherlands.

The writer wishes to acknowledge his indebtedness to Mr. Peter Caldwell of the Chemistry Department for carrying out the analytical work, to Mr. James Kirkwood of the Dairy School for supplying samples, and to Mr. M. M'Fadzean for making arrangements for the sampling of cheese at the Kilmarnock Shows.

FARM PESTS—BIRDS.[1]

James Ritchie, M.A., D.Sc., F.R.S.E.,
Natural History Department, Royal Scottish Museum.

Birds and the Garden (*concluded*).

The Lesser Garden Pests.—In the preceding articles have been mentioned the birds which cause the greatest amount of damage in gardens, and to which on this account the gardener must pay most attention. There remains a residue of pests which

[1] Articles in this series, dealing with Mammal Pests, commenced in the Journal in July 1922. The first article on Bird Pests appeared in January 1924.

stand on a different footing from these predecessors. In the first place the damage they accomplish, though it may be fairly regular, is relatively slight, and, in the second place, garden produce is but a second string to their bow, the first string being insect or animal food, so that all, with perhaps the exception of the Blackcap, are on balance decidedly useful birds, even in the gardens which they plunder. The group includes many of the lesser frequenters of the garden in spring and summer.

The Warblers.—The most common of these throughout Britain is the Common Whitethroat (*Sylvia communis*), a summer resident from April to September in most parts except the extreme north of Scotland. During the greater part of its sojourn in this country it feeds upon insects, among which are included garden pests such as caterpillars, green-flies and two-winged flies, but in July and August, when the young are hunting on their own account, the broods enter gardens and turn their attention to small fruit. They occasionally pick gooseberries and eat peas, but their favourite fruits are red, white and black currants and rasps. It may be some comfort to know that, unlike others of the lesser bird pests, they are thrifty feeders, for Mr. Bolam [1] has repeatedly seen them descend to the ground to recover a fallen berry, a rare trait in bird-life in his experience. Dr. Collinge's analysis of the stomach contents of 17 specimens shows an overwhelming balance of insect food.[2]

The Blackcap (*Sylvia atricapilla*), also a summer resident, which arrives in late April and departs in September or later, is widely distributed in Britain during these months and is common in most parts. It is larger than the Whitethroat, and from it and all the other common warblers may be distinguished by its black or brown cap. There is some difference of opinion regarding its activities in the garden. Mr. Bolam regards it as less harmful than the Garden Warbler, and considers that it prefers small berries, and particularly the fruits of flowering-currants, honeysuckle and ivy. But the mass of opinion looks upon it as one of the worst of the lesser garden pests. Perhaps its harmfulness depends upon its opportunities of doing damage, for it is noticeable that the most serious indictments come from the southern counties of large orchards. Thus Smith has recorded of the Kent area: [3] "A family of Blackcaps in an orchard commit great havoc. They do not eat a quarter of the fruit they pick; they are also very fond of raspberries and figs. It is the worst summer bird we have in the fruit plantations, and I think the only one of our summer visitors that does much mischief."

A similar opinion of a well known fruit grower is recorded by Dr. Collinge (*op cit.*, p. 22): "These birds do a large amount of damage to wall fruit; here we destroy all we can. If protected at all, or allowed to increase, it will become one of the worst orchard pests."

[1] G. Bolam: "Small Birds in the Garden," *Scottish Naturalist*, 1921, p. 71.
[2] W. E. Collinge: "The Food of Some British Wild Birds," 1913, p. 21.
[3] F. Smith: "The Fruit Grower and the Birds," Maidstone, 1906.

On the other hand its insect fare is extensive and varied, and much of its vegetarian food is harmless. "Its food consists of spiders, aphides, and many other insects, sometimes captured on the wing, and of wild fruits, including blackberries and the berries of ivy, privet and elder. It is also devoted to cultivated fruit, attacking currants, strawberries, raspberries and cherries, whilst, like the Whitethroat, it opens pea pods."[1]

The last activity is vouched for by Dr. Collinge's analysis of the stomach contents of 33 individuals, of which nine contained numerous peas. Of the 33, 26 had been feeding on small fruits, the remains of which were recognisable, and comparatively few contained insects; but the statistics suggest that the birds were mostly killed during the fruit season, and therefore can hardly be taken as a fair sample of the whole season's activities.

Dr. Collinge is of opinion that the Blackcap is increasing in numbers as a summer visitor to Britain, and tends to pay more frequent visits to orchards. He considers that in small numbers it probably does more good than harm, but does "not advocate any protection for this bird, as there is considerable likelihood, if it becomes at all numerous, of it being a very undesirable orchard pest."

Last of this trio of warblers reputed to be garden pests is the Garden Warbler (*Sylvia borin*), distinguished from the Blackcap by the absence of a cap, and from the Whitethroat by the uniform colour of chin, throat and underparts. It is a summer resident in Britain, but while it is common in England, in Scotland, outside the Clyde and Forth area, it is very local, and beyond the north of Perthshire it has not been known to breed. Garden Warblers, according to the observations of Mr. Bolam, "seem to be most addicted to rasps, but failing these they fall back indiscriminately upon either red or white currants." He has not noticed them touch black currants. Other observers have recorded that they take late cherries. But the numbers of the Garden Warbler are so few that it cannot do much harm, and it destroys many green-flies and caterpillars of the small Cabbage White butterfly, as well as other noxious insects. Of the many other warblers which visit Britain it can be said with Archibald[1] that "If ever they touch fruit, it is certainly exceptional, and for practical purposes it is safe to say that the benefit derived from their presence is not the least detracted by any loss of garden produce."

The Redbreast (*Erithacus rubecula*).—In view of the constant presence and audacity of the Robin in our gardens, it is perhaps not surprising that of all the assemblage of small birds Mr. Bolam found it to be the most conspicuous fruit-eater. In his Cumberland garden black currants were the favourite food, but the eating was of a desultory and perfunctory kind, and the appearance of an earthworm never failed to seduce all the birds within view from their fruit. In other places they have been seen to take a few red currants and cherries, as well as the berries of ivy and

[1] C. F. Archibald: "Wild Birds, Useful and Injurious," *Journ. Roy. Agr. Soc.*, vol. 5, 1894.

honeysuckle. The major part of the Robin's food, however, consists of moths and butterflies and their caterpillars, beetles and their larvæ, small slugs, wood-lice and earthworms, so that over all it is a decidedly useful species in the garden.

The Tits.—Of the eight species of tits which nest in Britain suspicion has fallen upon three only—the Great Tit, the Blue Tit and the Cole Tit—and in each case the damage alleged is similar. The Great Tit (*Parus major*) attacks pears and apples, pecking the skin near the stalk and damaging the fruit for marketing. It plucks to pieces the blossoms of apples and pears, and occasionally eats bees. Mr. Bolam has observed one picking up healthy bees as they landed upon the alighting board of a hive. The Blue Tit (*Parus cæruleus*) also pecks holes in ripe apples and pears, pulls the half-expanded blossoms of these trees to pieces, and has been reported as attacking the buds of the Monarch Plum. The Cole Tit (*Parus ater*) destroys black-currant buds when they are opening, eats the embryo bunches of fruit, and has been found by some fruit-growers to be more destructive to pears and apples than the Blue Tit.

What does this indictment amount to, looked at a little more closely? It is admitted that holes are occasionally pecked in ripe apples and pears by tits, but the total amount of damage is not very serious, and it would seem that it could be easily prevented. The tits are readily allured from their somewhat casual visits to fruit by the presence of sunflower seed, and several large fruit-growers have grown sunflowers with success near their orchards, Mr. F. Smith stating that for several years he has saved his fruit in the garden by planting sunflowers; if there is enough sunflower seed they will not touch fruit.

As for the destruction of blossom buds, every observer who has taken the trouble to examine with care the buds destroyed by tits (and we need mention only Yarrell on the scientific side and F. Smith and C. F. Archibald on the economic) has discovered that the plucked buds contained insect larvæ. The insect, not the bud, is the attraction, and were the larvæ left to feed and multiply the ultimate damage would be much greater than that attributed to the tits. In destroying the buds they are saving the fruit crop.

When a further glance is taken at the generality of the food of tits, one is lost in wonder at the vast amount of good work they accomplish. Gardeners, fruit-growers and ornithologists bear testimony to their merit. It is sufficient to refer to the most recent examinations and reports, those of Dr. Collinge published in 1919.[1] An analysis of the stomach contents of 32 specimens of Great Tit (we trust that no more of these valuable birds need now be sacrificed, even in such a cause) showed that over all the food consisted of 77 per cent. by volume of animal matter and 23 per cent. of vegetable food. But 66·5 per cent. was wholly composed of injurious insects, and less than 20 per cent. of fruit

[1] W. E. Collinge: "The Food of Wild Birds," in *Journ. Board of Agriculture*, March 1919, p. 1453 *et seq.*

and other vegetable matter that had better been left untouched; so that Dr. Collinge concludes that "as a destroyer of insects this bird is one of the most valuable we have." The Blue Tit is even more useful. An examination of 50 adults and 39 nestlings showed that 78 per cent. by volume of the food consisted of injurious insects, whereas only 10 per cent. represented fruit and similar damage. "All who foster or aid in its destruction are doing a serious injury both to themselves and fruit-growers in general."

Occasional Pests.—There are a few birds which, while they cannot be reckoned as major or minor pests taking a regular toll of garden produce, yet on occasion pay serious enough visits to the garden. Several have been mentioned in connection with other types of misdemeanour.

Of the occasional pests probably the worst is the Wood-pigeon. From it both vegetable and fruit garden may suffer. In spring or autumn it sometimes takes the seedlings of green crops such as peas, lettuce, cabbage, cauliflower, turnips and beet. In summer it falls upon a limited range of fruit; cherries are devoured at all stages, from green to ripe, and Hooper records a complaint made to him that one year at Pershore "wood-pigeons, or coifs, as they call them there, were a plague and took the gooseberries whole." [1]

The Pheasant, like the wood-pigeon, finds the succulence of green crops, such as cabbages, cauliflowers and brussels sprouts, an irresistible attraction in gardens bordering the coverts, and I know such a garden on Tweedside where repeated sowings of such crops have had to be made because of the destruction wrought by Pheasants among the seedlings. In the same garden Pheasants annually play havoc with the bulbs of crocuses, tulips and hyacinths, and Sir Herbert Maxwell has recorded a case in Berkshire, where beans were picked from a row of scarlet runners and bulbils from the leaf axils of the tiger-lily [2]—a curious taste.

Rooks are not often seen in the garden, but there is sufficient evidence to show that occasionally their harmful activities extend thither. Probably their most serious damage is done in the extensive fruit fields of Blairgowrie in Perthshire, where they destroy many raspberries. Elsewhere, especially in times of drought, they take cherries, gooseberries and strawberries, sometimes pecking even apples and pears; and nuts, such as filberts and walnuts, seem to be a favourite diet.

Last of the occasional pests, and least important because of its comparative rarity in most districts, is the Jay. In the vegetable garden it may strip the pods from whole rows of peas, in which respect it resembles the Magpie, and in the fruit garden it eats cherries and plums. Its worst offence, however, is a wasteful pecking at ripe apples, so that according to Theobald it spoils "countless numbers of the best coloured apples." [3]

[1] C. H. Hooper: "Fruit Growing and Bird Protection," *Journ. Roy. Soc. Arts*, vol. 55, 1906, p. 81. [2] *Scottish Naturalist*, 1924, p. 183.

[3] F. V. Theobald: "Economic Ornithology in relation to Agriculture, Horticulture and Forestry," *Science Progress*, 1907, p. 270.

Birds and the Woods.

A few of the native birds of Britain are true woodland species, living in and feeding in the forest, but in addition a somewhat larger number, which as a rule gather a livelihood in the open, resort to the woods for sustenance at special seasons or on special occasions. The harm done by the birds touches the wood at various stages of its development. At the very commencement of its growth the seed-bed may be ravished and the seed itself, or later the seed-leaves of the germinated seed, devoured.

The young plantation suffers through the destruction of leaf buds. This may take place in winter when other food is scarce or unobtainable, or in spring when the buds, swollen with sap, contribute both food and drink to the needy bird. Both old and young trees are attacked in this way, but while a grown tree can well spare some of its profuse growth, young trees are less able to meet the sacrifice of their leaf buds. Should the damaged bud be the growing point of the tree, however, the harm done is serious in either case, for the subsequent regular development of the tree is prevented. Even in such a case the young plantation is the greater sufferer, since the tips, especially in times of snow, are more easily reached.

At a somewhat later stage the plantation may be subject to deformity from physical pressures, such as the roosting of hordes of starlings, or even of the lesser numbers of wood-pigeons, both of which have been known to break branches to quite a serious extent. Further, there are records of young trees deformed by the sheer weight and disturbance to growth caused by the presence of the nests of rooks.

The full grown tree, having escaped the troubles which afflict the young, is comparatively safe from harm by birds, but it has a set of particular destructors in the woodpeckers, which tend to avoid all but the large boles of mature development.

Over all, the damage done by birds to trees can hardly be called serious, and the above summary of the types of destruction done indicates that this is a matter for the professional forester or large landowner rather than the farmer. Yet the farmer, now often also the proprietor, may have some interest in the preservation of his woodland, and for this reason a short account of the birds more closely concerned in the damage is included here.

True Woodland Birds as Pests.—By true woodland birds I mean such as live, feed and nest in the forest and are seldom seen beyond its bounds. They are few in number, for although the margin of the wood is tenanted by a numerous bird population, their depths are almost devoid of bird-life. The species that are of most significance from our present point of view are the Crossbills, the Capercaillie and the Woodpeckers, but the harm wrought by these differs very much in kind.

The Crossbills.—Two races of Crossbill (*Loxia curvirostra*) occur regularly in Britain—the common continental form and the Scottish Crossbill—and although the former is, in the main, an immigrant while the latter is a resident, both play similar parts in the woods.

Though they do not often show themselves, owing to their habit of feeding in the tree-tops, the Crossbills are distinctive birds, the adult males being of a dull crimson hue while their juniors are blotched with orange and yellow. The less gaudy females are yellowish brown suffused with a dash of green. The most striking character in both sexes, however, is the bill, the upper and lower parts of which distinctly cross each other, as if by some misfit both tips had grown too long. The crossing is

THE SCOTTISH CROSSBILL.[1]

no accident, but a fine adaptation due to the peculiar feeding habits of the birds, for in the young the tips meet in the ordinary manner of the finches.

The Scottish Crossbill is peculiar to Scotland, and even here its regular breeding area is limited to the region from northern Perthshire to Sutherland, and from western Ross to Banffshire. In winter, and even then on rare occasions, it has been found as far south as the Solway.

The continental Crossbill reaches Britain in summer, from

[1] The figures are from Saunders' *Manual of British Birds*, by courtesy of Messrs. Gurney & Jackson, Edinburgh and London.

mid-June to August, and although it occurs regularly in some districts, in most it appears only occasionally. But at fairly definite intervals of years it bursts from its continental pine-woods and in large numbers invades Britain. After such invasions it frequently prolongs its stay over the following year or more and becomes for the time being a British nesting bird, the area it colonizes being generally outside the territory of its Scottish cousin.

The Crossbills feed almost wholly upon the seeds of coniferous trees. The cones are wrenched off, held firmly by the feet, and scale after scale is pulled back by the powerful bill so that the seed revealed underneath may be devoured. Beneath the tree a collection of disembowled cones often gives a first hint of the presence of the birds in the branches above. The seeds of Scots fir seem to form the most favoured food, but larch seed is also eaten, as well as that of spruce, alder and a few wild fruits, nuts and leaf buds. Sometimes, it is said, the birds add to their vegetarian diet the insects to be found on the trees they visit.

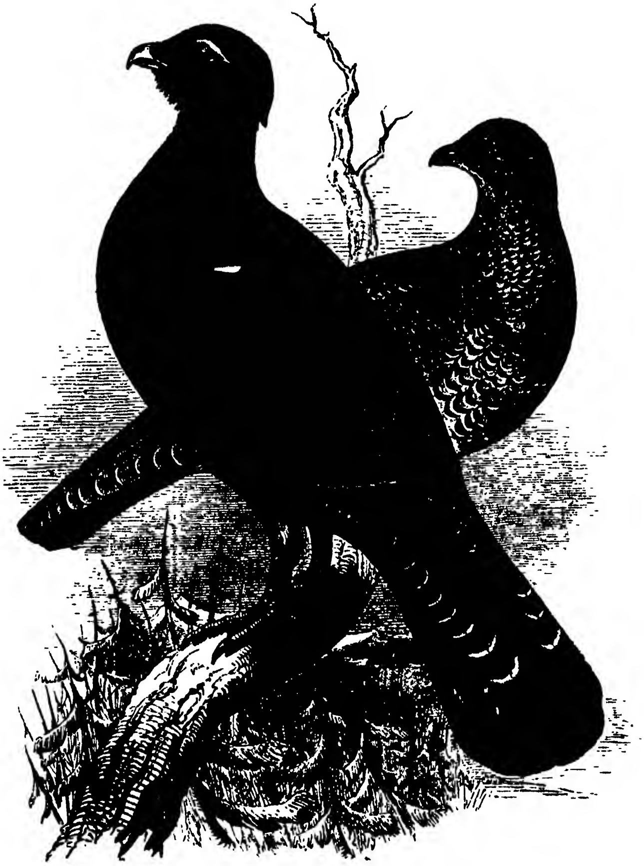
Crossbills are not a numerous race, and in years of plenty there must be enough and to spare from the harvest of the woods for their needs, but in poor seasons and where the fir seed is gathered for sale they may do a calculable amount of damage.

The Capercaillie (*Tetrao urogallus*).—This, the largest of the grouse family, is so much a bird of the woods that with the disappearance of Scottish forests it also disappeared in the latter half of the eighteenth century. The Gaelic name, said to signify "old fellow of the woods," is no inapt appellation. The present stock of Capercaillies, which is widely distributed in Scotland from Inverness-shire to Lanarkshire and from Argyll to Aberdeenshire and is annually extending its conquests, is very largely derived from a few birds imported to Taymouth Castle in 1837.

Like its relatives the Capercaillie nests on the ground, and here the sombre-coloured female bird may sometimes be seen grubbing amongst the fallen pine-needles. But during the day, at any rate, the birds are more often to be found high in the fir trees, whence, being disturbed, they fly with a clatter through the branches, the outstretched neck, glossy-green breast and large tail of the cock being very noticeable in flight.

Capercaillies feed entirely in the wood. They may pick up insects which thrust themselves under notice, or in autumn feed upon such berries as they can find, but their staple food throughout the year consists of buds, young leaves, tender shoots and pine needles. It is impossible to say what proportions of these ingredients make up their diet, but my own experience, during the month of August on Speyside, indicates that needles of coniferous trees form the staple food. Examinations of scores of droppings showed that the waste consisted solely of the needles of larch, and yet Scots firs and native birch trees were abundant in the woods inhabited by the capers.

The damage alleged against these birds is that in feeding they nip off leading shoots and so ruin the regular development of the trees. The indictment is true to a limited extent. In young plantations the caper may be able to reach to the leading shoot of a fir, and in these young plantations considerable damage may be done. Even when the trees have grown to some height they may still fall to the caper, for the reach of the bird is vastly extended when several feet of snow, with a frost-firmed surface, cover the ground. But it must be remembered that capercaillies prefer old woods, and it is probably only when the stock tends to become over numerous that they begin to dwell in the young



THE CAPERCAILLIE.

plantings. It was the disappearance of the old woods which ousted the capercaillie in the past century, and at the present day the recent destruction of old woods on an estate on Donside has greatly reduced the stock of capers there.

The birds are said also to damage old trees by nipping off the leading shoots. I doubt if there is much substance in the complaint. A male bird, and males are oftener in the trees than females, weighs 9 to 12 lbs., and the female weighs 4 to 7 lbs. It is obvious that there can seldom be a branch of sufficient strength to bear such a weight in sufficient proximity to the leading shoot of a tall larch or Scots fir to enable the bird to work its will upon the vital leader. Except in young plantations the damage done by capercaillies is far more than compensated for by the sport they give, their value (somewhat discounted by their flavour) as food, and the occasional noxious insects they eat.

The Woodpeckers.—Of the three species of woodpeckers which are resident in Britain, two, the Green Woodpecker (*Picus viridis*) and the Lesser Spotted Woodpecker (*Dryobates minor*) are almost wholly confined to England and Wales. There the Green Woodpecker is widely distributed except in the northern counties, where the Lesser Spotted also is extremely rare. The Great Spotted Woodpecker (*Dryobates major*), once a native of Scotland, became extinct there about the middle of last century, but during the last forty years it has gradually reclaimed its lost ground, and is now to be found from the Solway to Moray and from Forfarshire to Argyllshire. In England and Wales it is widely distributed in wooded areas.

These beautiful and interesting birds are outstanding in plumage as well as in their structural adaptation for a highly specialised form of livelihood. The plumage of the Green Woodpecker or Yaffle is of a soft olive green with a red cap, that of the others is variegated red, white and black, but all are peculiar in that they seldom perch, and habitually cling to the upright trunk of a tree with their sharp claws, resting their weight upon the rigid tail feathers which are pressed against the trunk. Moreover each possesses a strong beak, fitted for driving holes in wood, and an exceptionally long fringed tongue, clearly adapted for capturing insects and dragging them from their hiding holes.

There has been much controversy regarding the economic significance of woodpeckers. The greater part of their food consists of insects and insect larvæ, especially many wood-boring kinds, which are found under the bark and in crevices in the bark, such as the longicorn *Rhagium* or the bark-boring Scolytidæ. They have been seen to split oak-galls to get at the Cynipid larva within, to pick greenflies from the under surfaces of leaves, and to attack ant-hills in order to capture the scurrying ants and their grubs, a habit specially characteristic of the Green Woodpecker. The larger and stronger-billed species, the Green and Great Spotted Woodpeckers, sometimes turn to a vegetarian diet when insect food becomes scarce, eating acorns, nuts, beech-mast and berries, and from these it is a short step to garden and orchard fruits, which occasionally suffer in autumn.

The food list is almost wholly favourable to the cultivator, but unfortunately woodpeckers bore small holes in trees in search of larvæ, excavate larger cavities for the hidden nest, and sometimes completely girdle the bark on a tree trunk. On this account they have been condemned, but the judgment is a hasty one. The bark-borings are made for the purpose of capturing the larvæ which are known to lurk underneath, and which, eventually, in their successive generations would have done harm to the forest much greater than that caused by the woodpeckers in their destruction.

As to the nesting holes: it must be admitted that the birds occasionally work in healthy trees, and that they often commence holes which are never completed as nesting places; but as a rule they either make use of cavities rotted in trees, or commence drilling where already the bark is festered and easy to penetrate because of the action of fungus, or drill in dead trees or in trees the wood of which tends to be soft or decaying.

Although opinions have varied, it is undoubted that the weight of opinion at the present time is strongly in favour of woodpeckers as birds which by their destruction of insects do far more good than harm to the forester.

A method of minimising the damage to healthy trees by woodpeckers has been made use of with some success by a French landowner, M. Kercado. He points out that in healthy trees the Green Woodpecker (and the others follow the same habit) in order to facilitate its drilling chooses those in which surface scars have been formed by a fungus after pruning. He advises that in pruning a branch a stump three or four inches long should be left, instead of a close cut being made at the origin of the branch. Thus the species of fungus which causes the scar is discouraged, and scar-formation, harmful because the rough broken surface retains rain-water and induces the process of decay, is prevented.

These remarks upon the destruction caused by the true woodland birds may be fittingly concluded by an interesting observation made by a well-known French writer on forest zoology, M. Mathieu. He has well pointed out that the number of insectivorous birds in a forest may be taken as an index of the administration of the forest. The most favoured pasture for large numbers of insects is presented by dead, dying and weakly trees or branches. And large numbers of insects are reflected in large numbers of the birds which feed upon them. In short, therefore, the bird index may be roughly summarised: many insectivorous birds, many insects, unhealthy woods; few birds, few insects, healthy woods.

CALCIUM CYANIDE AS A GLASSHOUSE FUMIGANT.

HERBERT W. MILES, M.Sc., N.D.A.

WITH the recent expansion of the glasshouse industry there has been a greatly increased demand for glasshouse fumigants, and a more commonly expressed dissatisfaction with the old method of generating hydrocyanic acid gas by means of sodium cyanide or potassium cyanide and sulphuric acid diluted with water. This method requires considerable preparation and no small amount of skill, for the cyanide has to be accurately weighed and frequently divided into smaller amounts, and the acid carefully measured and diluted. The operation of fumigating, too, is fraught with danger, and the operator, after dropping the cyanide packages into the acid, has to hurry out of the house, for the hydrocyanic acid gas is evolved with great rapidity and reaches a toxic concentration in a few minutes.

Within the last two or three years calcium cyanide has been put on the market as a glasshouse fumigant. The commercial grade recommended for this purpose is guaranteed to contain not less than 40 per cent. and not more than 50 per cent. of pure calcium cyanide. Analysis of sixteen samples taken at random from various consignments showed the range of pure calcium cyanide content to be from 46·10 per cent., the lowest recorded, to 50·33 per cent., the highest, the average for the sixteen samples being 48·97 per cent. In appearance this calcium cyanide resembles fine sand, and is bluish grey in colour, somewhat like basic slag. On exposure, the moisture in the air reacts upon the calcium cyanide and hydrocyanic acid gas is slowly given off.

Method of using Calcium Cyanide.—Prior to fumigating a glasshouse it is advisable to see that it can be rendered air-tight or nearly so. Broken panes of glass should be repaired or covered and cracks about joints or doors stopped with putty or pasted over with stiff paper. Ventilators should be in good working order so that the house can be completely closed down and easily opened up again. Attendance to these preliminary details does much to ensure success in fumigation, for wastage of the gas is prevented and draughts, which produce uneven distribution of the fumigant, are avoided, therefore the risk of injury to the plants is minimised.

The operation itself is extremely simple. In the evening, after sundown, the calcium cyanide is sprinkled along the glasshouse paths and the house closed down and locked.

A thumb pot or a suitable tin with a hole in it may be used to obtain an even distribution of the fumigant, but special hand distributors are procurable, and are to be recommended for the ease and accuracy with which small amounts can be measured. These distributors are either conical or cylindrical with a conical feed; the conical distributor is fitted with a graduated paper lining so that the amount can be read as the calcium cyanide is poured in, and the cylindrical distributor has a mica window on which the quantity graduations are marked. When the required amount has been poured into the distributor the operator turns the tap and walks quickly down the glasshouse, permitting the cyanide to run out on the path.

In commercial houses of the open range type it frequently happens that insect attack is localised, or that crops growing side by side in the glasshouse cannot withstand to the same extent the action of the hydrocyanic acid gas. In order to meet these conditions it has been found that close canvas curtains, or wooden supports to which oiled or tarred paper has been fastened, can be used to enclose the portion to be fumigated, or to shut off a section of the house where fumigation is unnecessary or inadvisable. The essential point is that the curtain or partitioning extends from the roof to the floor, so as to prevent as far as possible the dispersion throughout the house of the toxic fumes.

When calcium cyanide is applied in a glasshouse it absorbs the moisture from the air and toxic fumes are gradually evolved, some little time elapsing before the toxic concentration is reached. Early next morning, before the sun strikes the plants, the fumigated house should be opened up and thoroughly aired; workmen can then enter the house for the performance of their duties.

Dosage.—The dosage of calcium cyanide varies considerably according to the character and the stage of growth of the plants to be fumigated, and the pests it is desired to control. Amounts ranging from one-twelfth to two-thirds of an ounce per 1000 cubic feet have been successfully used, but as a general rule it is found that one-quarter ounce per 1000 cubic feet gives a fairly high degree of efficiency in pest control with a maximum freedom from injury by the hydrocyanic acid gas. Plants of very delicate growth are susceptible to injury, and it is advisable that they be fumigated with low dosages only; these dosages may, however, be repeated at intervals of ten days or a fortnight and a fair measure of pest control obtained. For plants like *Asparagus plumosus* and *Asparagus sprengeri* the dosage is as low as one-eighth ounce per 1000 cubic feet, but stronger plants like carnations have been successfully fumigated under English conditions with a dosage as high as two-thirds of an ounce per 1000 cubic feet.

Measuring the House.—When fumigating with calcium cyanide it is essential that the material be carefully measured and the cubic contents of the house accurately calculated, for errors may result in injury to the plants to be fumigated, especially where growth is delicate.

To calculate the amount of calcium cyanide to use for a fumigation, take the capacity of the house to the nearest 1000 cubic feet and divide the thousands number by the figure in the dosage,—e.g. for 42,000 cubic feet at a dosage of one-eighth, the amount of calcium cyanide required would be 5¼ ozs.; for a quarter-ounce dosage, 10½ ozs. would be needed.

General precautionary Measures.—The use of hydrocyanic acid gas as a glasshouse fumigant necessitates certain precautionary measures, for the gas is not only highly toxic to insects, but when used carelessly or under unfavourable conditions may be seriously injurious to the plants.

One of the most important factors predisposing towards injury is sunlight. It is advisable therefore that fumigations should not be carried out until about an hour after sunset. The use of calcium cyanide as a source of hydrocyanic acid gas considerably diminishes the risk of injury to the plants due to the effect of sunlight prior to the fumigation, for a toxic concentration is not reached until some little time after the material is sprinkled in the glasshouses. During the summer, when the nights are short and the sunlight becomes intense during the early morning, much damage may be done in houses fumigated overnight, unless they are opened very early the following morning. When such conditions prevail as in June, July and August, it is essential that fumigated houses be opened soon after dawn before the sun strikes them, in order to avoid any tendency to scorching.

Another important point in this connection is that there should be no moisture on the plants at the time of fumigation. Hydrocyanic acid gas has a strong affinity for moisture, and where plants with wet leaves are fumigated a weak solution of prussic acid forms on the foliage. The absorption of this acid by the leaf, or its contact with the epidermis, may cause a burning or scorching of the foliage.

Moisture on the foliage may occur in two ways. In a heated house on a sunny day the air becomes very warm and the soil temperature rises considerably. As the evening comes on or with the springing up of a cool breeze the air temperature may fall rapidly, and at sunset it may be found that, owing to the warm soil, the plants are taking up more moisture than the leaves can transpire into the cool air of the glasshouse, with the result that globules of moisture are exuded through the pores of the leaves.

Globules of moisture may form on the leaves because of a fall in the temperature of the glasshouse. Under normal conditions there is always a certain amount of water vapour in the atmosphere, and in glasshouses the relative humidity is often as high as 95 per cent. As a result of the high degree of humidity a fall in the temperature of the glasshouse usually means the direct deposition of water in the form of dew upon the plants.

It will be seen that moisture conditions are closely bound up with temperature, and for this reason the temperature of a glasshouse is important in connection with fumigation. Fumigations with calcium cyanide have been most successfully carried out between the temperatures of 55° and 70°, but at whatever temperature the fumigation is carried out every effort should be made to keep it constant, as it is only by so doing that moisture can be prevented from forming on the leaves of the plants and the likelihood of scorching eliminated.

Results of Experiments with Calcium Cyanide.—Over one hundred controlled fumigations have been carried out during 1925 and 1926, and the results of these are of considerable interest in that they show that calcium cyanide can be used to control a number of the most serious insect pests of glasshouse crops, and that a wide range of plants can be fumigated without injury.

The greenhouse white fly, *Trialeurodes vaporariorum*, Westw., has been successfully controlled with dosages varying from one-twelfth ounce per 1000 cubic feet in spring, to two-thirds ounce per 1000 cubic feet in autumn. The temperatures of the houses at the time of fumigation have varied from 52° F. to 77° F., and the relative humidity varied from 71 per cent. to 95 per cent. It has been found that low dosages in spring give effective control, and fumigations repeated at intervals keep the pest in check throughout the season. Towards the end of the summer, however, when with many crops the glasshouse conditions become rather dry, dosages up to two-thirds ounce per 1000 cubic feet may be necessary to give a complete kill of the adult insects. Plants fumigated for the control of white fly include tomato, arum, chrysanthemum, cucumber, runner bean, freesia, and azalea.

Several species of aphides occur in glasshouses : thus the green aphis, *Myzus persicæ*, Sulz., infests most plants. A mottled greenish species, *Myzus circumflexus*, Buck., is common on arums; the black aphis, *Aphis rumicis*, L., occurs on asparagus spp.; and *Macrosiphoniella sanborni*, Gill., attacks chrysanthemums. Effective control was obtained under ordinary glasshouse conditions with dosages varying from one-fifth to one-half ounce of calcium cyanide per 1000 cubic feet. The conditions influenced results to a considerable extent, and where higher dosages were necessary it was probably because of the different conditions prevailing. Thus satisfactory control of green aphides, *M. Solanifolii*, Ashm., on tulips, and black aphides, *A. rumicis*, L., on *Asparagus Sprengeri* in spring was obtained with dosages well below one-quarter ounce, whereas in the colder damper conditions it required up to one-half ounce to control most species.

Thrips are often particularly troublesome in glasshouses, and in the course of these investigations four species have been dealt with :—*Thrips tabaci*, Lind., on carnations, *Heliothrips bicinctus*, Bagn., on smilax, *H. hæmorrhoidalis*, Bché., on arums and tomatoes, and *Parthenothrips dracænæ*, Heeg, on Kentia palms. Fumigations with dosages of one-quarter to one-third ounce of calcium cyanide per 1000 cubic feet have given satisfactory control of the adults, but the nymphs were found most resistant to the hydrocyanic acid gas. Temperatures at the time of fumigation ranged between 55°-65° F., and the relative humidity between 85-95 per cent. The most satisfactory control was obtained by a series of three or four fumigations at seven to ten day intervals. Mealy bugs, *Pseudococcus citri*, Risso, on vines, and *P. maritimus*, Erh., on tomatoes, have been controlled by periodic fumigations commencing early in the season with low dosages and increasing these as the season advances.

The chrysanthemum leaf-miner has been held in check by periodic fumigations at dosages from one-quarter ounce to one-third ounce commencing at the time the plants are taken indoors for flowering; in this way the flies are killed as they emerge from the puparia in the leaves.

Conclusion.—Experiments under a variety of conditions indicate that calcium cyanide is an efficient and adaptable glasshouse fumigant against such pests as aphis, thrips, white fly, chrysanthemum fly and mealy bug. For the majority of plants routine fumigations with one-quarter ounce per 1000 cubic feet will maintain a high degree of pest control, but for delicate

plants a lower dosage is advisable, while for some plants a larger dose is necessary to control the pests attacking them.

Since conditions vary considerably in glasshouses and nurseries, growers should commence a series of fumigations with a low dosage, gradually increasing the amount of calcium cyanide until a satisfactory control is obtained without any deleterious effects on the plants fumigated. It cannot be too strongly emphasised that it is preferable to obtain pest control with a series of say three fumigations at intervals of about ten days with a low dosage, than to run grave risks of injuring the plants by attempting to completely eradicate the pest with one severe fumigation.

The special advantages accruing from the use of calcium cyanide as a source of hydrocyanic acid gas are the ease with which the material can be used : there is no mixing, it is simply poured from the tin into the measuring and distributing receptacle; its relative cheapness : a house with a capacity of 30,000 cubic feet can be fumigated with one-quarter ounce dosage for 1*s*. 4*d*.; and there is a minimum of risk to both the operator and the plants owing to the gradual evolution of the hydrocyanic acid

---

Merchandise Marks Act, 1926.

THE Merchandise Marks (Imported Goods) Act, 1926, which received the Royal Assent on 15th December 1926, is a measure of a comprehensive nature applicable to all classes of goods, agricultural and industrial. As a Bill it was introduced by the Government to supersede the Merchandise Marks (Agricultural Produce) Bill of the previous session.

The Act does not of itself confer any degree of protection or preference on home and Dominion industries. It enables the Government, however, by means of Orders in Council to prohibit in the United Kingdom the sale or exposure for sale of imported goods unless these bear an indication of their origin. The term "Imported goods" does not for the purposes of the Act include goods which since the date of importation have undergone in the United Kingdom any treatment or process resulting in a substantial change in their nature; nor does the Act apply to the sale of any foodstuffs which have undergone a process of cooking, curing or preserving in the United Kingdom.

Any Orders in Council that may be made for the purposes of the Act will follow upon the investigations and recommendations of Standing Committees which will be set up by the Government Departments concerned, and to which will be referred all applications which, in the view of the Departments, represent substantially the interests of either producers, manufacturers, traders, consumers or any body of wage-earners. So far as the agricultural and horticultural industry is concerned, Standing Committees will be appointed jointly by the Home Secretary, the Secretary of State for Scotland and the Minister of Agriculture and Fisheries. Each Committee is to consist of not less than three and not more than five suitable persons.

Every Order in Council will specify (in addition to any other requirements that may appear to be necessary or expedient) :—

(1) The manner in which " indication of origin " is to be applied to goods. The question of the practicability of marking any particular class of goods and of the method of marking to be adopted will be matters for the consideration of the Standing Committee. The " indication of origin " to be required will be either the name of the country of origin or the words " foreign " or " Empire " as the case may be.

(2) The date of commencement of the Order.

(3) Whether goods are to bear an " indication of origin " at the time of importation or of exposure for sale wholesale. While, in view of the possibilities of the re-export of goods, the marking of the " indication of origin " will generally be only on retail sale, the Standing Committee may recommend and the Order may require the marking at the time of importation as well as at subsequent stages of trade.

All Orders in Council made under the Act will be subject to the approval of Parliament.

If, after an Order in Council has come into operation, it is proved to the satisfaction of the Government Department concerned by persons substantially concerned in the matter that their interests are unduly prejudiced by the Order, the Department may direct the temporary suspension of whole or part of the requirements of the Order until the question has been investigated by a Committee and the Department has come to a conclusion after consideration of the Committee's report.

A further provision of the Act requires an " indication of origin " to be given in all cases in which imported goods sold in this country bear the name or trade mark of a firm in the United Kingdom.

The new Act is to be construed as one with the Merchandise Marks Acts, 1887 to 1911, which made illegal the application of any false trade description to goods and the sale or exposure for sale of any such goods. The expression " trade description " was defined as including any description, statement or indication as to the country of origin or manufacture, the mode of manufacture or production, or the material of which the goods are composed.

Fertilisers and Feeding Stuffs Act, 1926.

By the passing of the Fertilisers and Feeding Stuffs Act, 1926, all previous legislation dealing with the control of the sale of fertilisers and feeding stuffs will be superseded by new provisions which will come into force on a date not earlier than 1st July 1927, as may be appointed by the Agricultural Departments.

The new Act amends the Statute of 1906, which, as a result of the experience of farmers, traders and local authorities alike, has proved to be unworkable and inadequate for its purposes.

The principal objects of the Act are :—

(1) to define the various articles to which in future the law shall apply;

(2) to improve the existing law enabling a purchaser to found a civil action upon the warranty given by the vendor;

(3) to provide facilities for testing such a warranty by analysis, and to enable the purchaser to do so without being exposed as he is at present to the risk of becoming involved as a witness in criminal proceedings against the vendor;

(4) to limit the criminal liability of the vendor to goods which are in his possession or under his control.

The Act discriminates between civil and criminal liabilities, and thus separates the enforcement of the civil rights of the purchaser from the criminal proceedings undertaken by local authorities.

Every person who sells as a fertiliser or feeding stuff any article to which the Act applies, whatever name be applied to the article, is under obligation to furnish a statutory statement which shall have the effect of a written warranty by the seller containing (1) the name under which the article is sold; (2) such particulars of the nature, substance and quality of the article as are mentioned in relation to the article in the Schedule; (3) in the case of a feeding stuff, the names of any ingredients which are included in the Third Schedule to the Act.

The Schedules, in which are set out the articles to which the Act applies, are one of the most important features of the Act. The First Schedule contains all well known feeding and fertilising substances which are capable in ordinary course of trade of being valued accurately according to the usual methods of analysis. Opposite each substance in the Schedule are prescribed the particulars regarding it which must be furnished by a vendor in the statutory statement. The whole of the Act will apply to the articles in this Schedule. The Second Schedule contains such substances as slaked lime, ground chalk, dried blood, clover meal, dried yeast, &c., together with a description of the particulars in regard to each which require to be contained in the statutory statement. To these articles the provisions of the Act relating to warranties will apply, but not those relating to criminal proceedings for false description. The Third Schedule contains a list of the irregular ingredients (such as husks, chaff, wheat or rye straw, sawdust &c.) the presence of which must be declared in any feeding stuffs. The Fourth Schedule details, in relation to the various articles sold as fertilisers and feeding stuffs, the respective definitions implied in the sale of these articles under the names in general use. The use of any of these names in a statutory statement implies a warranty that the article corresponds with the relative definition in the Schedule.

The Fifth Schedule contains a list of the ingredients which under the Act are regarded as deleterious when present in feeding stuffs to a specified extent.

In Scotland the local administration of the Act will lie as heretofore with the local authorities under the Diseases of Animals Act, 1894, who shall appoint analysts, inspectors and samplers. The Act provides, however, for the exercise by the Board in special cases of the powers of a local authority.

Powers are given to the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland jointly to make all regulations required for the purpose of bringing the Act into operation; and for this purpose they will be assisted by an Advisory Committee which will be constituted under the provisions of the Act.

Notes from Craibstone.

Source of English Broad-leaved Red Clover.—In reports published during recent years on experiments at Craibstone and other centres in the North-east of Scotland attention has been drawn to the general superiority for these districts of English Broad-leaved Red Clover over most foreign samples, and especially those from comparatively warmer climates such as the South of France, Italy, Chili and the U.S.A. In some cases English Red Clovers of comparatively poor quality, germinating only 60 per cent., have been found to produce distinctly superior crops to such foreign samples germinating as high as 99 per cent., and therefore in buying Red Clover a knowledge of the source of origin is of even greater importance than a knowledge of the germination.

With a view to finding if there is any marked differences in the samples of English Broad-leaved Red Clovers from different districts, samples have been collected during the past two or three years from practically every county in England in which Red Clover seed is grown for the market. While the majority of these were superior to foreign samples used in the tests for purposes of comparison, some of them were comparative failures, and further tests, therefore, have been made for the purpose of finding if this failure could be correlated in any way with the soil and climatic conditions of the districts in which the seeds were grown. Generally speaking, however, it has not been found that the failures could be attributed to differences in the soils and seasons, and it has only been this season that a probable explanation of the failures has been arrived at.

One sample of Red Clover seed was got from Norfolk in 1925, and the amount of clover in the hay crop during the past year was so small that a full history of this sample of seed was obtained, and it was found that, although grown in England, the grower had sown a mixture of French and Chilean seed. The reason why this particular farmer sowed the foreign seed was that his own crop in the previous year was a failure owing to adverse weather conditions, and he had great difficulty in obtaining a really good sample of English-grown seed. This sample, therefore, to all intents and purposes was a foreign sample although grown in England, and quite honestly sold as English-grown Broad-leaved Red Clover. The climatic differences, of course, between Norfolk and the North of Scotland are great, and the former might suit Chilean and French Red Clover seed quite as well, and the crop might be quite satisfactory. Also, if sown again under the same conditions, this English-grown foreign Red Clover seed might do quite well. No blame could be attached to the grower for selling such seed as good and genuine English Red Clover, but it evidently has not that inherent hardiness of constitution necessary for the harder climate of the North of Scotland.

In buying Red Clover seed, therefore, it is not sufficient for a North of Scotland farmer to know that the seed has been grown in England; it is equally necessary to know that it has been grown from a good English stock.

If it is impossible for the buyer to trace the history of samples of Red Clover seed offered to him, in order to avoid any disappointment from the causes mentioned, it would be well for him to get three or four different lots of English-grown Red Clover, that is, grown in England from English stock, and mix them.

There would seem to be great room in this country for introducing some system of registration such as that which has for some time been practised in some European countries as well as in North America. Such a system has been started in Montgomery, Vale of Clwyd and Cornwall with Late-flowering Red Clover.

If it were ascertained what stocks of English Broad-leaved Red Clover are most reliable in the North of Scotland arrangements might be made so that they would be more largely sown by English farmers for the production of seed. This in principle is really what is being done in Scotland for the production of seed potatoes for the English market.

Golden Wonder Potatoes.—Reference was made in a former note to the idea prevalently held that Golden Wonder is a poor cropping variety of potatoes. It was pointed out, however, that, as a result of trials carried out at Craibstone, it had been found that, in the North-east of Scotland at all events, the poor cropping power of this variety is not entirely due to any inherent fault or weakness in the variety itself, but that there are three reasons for its non-productivity, viz., that the great majority of stocks are affected with mosaic; that, as it is a very slow grower, it must always be sprouted if the best result is to be got; and that because many people, expecting only a very small yield, apply only a very small quantity of manure. Results were given showing the effect on the crop of each of these factors acting separately.

During the past two seasons trials were carried out where these factors were combined, so that in one case all these favourable conditions were present, in the other all were absent. On Plot A seed was used from a mosaic-free stock, the seed was sprouted before being planted, and a liberal dressing of artificial manures was applied. On Plot B seed from affected stock was planted, the tubers were not sprouted, and only one-third the quantity of artificials used on Plot A was applied. The following are the results :—

PLOT A.—Favourable conditions.	PLOT B.—Unfavourable conditions.
Treatment.	
Without mosaic.	With mosaic.
Sprouted.	Unsprouted.
Good manuring. With dung (7 cwt.).	Poor manuring. With dung (3 cwt.).
1½ cwt. sulphate of ammonia.	½ cwt. sulphate of ammonia.
4 " super.	1½ " super.
½ " steamed bone flour.	½ " steamed bone flour.
1 " sulphate of potash.	½ " sulphate of potash.

Yields.	A 1925 T.	A 1925 C.	A 1926 T.	A 1926 C.	B 1925 T.	B 1925 C.	B 1926 T.	B 1926 C.
Ware ...	13	18	10	4	7	12	5	1
Seed... ...	2	5	5	6	2	0	4	7
Small ...	0	10	0	16	0	9	0	17
Total ...	16	13	16	6	10	1	10	5

It will be seen that not only was the total crop considerably increased, but the amount of ware was also much greater in Plot A than in Plot B. Owing to the sprouting, the crop from Plot A was earlier, and the tubers were found on cooking trials to be of better quality.

As many farmers are in the habit of planting Golden Wonder very early with the expectation that the longer growing season will increase the yield, trials have been carried out during the past few years with a view to finding how far early planting will be advantageous. During the past season different plots were planted at intervals of a fortnight from the beginning of March to the beginning of June. The plots were in duplicate, the seed in one case being sprouted and in the other unsprouted. From the results so far obtained it was quite evident that the condition of the soil at the time of planting is of more importance than the time of planting. The earliest planting, in the beginning of March, was not so good as that in the beginning of April, and the planting in the beginning of May was quite as good as that in the beginning of April, both being better than in mid-April, and these results apply to both sprouted and unsprouted seed. The soil in mid-April was not in good condition for planting.

One of the great advantages of the sprouting is that the planting can be delayed until the soil is in good condition without, as it were, reducing the length of the growing season.

Russian Sunflower Seed Cake.

THE following note on Russian sunflower seed cake is contributed from the Rowett Research Institute, where the experiments referred to were carried out by Messrs. J. A. Crichton, M.A., B.Sc., (Agri.), R. W. Farquhar, B.Sc. (Agri.), and G. B. Bisset, B.Sc. (Agri.).

Some time ago we were informed from what appeared to be a reliable source that Russia produced large quantities of sunflower seed cake which might be imported to this country at a price that would make its use profitable to the stock feeder. This cake is used in the continent as a cattle food, and has been found satisfactory for the production of both beef and milk, but it has never come into general use in this country. It seemed desirable to investigate its food value because every new feeding stuff which becomes available on the market increases the range of choice of the experienced farmer, and thus gives him greater facilities for taking advantage of fluctuations in the prices of different concentrates.

The fact that the material could be imported from Russia makes this investigation of special interest to the North-East of Scotland. Since the war the herring fishing industry has been in a state of depression owing to Russia being unable to import herring and the British Government is being asked to supply credits to enable this trade to be resumed. It would, of course, be a sounder business procedure for Russia to establish real credits by exporting to this country commodities we need. We could then exchange herring for these commodities. Sunflower cake is evidently available and can be exported to this country. At least we have been able to get a consignment without any difficulty. But we had little information as to its value. We therefore undertook an investigation to determine its feeding value as compared with other concentrates in common use.

Samples of cake were analysed to determine its chemical composition, and a number of feeding tests were carried out with pigs, sheep and cattle. It may be stated here that the results of these tests seem to show that sunflower seed cake is of about the same value as other protein-rich substances. It is intended in the near future to publish an account of these feeding tests on different classes of farm stock. This preliminary note deals only with its chemical composition and feeding experiments with pigs.

Chemical Composition.—The cake obtained was partially decorticated. It was ground to a meal before use. The following table compares the composition of the meal with that of some other concentrates in common use.

TABLE I.

	Prot.	*Carb.*	*Fat.*	*Fibre.*	*Starch Value.*
Sunflower Cake	40	24	8	13	65
Linseed Cake	30	36	10	9	74
Extracted Soya Bean ...	42	26	2	5	64
Palm Kernal Cake	19	45	8	13	75
Decorticated Cotton Seed Cake	40	26	10	8	70

It will be seen that sunflower cake is very rich in protein. Its starch value is about the same as extracted soya bean meal but lower than the others quoted. On account of its high protein content it should be of special value for young rapidly growing animals and for milk and egg production. It would also have a high manurial value.

Feeding Tests.—As we had no experience of feeding sunflower seed cake, the first test was carried out to ascertain whether pigs would eat it readily, and, if so, whether they would thrive on it. Two comparable groups, each of six young pigs of the Large White Breed, of an average weight of 60 lbs., were taken. To one of the groups there was given a ration with no sunflower cake, and to the other the same ration with the addition of sunflower seed cake ground to a meal to the extent of nearly 15 per cent. of the total ration. The two rations were as follows :—

I.		II.	
Ground Barley ...	10 pts.	Ground Barley ...	10 pts.
White Sharps ...	6 ,,	White Sharps ...	6 ,,
Ground Maize ...	2 ,,	Ground Maize ...	2 ,,
Fish Meal ...	2 ,,	Fish Meal ...	1 ,,
		Sunflower Meal ...	3 ,,

Both groups were given an allowance of green food and access to a mineral mixture.

The feeding experiment was continued for 90 days. At the end of the time all the animals in both groups appeared quite normal. The rates of gain are shown in the following table :—

	Group I.	*Group II.*
Average gain per pig per day (lbs.) ...	1·13	1·10
Food consumed per 1 lb. gain	4·59	4·33

The differences in the rate of increase in weight in the two groups is within the limits of experimental error. The result seemed to indicate that sunflower seed meal could be used for the feeding of pigs up to at least 15 per cent. of the ration.

A second experiment was carried out to compare sunflower seed meal with soya bean meal and decorticated earth nut meal. Four groups each of eight ordinary commercial pigs of the Large White Breed of an average weight of 56 lbs. were arranged to be comparable as regards quality, size and sex.

The basal ration fed consisted of :—

Ground Maize	2 pts.
White Sharps	2 ,,
Barley	1 ,,
White Fish Meal	1 ,,

Varying amounts of earth nut meal, soya bean meal and sunflower seed meal were added to the rations of the different groups in such proportions that the total of these three was the same in each of the groups, viz. :—

	Group I.	*Group II.*	*Group III.*	*Group IV.*
Ext. Soya Bean Meal	3	2	1	0
Dec. Earth Nut Meal	3	2	1	0
Sunflower Seed Meal	2	4	6	8

The ration of group I contained sunflower seed cake to the extent of just over 14 per cent. of the total, and the proportion was progressively increased in the other groups until in group IV it reached over 56 per cent.

In addition to the above ration a daily allowance of approximately half a pound of raw potatoes per pig was given, and the animals had access to a box containing mineral salts. The following table shows the rates of gain :—

TABLE III.

	Group I.	*Group II.*	*Group III.*	*Group IV.*
Percentage of Sunflower Seed Meal in ration (approx.)	14	28	42	56
Average gain per pig per day	1·11	1·18	1·14	1·01
Food consumed per 1 lb. gain	4·12	4·18	4·29	4·53

In estimating the food consumed per 1 lb. gain in live-weight, 4 lbs. potatoes were taken as equal to 1 lb. of meal.

According to these figures the group which did best is group II, i.e. the group receiving a ration with 28 per cent. of sunflower seed meal. The differences in the rates of gain, however, in the various groups are within the limits of error for such small groups of commercial pigs. In group IV, with 56 per cent. of sunflower seed, some of the animals did as well as those in groups I, II and III. Others, however, did not thrive. The latter account for an increase in the food consumed per lb. gain in that group.

The result of this test seems to show that sunflower seed cake can be used to replace extracted soya bean meal and decorticated earth nut meal in rations for pigs, and that it is of about the same value as other commonly used concentrates.

The results of these feeding tests agree on the whole with the results of the chemical analysis. They seem to indicate that sunflower seed meal has about the same feeding value for pigs as extracted soya bean meal and decorticated earth nut cake. If the material can be obtained at a rate substantially less than these concentrates, it would appear to be advantageous to the pig feeder to use it.

THE following article dealing with the economic balance of town and country has been received from a contributor :—

The Economic Balance of Town and Country.

In the controversy between the two schools which respectively urge that (1) so far as nature allows it an effort should be made to produce within a country most of the goods which satisfy human wants, and (2) that each country should concentrate on the things which it is most fitted to produce and exchange its surplus of these for the other things needed, there arises a discussion as to the employment of two capitals. To put the point most clearly we may suppose the one capital to be applied to the growing of grain and the other to the making of cotton goods. The products of the two capitals are supposed to be exchanged against one another. According to the one school there will be more business, more industry in the country, if the two capitals are invested in their respective businesses in the same country.

According to the other theory it is better that any capital in a country should be employed in the particular form of production for which the country is suited.

The supporters of the latter theory would then probably go so far as to say that if making cotton goods were a more lucrative form of industry in the country than growing grain, the two capitals should on the whole be fused into one capital for the purpose of making more cotton goods, leaving only a little part of the total capital to be used for growing grain in that country. The grain that the inhabitants of the country need would better be bought from another country such as the United States, where nature favoured the growing of grain.

The exchange would then be between the produce of a different two capitals, i.e. the two invested in the respective countries in making cotton goods and growing grain.

The theory assumes that there is a free exchange between the two countries. On the whole it was probably true of the conditions which prevailed in the world of Europe and America before the War that the various capitals were most productive if employed according to the " free trade " theory.

This theory, however, made certain assumptions, particularly—

(1) that the cost for transport for great distances was fairly low;

(2) that there would be a market to consume what may be called the " surplus " of goods made under the conditions which ensured the most productive application of capital and labour.

In the background there was another postulate, i.e. that the normal condition of the civilised world should be peaceful and that its peace should not be seriously disturbed. On economic grounds as well as for ethical motives the old Manchester School set great store by the maintenance of peace.

In the years that have passed since the War the two conditions above mentioned have not been complied with. Though there has been more shipping than trade, freights have not been as cheap as they were formerly, so that the successful application of the capital on exclusive purposes in different areas, so far as depending on easy exchange of the products, has lost one of its indispensable supports.

Again the market has shrunken, the world does not want such a high volume of production. Under these conditions countries within which there was a greater exchange of goods of various kinds, all being produced within the country, have found their economic position to that extent less unstable since the War than it might otherwise have been. This is largely because, as an essential element in such a system, there is a greater production of foodstuffs in the country than has been the case under our economic policy. The agriculturist produces something for which there will always be a demand, and therefore even in bad times his industry will be less affected by unemployment, except of a seasonal character, as in the building trade; hence in most European countries there exists a numerous body of agricultural workers, who will tend to keep down the general level of unemployment by raising the average of employment all over, and at the same time create a large market for goods produced in other industries. Further, the different groups of exchanging producers will be more in contact with one another than if they were sundered by great distances and living in different political communities, and so exposed to such hindrances to exchange as fluctuating currencies.

It will be noted, however, that the large agricultural populations of most European countries are due to the existence of the landholding peasant in great numbers. Their " demand " for other goods would hardly be as great if the majority of them were rather poorly paid agricultural labourers.

Thus the number of persons engaged in agriculture in the Free State of Prussia is said to be nearly 9 millions. No doubt this includes many women and young persons. But it is much greater than the agricultural working population in this country, the majority of which are wage-earning workers; and roughly the total population of Prussia is comparable to that of Great Britain.

Urbanisation so thorough as ours has upset the earlier balance of town and country, under which, be it noted, flax and wool, hides and wood fuel, as well as food, were produced in the rural districts.

Under our system we have to have large export industries as in cotton goods and coal (the latter a growing one in the last generation); besides these we earn money in shipping and finance, the two latter " industries " supporting sailors and clerks, while a considerable income derived from foreign investments (held mainly by middle class people) to a certain extent reaches the working classes in the form of wages and so helps to pay for our great imports of foodstuffs and other goods supplying elementary needs. Few countries can have so relatively large an industry as our cotton industry, producing so predominantly for export. It is like the Canadian grain-growing industry.

Assuming, then, that it stabilises matters to have a large agricultural population in a country, one has to ask the further question how population should be distributed in a country so as to make exchange easy between country and town.

There are manifest degrees in the nearness of contact between food producer and consumer. The French peasant or his wife, who brings his goods to the market of a country town, is in close touch with the consumer. So, too, the farmers of the North and Midlands of England are in reasonable touch with the industrial centres of the country, and they produce the things which favour the near as against the distant producer, such as dairy produce, potatoes and meat. The greater part of England south of Birmingham has only one big urban market, i.e. London, from which a great part of the area seems further than Belgium and Holland. This is a disadvantage because in this country the producer who sends to the market of a great city is perhaps on the whole less exposed to the superior bargaining power of the middleman than if he were sending to the country market town, such as exists between Norwich and Exeter. Thus it has been found that the farmer sending his live stock to the little local markets in such a typically rural county as Oxfordshire is exposed to great fluctuations in prices from week to week.

Hence on the whole the northern English farmer is better adjusted to his economic milieu than his brother of East Anglia or the South-West.

At the same time the feeding of such thickly populated industrial or urban areas as the West Riding, South Lancashire, London, Westphalia, Saxony, Paris, Berlin and New York must depend to a certain extent on foodstuffs brought from a distance, even if they are situated in countries the policy of which is not to favour free exchange.

As compared with the arrangements for feeding the townspeople in countries like England before the industrial revolution, or like the greater part of France, Spain or Italy at the present time, the machinery for doing the like for such modern urban regions is complicated, artificial, and to anybody who is not habituated to life under such conditions, precarious.

We have come to take it for granted that such communities can be fed without extraordinary efforts, but the possibility of doing so was part of the world order as it existed towards the end of the 19th and in the early part of the 20th century. The recent changes which have affected Great Britain to a greater extent than most other countries in virtue of its extreme dependence on international trade, seem also to have made it much harder for the inhabitants of the great urban areas to live at the standard of comfort which they had reached. Such areas cannot be self-sufficing as regards their elementary needs and must import like any " free trade " country. And they may have to import now from any quarter. Thus before the War three-fifths of the meat supply of this country was home-produced; since the War London has taken three-fourths of its meat from abroad in a chilled or frozen state.

One does not impute everything to the War. The 19th century civilisation was based on general cheapness, not least on cheap coal and transport, which in turn depended partly on low wages for miners, railwaymen and dockers, and these are all now higher.

The increased difficulty of feeding great urban areas is reflected in the common complaint that the consumer does not buy cheap, the producer gets little profit and most goes to the middleman. The complaints are heard in the eastern part of the States as well as in this country. And if New York gets most of its cereal food from Minnesota or Kansas and its meat from regions not much less west, and only milk from its own State, its position does not differ notably from that of Liverpool and Manchester.

It is natural to suppose that a large and growing urban population should stimulate the demand for home-produced foodstuffs and therefore cause at least a moderate increase in the agricultural community; but this has hardly happened in Great Britain. The growing difficulty of bringing food to and distributing it among the urban centres must account to a certain extent for the failure of such an expectation. Should then the agricultural system of the country have been more carefully adjusted to a state of things in which (1) the urban population was determined to get its food from any quarter, but was manifestly more dependent on near sources of supply for certain foodstuffs, (2) the relation of producer and consumer would be improved by steady and abundant supplies of goods of uniform quality being guaranteed to the latter.

If the existence of great urban areas is more difficult to maintain than it was in the past, the inhabitants will naturally turn to those who do most to get over these difficulties, so far as that lies in the hands of producers and distributors. London will get food by sea from the countries just over the North Sea or Channel so long as it is cheaper all round to do so.

It is true that after 1850 the loss on corn lands was made up by the growing demand for meat and milk; but that benefited the North and West, and there does not appear to be any similar compensation available at the moment to relieve some of the hard-hit arable districts.

Of course it is not possible to get away from what is prescribed by climate and soil and not easy to break with tradition; it is, however, permissible to ask whether the rearing and feeding of live stock for beef and mutton and pork, which plays so great a part in our husbandry, is the most suitable form of " agriculture " for a rural community serving a large urban market. Our "fresh milk" industry is however manifestly quite fitted to our circumstances, though even here an article which is 88 per cent. water should not be moved great distances.

What seems to be needed is that our food production should be better "marshalled." This implies local specialisation; it also implies that in order to overcome the difficulties of getting food to the actual consumer in the cities of half a million or a million inhabitants, the producer should meet the middleman half way and do part of his work for him, as the much bruited Danes do. Unfortunately the two interests are less of one accord with us than they are in Denmark. And the sort of goods, in which "grading" and mass production comes easiest, are those which our farmers have been inclined to consider side lines—butter, eggs, bacon, poultry, &c. Further, the 150 to 200 acre farm depending on hired labour is not perhaps the best milieu for the production of such goods.

Of course our farmers, instead of competing with Danes, Dutch, Irish and Normans, may stick to beef and mutton and to a certain extent pork, and certain varieties of cheese and more expensively cured bacon, and prefer to serve a "quality" market, leaving the multitudes to eat imported beef and mutton, just as most of us eat bread and pastry from flour milled from imported grain; but this would be an exchange between the agriculturist and the west end of the urban population, to establish and maintain which the farmer would again be unduly indebted to the middleman.

Further our farmers will long be liable to a competition, the nature of which does not seem to be unduly recognised. Most of the countries which export foodstuffs to us are protectionist in their fiscal policy. Now, according to economic theory, we pay them by the export of industrial products or by services. But their tariffs make it difficult for us to send them the products of industry. Hence they take less in the way of goods from us against what they send us in foodstuffs than they otherwise would—or in other words, we get our imports of foodstuffs cheaper than we otherwise should. This state of things puzzles the middle west wheat grower, who cannot make out why he has to take a lower price for the surplus wheat exported to Great Britain than for the part which is sold in the States.

The Sugar Beet Crop of 1926.

REPORTS have been received from the three Scottish Colleges of Agriculture with regard to the Sugar Beet crop of the past season. The more important features embodied in these reports are briefly noticed here.

Moray and Nairn.—The area of the crop was 115 acres. The average yield per acre is likely to be about 9 tons washed beet, and the analyses received vary widely from below 15 per cent.

up to over 19 per cent. All crops were grown in shallow drills in width from 22 to 26 inches. The time of seeding was on the average about the third week in May, but good results have been obtained from earlier and later sowings. The manurial treatment in many cases was the same as for the turnip crop, with the addition of extra potash. Where beet was grown last year, the following crop this year has been distinctly superior to that following turnips or potatoes. While the acreage of suitable land in the county is limited, the prospects are an increased acreage and an increased number of growers next year.

Aberdeenshire (West).—The trials were all conducted under agreement with the Anglo-Scottish Sugar Beet Corporation, and consisted mainly of one acre plots. The returns so far obtained show a yield of washed roots of from 6 to 12 tons per acre, with from 16·3 to 17·3 per cent. of sugar. In a College experiment carried out on a good light loam, the seed was sown on the flat in 21 inch rows. The average yield of washed roots was 10 tons 12 cwts. per acre, with 17·2 per cent. of sugar content. The practice of sowing in drills, or on the flat, was fairly well divided, the method of putting down the crop being governed to some extent by the implements at the disposal of individual farmers. The distance between the rows varied from 15 to 24 inches. The greater distance was employed mainly where drills were set up. Opinion now seems to favour 21 or 22 inches. Sowing took place between the 15th of May and 5th June, but most crops were put down between 21st and 28th May, which seemed this year to have been a suitable period. Dunging in the autumn was fairly general, but great variations occurred in respect of the artificials used. It was observed that the heavier applications of well balanced manures was distinctly more effective than the expedients used by some of applying a turnip or other mixture, which did not comply with the full requirements of the beet crop. Farmyard manure is an important factor, especially on the more open soils, and thick seeding and early singling are necessary. Frequent cultivation between the drills can be strongly recommended both for keeping the ground clean and for its influence on the crop. A top-dressing of nitrate of soda had a very stimulating effect. The increase in weight of crop, especially in respect of leaves, was found to be much influenced thereby.

Berwick.—On three farms of medium loam soil the yield ranged from $11\frac{3}{4}$ tons to $13\frac{1}{10}$ tons of clean washed beet with a sugar percentage of 17 per cent. to 18·6 per cent. The crop was sown in the middle of May in 24 inch drills. In another case the yield was only from 7 to 9 tons and the beets were not sent to the factory.

East Lothian.—Reports from eight farms showed that the crops had proved satisfactory in six and fairly satisfactory in two. Yields of $10\frac{1}{2}$ tons to 13 tons per acre of washed beet were secured. The sugar content varied from 17 per cent. to 18 per cent.

Fife.—The yield reported from eight farms ranged from 8 to over 14 tons per acre, and in only two cases were the results described as barely satisfactory. The sugar content was high, varying from nearly 17 per cent. to over 18 per cent.

Forfar.—Observations from sixteen farms show that results were considered satisfactory in fourteen cases. The yield varied from about 9½ tons to 13½ tons per acre. The sugar content ranged from 17 per cent. to 18 per cent.

Perth.—The returns from seven farms show that in three cases the crop was definitely a success. The yield varied from over 10½ tons to 14 tons per acre, the sugar content being on an average 17 per cent.

Argyll (South).—It is reported that the crop was more successful than its predecessor of 1925. A better seed-bed was obtained and the crop brairded more regularly and vigorously. Bolting was rare in comparison with last year's experience. On one break of 5 acres scarcely a shot plant was present. This feature may be partly attributable to a more favourable season, but it is significant that on two farms, where heavy bolting occurred, last season's seed was used. Very few returns of yield are yet to hand but generally the crops promise well.

Ayrshire.—The greater part of the beet crop was grown on the same land as in the previous year, but conditions were much more favourable. The manuring was in most cases similar to that of late potatoes, and the crop was mostly seeded in the second half of April and the first half of May. At most centres the seed was drilled in rows 24 inches apart, in contrast to the 18 to 20 inch row of the previous year. The plants were generally singled at a 7 to 8 inches interval. The best crops were secured from the seedings in the second half of April. The crop as a whole was very much better than in the previous season, the average yield per acre being 8 tons of 15 to 16 per cent. sugar content. Some of the best sections reached a yield of 14 tons per acre of beet of nearly 17 per cent. sugar.

Poultry Keeping on a Small Scale.

THE idea of this attempt at poultry keeping originated during the war, when new laid eggs were selling in the shops as high as six shillings a dozen. If these so-called "new laids" had of a certainty come straight from the nest the price would have been paid willingly, but since, as often happened, the flavour as well as the price was high, the writer began shortly after the war a small experiment in poultry keeping which has not only proved successful in its immediate object, but has also proved full of interest in many ways.

Here in the first place is the profit and loss account for the sixth year extending from 1st November 1925 to 31st October 1926 :—

Expenditure.	£	s.	d.
1. Value of live stock at 1st November 1925 ...	£28	13	0
2. Rent of land	3	0	0
3. Annuity to pay off cost of poultry houses and other equipment, with interest in 10 years ...	11	0	0
4. Chickens bought — 32 pullets, 7 cockerels ...	6	3	8
5. Cost of food and grit ...	40	12	4
6. Sundries	2	0	0
7. Balance, being profit to set against labour ...	32	0	10
	£123	9	10

Receipts.	£	s.	d.
1. Eggs sold (7,638) ...	£76	2	6
2. Eggs used in house, 1,768 at 2/- per dozen	14	14	8
3. Poultry used in house	6	4	0
4. 5 Light Sussex cockerels sold	1	18	8
5. Manure	*Nil.*		
6. Value of live stock at 31st October 1926 ...	24	10	0
	£123	9	10

The following figures relate to the numbers of hens and eggs during each month of the year, and the prices realised for the eggs that were sold :—

	No. of Hens.	No. of Eggs.	Eggs per Hen per week.	Eggs sold. Dozens.	Price per dozen.
November ...	73 to 66	486	1·62	$33\frac{1}{3}$	3/8 to 4/-
December ...	66	536	1·83	$38\frac{7}{12}$	4/-
January ...	66	625	2·13	43	4/- to 3/6
February ...	66	621	2·35	45	3/6 „ 2/8
March... ...	66 to 64	1,244	4·3	$74\frac{1}{2}$	2/8 „ 1/10
April	64	1,229	4·7	$80\frac{1}{2}$	1/10 „ 1/6
May	64 to 61	1,224	4·48	$81\frac{1}{2}$	1/6 „ 1/10
June	61 „ 59	1,074	4·14	72	1/10 „ 2/-
July	59 „ 56	763	3·02	$66\frac{1}{12}$	2/- „ 2/2
August ...	56 „ 52	634	2·63	$40\frac{9}{12}$	2/2 „ 2/6
September ...	52 „ 49	570	2·63	$39\frac{1}{4}$	2/6 „ 2/10
October ...	49 „ 42	340	1·70	22	2/10 „ 3/-
TOTAL ...	...	9,406	...	$636\frac{1}{2}$ dozen sold for £76, 2*s.* 6*d.* = 28·704 pence, or almost 2*s.* $4\frac{3}{4}$*d.* per dozen.	

The following notes supplement the preceding figures.

Land.—The fowls are kept on two small plots of grassland attached to a cottage which is situated in a quiet district within the boundaries of a city. The whole area occupied by the poultry extends to less than one acre, which for the purpose of these accounts has to bear a rent of £3. (Item 2 of expenditure.)

Cost of Equipment.—The initial capital outlay was over £80 for poultry houses, fencing and other equipment, which were bought in the dear period of 1920, and for the purpose of these accounts this money is being repaid with interest in ten years by an annual charge of £11. (Item 3 of expenditure.)

Live Stock.—The stock, which consists chiefly of White Leghorns, was valued at the beginning and end of the year as follows :—

At 1st November 1925.				*At 31st October 1926.*			
7 White Leghorn capons at 6*s.*	£2	2	0	15 1924 hens at 3*s.* ...	£2	5	0
7 1923 hens at 3*s.*	1	1	0	27 1925 hens at 5*s.* ...	6	15	0
30 1924 hens at 5*s.* ...	7	10	0	31 1926 pullets at 10*s.* ...	15	10	0
36 1925 pullets at 10*s.* ...	18	0	0				
	£28	13	0		£24	10	0

Feeding.—Morning feed—2 parts wheat.
1 part oats.
1 part broken maize.

The morning feed in the form of dry grain is fed on the grass except in very stormy weather, when it is thrown among the litter on the floor of the house.

Evening feed—3 parts sharps.
1 part bran.
2 parts Indian meal.
1 part Sussex ground oats.
1 part fish meal.

The evening feed is given in the form of wet mash, to which the house scraps are added.

During the winter months the proportions of fish meal and maize are slightly increased, and half of the morning feed of grain is thrown among the litter on the floor after dark so that the fowls may be kept busy scratching as soon as they come down from the perches in the morning.

Chickens.—After the second laying season all hens are used as boiling fowls for the table, so that half of the flock have to be replaced every year by pullets. These pullets have been obtained in various ways. In 1926 they were bought at the age of six weeks from a smallholder who rears more than he requires for his own use. In 1924 and 1925 day-old chicks were bought from a reliable breeder and reared in a hover until about six weeks old, when they were able to get along without any artificial heat. Some of the pullets were also obtained by hatching and rearing by means of broody hens.

There are advantages and disadvantages attaching to all these methods, and everyone must decide for himself which method to adopt according to his own particular circumstances. If, however, it is expedient to adopt the natural and old-fashioned way of hatching and rearing by means of broody hens, there is every chance that the chickens will make the best possible progress without any check over the critical period of the first six weeks, after which there is little danger of trouble, and the pullets are likely to be in a vigorous and healthy state when they begin to lay. The experience gained in this case points to the best date for the hatching of White Leghorn chicks as being round about 7th April, which brings them on to lay during the month of September.

In 1924 and 1925 the White Leghorn cockerels were caponised and fattened for the table, at which they appeared at intervals from July till Christmas. This part of the experiment was highly successful. These capons proved to be excellent table birds and were fattened at no great expense.

Average number of hens kept during the year, ...	60
Average number of eggs per hen per year, ...	158
Net profit per hen per year, ...	10*s*. 8*d*.

No one need run away with the idea that the accounts for this particular year—1925-1926—have been specially chosen in order to show a good return. On the contrary, it has been a rather disappointing year, on account of the fact that the troublesome disease known as *Coccidiosis* appeared among the 1925 chicks. Not only were some of the young birds carried off, but a number of those that survived were not robust, and this had an adverse effect on the egg production during the past season. So that whereas the profit for last year (1925-26) as shown above was 10*s*. 8*d*. per hen, the profit for the preceding year, when there was no disease, was 15*s*. 1*d*. per hen calculated on the same basis.

Reviews.

The Dying Peasant, by J. W. Robertson-Scott (Williams and Norgate, Ltd., 10*s*. 6*d*. net).—Both in title and in contents this is an arresting book. The main part of it is devoted to a survey of the conditions under which the English farm labourer lives—his wages, his work, his housing and his social environment. While the conditions, admittedly, are not equally bad in all parts of the country, the agricultural worker, as the author sees him, is too often underpaid, while he and his family are in many places underfed and wretchedly housed, with the inevitable consequences on their physical development, mental energy, independence and enterprise. The picture is indeed a gloomy one, and, being drawn by the pen of so experienced an observer as Mr. Robertson-Scott, is one that cannot fail to make its impression on all who have at heart the welfare both of the industry and of the worker. Whether the author has put everything in its true perspective it is difficult for a Scottish reader to determine, but many of his facts are certainly disturbing. If one were to venture on criticism, one might say—at the risk of being " unreasonable," according to an anticipatory paragraph in the preface— that his book would have gained in balance if his evidence had been drawn a little more equally from the different classes concerned in agriculture, and if he had dealt more fully with the economic factors which must be among the underlying causes of the troubles that evoke Mr. Robertson-Scott's sympathetic protest. His remedies, one gathers, are chiefly on the lines of more general trade union organisation for the workers, and a higher standard of cultivation by the farmers so as to permit of better wages being paid.

The account of Scottish conditions is apparently based largely on a journey of 1,300 miles made through the country in the company of the Secretary of the Scottish Farm Servants' Union. Scotland on the whole comes well out of a comparison with England, as witness this paragraph :—

> " The agricultural class in Scotland is not without its faults. But the stranger who, with notions of a decadent British agriculture in his head, seeks to receive an impression of it in Scotland, will have his work cut out. As one expert said to me, ' Agriculture has always been a commercial proposition in Scotland.' Again and again, the stranger, in his motoring or on his walks through the country finds himself saying to himself some such thing as ' Clean land and the best cultivation ! ' He is particularly struck by the freedom of so much of the grass from weeds. He cannot but remark, also, on the farmers' possession of a first-rate type of farm servant, and on the fact that the wages paid seem so often to be well above wages ruling in the south. The visitor continually asks himself, Why? It is not easy to find an answer wholly creditable to the agricultural development in some parts of England."

Mr. Robertson-Scott deals with housing,—commenting on bothies, " chaumers " and tied houses,—small holdings, emigration, rural social life, education, &c. The subjects are not new, and it is a considerable tribute to the author to say that he is interesting on all of them.

Readers familiar with Mr. Robertson-Scott's style will find in this work all his wonted individuality, pith and breezy force. Here, as in many of his writings, he gives us a blend of the patient investigator and the graphic impressionist.

" *Research and the Land : An Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom,*" by V. E. Wilkins. (H.M. Stationery Office. Paper 2*s.* 6*d.*, Cloth 3*s.* 6*d.*)—If justification were needed for the bold and comprehensive scheme of agricultural research drawn up by the Development Commission in 1911 and since then gradually put into operation, it would be found in this account of the recent progress of the work carried out under that scheme. As enumerated in an appendix, there are now in England eighteen institutes and stations specially devoted to research in different branches of agricultural science, and five such institutes and stations in Scotland. In Northern Ireland, whose activities in this connection are also noted, the work is differently organised, being under the direct control of the Ministry of Agriculture. All told, however, there are well over a hundred trained scientific workers at the institutes alone, engaged in grappling with the problems of agriculture in all its aspects.

A second part of the Development Commissioners' scheme was the establishment of advisory centres throughout the country, at which local problems might be dealt with by specialists in various departments, who would also be available to advise farmers on points of difficulty. In England sixty-seven of these Advisory Officers have been appointed at fourteen centres, and seven officers at the three Scottish Agricultural Colleges.

The importance of the research service in all its branches may be gauged by the fact that the State is spending about £400,000 a year upon it. What are we getting in return?

The answer to this question is contained in the book under review. It is intended to give an account in popular terms of the different lines of research which are being followed by the workers in these institutes, by the officers of the advisory service, and by the members of staff in the various agricultural and veterinary colleges.

It is not possible in a brief notice to give any adequate idea of the range and character of the investigations described. The subjects dealt with include the physics, chemistry and biology of the soil; plant-breeding and the means by which improved varieties are introduced into the industry; the physiology of the living plant; fruit-growing, glass-house culture, and fruit and vegetable preservation; plant diseases and their treatment and control; the feeding of stock, with special reference to the mineral requirements of animals and the effect of exposure to ultra-violet rays; the varying composition of pasture grasses, silage and other feeding stuffs; animal breeding; milk production and utilisation; pig, poultry and bee keeping; animal diseases; agricultural engineering; and, finally, agricultural economics.

Some indication of the quantity and quality of the work in progress is given in the catalogue of published papers for the last four years, which occupies fifty-two pages of the appendix.

A series of illustrations is included, selected to present more vividly some of the aspects of scientific investigation.

Mr. Wilkins is to be congratulated on the graphic and lucid account he has given both of the general purpose which each institution has in view and of the various investigations in progress. He has marshalled his material in logical fashion so that each section leads on naturally to the next, and so has presented an orderly review of the whole field of work. The result is a most interesting and satisfactory production which no one engaged in agricultural research or education or administration can afford to be without, and which every farmer who takes an intelligent interest in his business will find a most useful guide to an understanding of the aims and methods of the scientific worker. The book deserves to have a wide circulation.

The Rural Industries of England and Wales. A Survey made on behalf of the Agricultural Economics Research Institute, Oxford. I. Timberwood and Underwood Industries and some Village Workshops, by Helen E. FitzRandolph and M. Daniel Hay. Oxford, at the Clarendon Press.—As explained in the preface, this is one of four volumes in which the reports on various rural industries have been collected together. A Report on the Rural Industries round Oxford by Miss K. S. Woods was published in 1921. The other surveys have been carried on in the last six years over the greater part of the non-industrial parts of England and Wales.

The present volume opens with a "Ballade of Rural Industries," the refrain of which is "Where are the Rural Industries?" In spite of this note the investigators seem to have settled down seriously to the business of discovery, and the timber and underwood industries appear to make quite a respectable show. One is apt to have a feeling that such rural industries as still survive are the relics of the small scale industries which succumbed to the conquering factory and large workshop, but that they had only a respite and would not survive the progress of mass production— or if that were not fatal to them, that foreign competition would finish them off. But just as there came a time when enclosures ceased to be made and commons were regarded as treasures to be preserved, and again when small holdings were deliberately formed out of large farms, so too the same set of influences are at work in favour of staying the destruction of rural industries.

Rural timber and underwood industries are naturally situated near a supply of wood, which indeed is indispensable to them. The reporters found that in most of the non-industrial districts of England there is enough wood in plantation or coppice to maintain some such local industry.

In the north-eastern counties, in spite of their numerous dales, little is carried on—as is more or less the case again in the south-western counties, though they are well wooded and mainly rural. On the other hand the Lake District and the South-eastern counties have a good deal to show. There is "clogging" in the former area, while in Kent, Sussex, and the rural part of Surrey, a variety of articles, from clothes pegs, besoms, walking sticks, to malt shovels and charcoal, are made. In the West Midlands and again in East Anglia the industries are sporadic, while such districts as the Cotswolds and Chilterns have small groups of workers in wood.

The authors of the book give two chapters to a classification of the kinds of trees most useful for timber and underwood industries respectively, and two more chapters in which they describe the processes of making the various articles produced in the two groups, and give some account of the trade organisation.

The mention of oak, ash, elm, beech and sycamore will remind the Scottish reader that the hardwoods, which are common in England, yield the raw material of many of the timber industries, and that the conifers which tend to replace them in his own country do not lend themselves to such a variety of uses—which fact may account for the scarcity of wood-using crafts in Scotland. Oak and ash, chestnut and hazel, willow and birch, are also used for the underwood industries.

Among the articles made from timber the chief are clogs, barrels and hoops, and various articles of turnery, as bowls, chair legs, mangle rollers, rolling pins, stools, bowls (the ball), brush-backs and certain articles of furniture. The chief products of underwood industry are baskets, barrel hoops, fencing, hurdles and besoms. The hurdles are used mainly in the sheep-folding districts—Gloucestershire, Kent, Norfolk, Suffolk and some of the down counties. The authors discuss the conditions and prospects of wood industries, but naturally their conclusions are stated in a guarded and balanced way. Factory competition and foreign competition are both to be feared, but if for certain articles the conditions of production are favourable to the small rural industries, they may hold on if the organisation of the business of selling is taken in hand. Such industries tend to depend on old markets and are at a loss to find new ones. Nor are those who follow them too quick to adopt power-driven machinery, even when it can be adopted to their style of craft.

The book also has some chapters on village workshops, i.e. those of the wheelwright, blacksmith and saddler, whose businesses seem to be in a decline in many rural districts, and the making of ropes, nets and halters.

The whole work has been done in an exhaustive manner, and the volume gives all the information needed by those who are anxious to preserve certain features of English rural economy.

As the survey involved many personal interviews with those carrying on one or two men businesses, a lively touch is often given by the quoting of *obiter dicta* of the workers.

The Cattle Breeder's Handbook. By J. A. Scott Watson, James Cameron and G. H. Garrad. The "Farmer and Stock-breeder" Manuals. Benn, 6*s*.—It is questionable whether three better authors could have been procured for a work of this nature. Each is an excellent exponent of his own sphere, and yet the work is so well knit together that it shows few traces of that dislocation which is of not infrequent occurrence in such a joint publication. It is only natural that, in the short space of some 145 small pages, there should be many omissions. The wonder is that so much should have been so well treated. The discussion on "Type," with which the book opens, is refreshing and remarkably free from the hackneyed phrases of most text books, which convey little information, and merely amuse the student and confuse the farmer.

The histories of the various breeds are well done, and while they will add little to the knowledge of the enthusiast of any particular breed, they will educate him concerning others. By the way, why should much more space be devoted to the Aberdeen-Angus than to any other breed? The chapters on pedigree beef herds and the raising of young stock are concise and yet give a wide range of information. Chapter VIII deals with milk production. The remarks on breeding are sound and to the point, though all will not agree with the authors that "a dairy bull is much more difficult to select than a beef bull."

The book closes with some useful remarks on fattening. On the whole the work gives an excellent general survey of cattle raising, though for detailed information concerning any particular branch the specialist will have to look elsewhere.

Principles of Dairy Farming. By G. H. Garrad. The "Farmer and Stockbreeder" Manuals. Benn, 7*s.* 6*d.*—"Success still depends as much as ever it did on the skill of the cowman," says Mr. Garrad in his preface. In the remainder of the book he points out how this success may be achieved. In probably no agricultural practice has greater progress occurred during the past few years than in dairying, and therefore an up-to-date book on this subject is naturally useful. The author has throughout kept the economic aspect before his readers, who may rest assured that no "improvement" is advocated which is not justified by results, a very useful guarantee to have in these days of agricultural advice.

The author gives much of the lore of his subject as well as the science. He explains his rations in terms that come within the comprehension of the man who has never heard tell of Kellner or Armsby. There is a useful summary of the mineral question. Silage is dealt with in interesting fashion, and there are welcome notes on the feeding of dry cows, influence of date of calving, the question of milking thrice daily, sterility and contagious abortion, to mention only a few points. Bacteria comes in for a chapter, and the book closes with what most farmers will heartily welcome, definitions and explanations of the various official grades of milk. A bibliography is appended which adds to the usefulness of this book, and shows readers where they may secure further information concerning any particular point.

Sexual Physiology for Biological, Medical and Agricultural Students. F. H. A. Marshall. 167 pp. Longmans, Green & Co., 1925.—This small book should be extremely valuable to those for whom it is written. Students who have not the time to study the author's larger work, "The Physiology of Reproduction," will find in the present volume the essentials of the subject given in a compact and lucid form. The only criticisms that could be made are that the chapter on the secretions of the organs of reproduction is rather dogmatic in relation to the controversial nature of some of the work discussed, and that the chapter on heredity and sex is not as adequate as the rest of the book. These, however, are small matters, and the book is certain to appeal to a wide circle of readers.

The Book of Rural Life : Knowledge and Inspiration a Guide to the best in Modern Living. 10 vol., 6200 pages, 6000 fig. and over 100 tables. Edit. Bellows-Reeve Company, 104 South Michigan Ave., Chicago, Ill. (U.S.A.), 1925. Price (excluding U.S. and Canada) 79·50 dollars, duty and postage not included.

—The following review of this work is taken from the quarterly bulletin of the International Institute of Agriculture :—

This book is an agricultural encyclopædia, and can be considered as a complete and characteristic account of North American rural life. The work consists of ten large volumes, and every phase of agriculture is exposed and treated in a simple and direct manner, as are also many other subjects relating to rural life. The book contains all that can possibly interest a farmer in the management of his farm. The ten volumes include altogether 8,500 original signed articles, with a total of 6,200 pages and 6,000 illustrations of animals, plants and country scenes, besides 100 coloured plates. The authors of the various articles are 250, the signatures are those of experts in agriculture and of a few collaborators from among those authorities so numerous in America who interest themselves in agricultural and allied questions. At the end of the last volume is a general classification of the questions treated, which is sub-divided into the following sections : (1) Agriculture; (2) Domestic economy; (3) Hygiene; (4) Education and culture; (5) Science; (6) Civil and commercial information.

A detailed index and, above all, notes on the special characteristics in the different articles ensures the quick discovery of the information required, and avoids repetition. Besides this the publishing firm proposes to keep the reader informed of the latest agricultural news by the publication of a yearly volume. The idea of such a book originated with John Bellew (of the publishing firm of Bellows-Durham Company of Chicago), who, himself the son of a farmer, has left no means untried (at least he has spent on it more than 250,000 dollars) to make his idea materialise. In short the print is excellent, the volumes bound in leather, the paper is very good, and the illustrations are clear and neat.

Broadcasting Market Prices and Technical Talks to Farmers.

UNDER an arrangement between the British Broadcasting Company and the Ministry of Agriculture and Fisheries a summary of the prices ruling at English and Welsh markets was up to the end of September 1925 broadcast every Thursday evening from stations in Scotland as well as from those in England and Wales. In order, however, to meet more adequately the requirements of Scottish farmers, the Board of Agriculture for Scotland arranged with the Company that it should broadcast instead a summary of the prices obtained by that Department from Scottish markets. The new service began on Thursday, 7th October, and it is hoped that it is proving of value to those for whom it is designed.

Arrangements have also been made between the Board, the Colleges of Agriculture at Aberdeen, Edinburgh and Glasgow, and the British Broadcasting Company for a co-ordinated series of twenty-six technical talks to farmers to be given fortnightly throughout 1927 by experts on the staffs of the Colleges, the Research Institutes, and the Agricultural Departments of the Universities. These talks will be simultaneously broadcast throughout Scotland. Points of special local interest will, however, in the meantime continue to be dealt with by means of short talks at the respective local stations.

It is also proposed that in addition to the series of technical talks referred to above, which will be given in the evenings, arrangements should be made for a series of afternoon talks dealing with agricultural subjects of a general nature.

Scottish Women's Rural Institutes.

THE Institutes have continued to make excellent progress during the past year, the number and approximate membership at 31st October 1926 being as follows :—

Area.	*Number of Institutes.*	*Approximate Membership.*
North-Western	... 90	3624
North-Eastern	... 118	6863
Central ...	... 90	6362
South-Eastern	... 78	4700
South-Western	... 150	8500
Scotland ...	... 526	30,049

In view of the termination at 31st October 1927 of the existing arrangement whereby an amount not exceeding £15,000 was made available for the Institutes' work from the money provided under the Corn Production Acts (Repeal) Act, 1921, over a period of five years, the future organisation and financial arrangements of the Institutes have been the subject of discussion during the year, particularly at the biennial Area Conferences. Two schemes were proposed, one stressing more strongly the local type of organisation, while the other provided for greater centralisation, especially in finance. The former was approved by the North-Western, Central and South-Western Areas, and the latter by the North-Eastern and South-Eastern. A conference of the Area Committees was held on 26th October under the auspices of the Board of Agriculture for Scotland for the purpose of discussing the situation thus created, and it is hoped that as a result of this discussion the movement will continue to be organised generally on the lines that have proved so successful hitherto.

Opportunities for the Farmer in South Africa.

Farmers and farmers' sons who are seeking new outlets for their energies frequently have difficulty in obtaining information on the prospects in South Africa, where land is cheap, labour plentiful and the climate unsurpassed. The 1820 Memorial Settlers' Association, founded in 1920 to commemorate and perpetuate the memory of the pioneers of 1820, exists solely to help and safeguard the young settler.

The Association is unique, and has won universal approval for the excellent and disinterested work it does in "fathering" the settler. For the young experienced farmer with capital from £600 it undertakes :—

1. To give detailed advice on farming opportunities through its offices in this country.
2. To obtain a reduction in the ocean passage.
3. To meet the settler on arrival and pilot him through the Customs.
4. To arrange a period of free training to meet the needs of the individual.
5. To give advice on purchasing or leasing land, stock, and implements, and generally to stand behind the settler until he is so firmly established as to require no further assistance.

Loans to cover initial expenses are available in approved cases.

The Association does not deal in land, and most strongly recommends that a settler should first gain local experience before embarking his capital.

Full particulars will be supplied on application to the London Office of the Association at 199 Piccadilly, W.1.

Labour on Scottish Farms.

The Agricultural Returns collected on 4th June 1926 give the following numbers of workers employed at that date on holdings exceeding one acre in extent. The occupiers of holdings, their wives and domestic servants are excluded, but members of the occupiers' families other than their wives are included.

	Regular Workers.	*Casual Workers.*
Males, 21 years old and over ...	59,544	8,251
Do. under 21 years old ...	21,857	4,321
Total of Males	81,401	12,572
Women and girls	18,641	9,941
Total ...	100,042	22,513
Grand total	122,555	

The grand total is about 500 above that recorded in 1925, but this is due entirely to a considerable increase in the number of casual workers, which varies from year to year (according to seasonal requirements) more widely than the number of regular workers. The latter show a diminution, as compared with 1925, of 2223. Males over 21 have diminished by only 206, or about one in 300; males under 21 by 1,039, or 4½ per cent.; and females by 978, or 5 per cent. Casual workers on the other hand are more numerous by 2,716, or 13½ per cent.

These returns have now been obtained for six successive years. The total number of regular workers has decreased from about 103,900 in 1921 to about 100,000 in 1926. Regular male workers have not, however, varied much, the loss in their case being only 700, or less than one per cent. Regular female workers on the other hand are fewer by 3,100, or 14½ per cent., and they have shown a decrease every year since 1921. Casual workers have ranged from a maximum of 23,000 in 1921 to a minimum of 17,150 in 1924. Variations of their numbers are not, however, of much significance.

The returns show that so far as regular male workers are concerned the staffs of Scottish farms have remained fairly stable since the post-war adjustment. Comparison with such pre-war figures as are available shows that a permanent reduction has taken place. This is accounted for partly by the decrease in the area of arable land, partly by the greater use of machinery on the farm and partly by the introduction of motor transport. Probably, however, apart from these causes, the shortage of men during the war and the increase in rates of wages have led farmers to adjust their staffs more closely to their actual requirements.

It should be noted that satisfactory returns of the numbers of women employed on farms are very difficult to obtain. The Census of 1921 and the Agricultural Returns of that year show remarkable discrepancies, which were discussed in an article in the issue of this JOURNAL for July 1924.

"The Journal of the Orkney Agricultural Discussion Society."

A PROMISING feature of recent years is a greater readiness on the part of the agricultural community to meet and discuss in public topics and problems of interest to the farmer. The establishment of agricultural discussion societies is perhaps more marked in parts of England than in Scotland, but the Glasgow Society, thanks to the energy and enthusiasm of Mr. Arch. Macneilage, its permanent secretary, has now quite a long history of useful activity, and the Orkney Society, if a younger institution, is apparently no less vigorous.

These examples might well be followed in many other parts of the country.

The Orkney Society has reached the dignity of a Journal, and the quality of the contributions reflects much credit on the Society. The articles are in the main papers read by Orkney farmers who are members, and the range of interest is indicated by such titles as " Business Methods," Farm Costings," " Milk Production," " Stock Feeding," " Seed Potato Growing," " Silage," " Pig Feeding," " Vegetable Growing " and " Fur Production." A feature of the papers is their practical character, emphasising as they do in every case those aspects of the subject which are of immediate local interest and value. The Journal is a really remarkable testimony to the progressive and enterprising spirit of the Orkney farmers.

Publications of the International Institute of Agriculture.

WE would draw the attention of our readers once more to the valuable publications of the International Institute of Agriculture. Recent issues include the "International Year Book of Agricultural Statistics for 1925-26," a volume of 660 pages containing full particulars of the area and production of crops, the numbers of live stock, and the trade in agricultural produce and requirements throughout the world; and the " International Year Book of Agricultural Legislation for 1925," which extends to 1,140 pages, and gives a conspectus of the laws and regulations affecting agriculture, land tenure, co-operation, &c. in each country, with the full text of the more important enactments. These volumes involve an immense amount of labour in the collection and arrangement of the data, and they can be carried out only by such a body as the Institute, which is in regular communication with practically every country in the world. Each of these may be obtained for 12*s.* 6*d.* from the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Annual Estimates of the Produce of Crops.

THE following statement regarding the produce of crops for 1926 was issued on 21st December :—

Preliminary Statement showing the ESTIMATED TOTAL PRODUCE and YIELD PER ACRE of Wheat, Barley, Oats, Beans, Hay, Potatoes and Roots in SCOTLAND in the year 1926, with

COMPARISONS for 1925, and the AVERAGE YIELD PER ACRE of the Ten Years 1916-1925.

Crops.	Estimated Total Produce.		Acreage.		Average Estimated Yield per Acre.		Average of the Ten Years 1916-1925.
	1926.	1925.	1926.	1925.	1926.	1925.	
Wheat ...	*Tons.* 56,000 *Quarters.* 256,000	*Tons.* 54,000 *Quarters.* 246,000	*Acres.* 53,777	*Acres.* 48,617	*Cwt.* 20·8 *Bushels.* 38·1	*Cwt.* 22·3 *Bushels.* 40·5	*Cwt.* 21·2 *Bushels.* 38·8
Barley (including Bere) ...	*Tons.* 109,000 *Quarters.* 567,000	*Tons.* 136,000 *Quarters.* 730,000	122,297	152,901	*Cwt.* 17·9 *Bushels.* 37·1	*Cwt.* 17·8 *Bushels.* 38·2	*Cwt.* 17·1 *Bushels.* 35·6
Oats ...	*Tons.* 750,000 *Quarters.* 5,031,000	*Tons.* 716,000 *Quarters.* 4,812,000	940,073	925,995	*Cwt.* 15·9 *Bushels.* 42·8	*Cwt.* 15·5 *Bushels.* 41·6	*Cwt.* 14·4 *Bushels.* 39·5
Beans ...	*Tons.* 3,000 *Quarters.* 13,000	*Tons.* 3,000 *Quarters.* 13,400	3,290	3,409	*Cwt.* 17·7 *Bushels.* 31·9	*Cwt.* 17·6 *Bushels.* 31·5	*Cwt.* 18·9 *Bushels.* 35·0
Hay from Rotation Grass	*Tons.* 719,000	*Tons.* 646,000	413,680	403,097	*Cwt.* 34·8	*Cwt.* 32·1	*Cwt.* 31·5
Hay from Permanent Grass ...	167,000	148,000	116,697	109,015	28·6	27·1	25·9
Hay from Timothy Meadows ...	112,000	97,000	49,560	47,229	45·1	41·0	42·2
Potatoes	899,000	995,000	141,871	142,155	*Tons.* 6·3	*Tons.* 7·0	*Tons.* 6·5
Turnips & Swedes	6,894,000	6,815,000	390,778	395,940	17·6	17·2	16·7
Mangolds ...	23,000	20,900	1,108	1,117	20·6	18·7	18·2

NOTE.—The winter sowing of wheat was mostly carried out before the end of November 1925, but owing to unfavourable weather later the remainder of the work was delayed, and spring sowings were in consequence somewhat greater than usual. The crop brairded slowly, but during the early summer months growth was vigorous and healthy, very little disease or damage by pests being reported. Warm weather during July helped to ripen the grain quickly, and at the end of August harvest began under very favourable conditions; at the end of September all of the wheat was cut and stacked. The sowing of barley, which was almost finished in April, was completed under favourable conditions during May. The plant developed in a satisfactory manner, with a good length of straw, but much of the crop became badly lodged during the stormy weather that occurred in August. Cutting was general at the end of August and continued with little interruption until the end of September. The condition of the crop was satisfactory in most cases, although in a few areas the grain was reported to be light and only of fair quality. Oats were slightly checked by frosts in May, but by the end of that month a strong thick braird was showing in most districts; at the beginning of June leather-jacket grubs were reported to be prevalent in some fields. The crop gave early promise of a good yield and, ripening quickly during August, developed into a bulky crop as regards both grain and straw. Where early harvested, the grain was secured in excellent condition, but in the later districts the laying of the oats by wind and rain made harvesting a tedious and expensive operation, and the crop suffered more or less seriously.

Potato planting commenced under very favourable conditions during the first half of April, but heavy rains interrupted the work, which was not completed until the end of May. The plants made good progress during June and July, and at the beginning of August reports received from more than half of the districts in Scotland were distinctly promising. Blight, however, then became prevalent, to a greater or less extent, in almost every part of the country, although some varieties of the crop were stated to be practically free from disease; at the end of September in some areas the haulms were so blackened and withered that lifting began on quite a large scale. The produce in some areas was more satisfactory than had been expected earlier, but, taken as a whole, the yield was below the average, and there was a larger proportion than usual of small tubers. The turnip crop at first made slow progress, and some resowing was necessary in a few districts owing to damage done by the turnip fly. At the beginning of August finger-and-toe was reported from almost every county along the east coast, and the crop was still reported to be backward, especially on stiff and heavy land. Prospects, however, improved in August, and crops benefited by the rains that fell during the autumn months. In south-western districts the roots bulbed well and at the end of November were reported to be considerably above the average; in other districts, however, the condition of the crop was variable.

The total produce of wheat, 56,000 tons, exceeds that of last year by 2,000 tons, or 3·6 per cent. The area under the crop is greater than last year by 5,160 acres; on the other hand the average yield per acre, 20·8 cwt., is less than in 1925 by 1·5 cwt., and shows a decrease on the decennial average of 0·4 cwt. Barley, with a total produce estimated at 109,000 tons, shows a decrease of 27,000 tons, or nearly 20 per cent. on the previous year's total. As compared with 1925 the area harvested has decreased by 30,604 acres; the average yield per acre by weight, 17·9 cwt., is greater by 0·1 cwt., and exceeds the ten years' average by 0·8 cwt., while the average yield by measure, 37·1 bushels, is 1·5 bushels in excess of the decennial average. The total production of oats is shown as 750,000 tons, an increase, as compared with the previous year, of 34,000 tons, or 4·7 per cent.; the area under the crop has increased by 14,078 acres. The yield per acre, 15·9 cwt., exceeds that of last year by 0·4 cwt., and is 1·5 cwt. greater than the ten years' average. The produce of beans, 3,000 tons, is the same as in 1925, while the area under the crop, 3,290 acres, shows a diminution of 119 acres. The yield per acre, 17·7 cwt., is greater than in 1925 by 0·1 cwt., but falls short of the decennial average by 1·2 cwt. The total acreage is the lowest on record.

The total produce of hay, taking all kinds together, is 998,000 tons, being 107,000 tons, or 12·0 per cent., above the previous year's tonnage. Hay from rotation grass shows a total produce of 719,000 tons, an increase of 73,000 tons, or 11·3 per cent. The yield per acre, 34·8 cwt., is greater than in 1925 by 2·7 cwt., and exceeds the decennial average by 3·3 cwt. The total produce of other hay, which amounts to 279,000 tons, or 34,000 tons more than in 1925, comprises 167,000 tons from ordinary meadows and 112,000 tons from Timothy meadows. The former has a yield of 28·6 cwt., or 1·5 cwt. in excess of last year's figure, and is 2·7 greater than the decennial average, while the yield per acre of Timothy meadows, 45·1 cwt., is 4·1 cwt. greater than in 1925, and is 2·9 cwt. in excess of the decennial average. The average yield of the two together, which is not shown in the table, is 33·5 cwt., or 2·7 in excess of the ten years' average.

The total produce of potatoes, amounting to 899,000 tons, shows a decrease of 96,000 tons, or 9·6 per cent.; the area under the crop, 141,871 acres, is 284 acres less than last year, while the yield per acre, 6·3 tons, shows a decrease of 0·7 ton on 1925, and of 0·2 on the decennial average. The produce of turnips and swedes, 6,894,000 tons, has increased by 79,000 tons, or 1·2 per cent., while the area, 390,778 acres, is 5,162 acres less than last year and is the lowest on record. The yield per acre, 17·6 tons, is 0·4 ton higher than last year and 0·9 ton above the decennial average. Mangolds show a total produce of 23,000 tons, or 2,100 tons more than the small crop of last year. The area under the crop, 1,108 acres, is 9 acres less than last year and is the lowest recorded since 1895; the yield per acre, 20·6 tons, is greater than for the previous year by 1·9 ton and exceeds the decennial average by 2·4 tons.

It will be observed that every crop except wheat, beans and potatoes shows an increased yield per acre as compared with the ten years' averages.

Acreage under each Variety of Potatoes in 1926.

A STATEMENT is printed on page 125 showing the acreages under certain varieties of potatoes in Scotland in 1926, as returned by growers of one acre or over. These returns cover 124,093 acres out of the total acreage of 141,864, the difference being accounted for by the complete exclusion of certain districts in the Highlands and Western Islands, and by the exclusion of holdings on which less than one acre is grown. Both the total acreage and the acreage included in the returns of varieties are practically the same as last year.

The area under First Earlies, 15,200 acres, shows a decrease as compared with 1925 of 755 acres, or 4·7 per cent. Epicure, with 9,294 acres, accounts for three-fifths of the total. Eclipse, with an increase of 184 acres, now takes second place, while Sharpe's Express has lost 649 acres, or 30 per cent. of last year's area, and is third. Duke of York, with a slight decrease, is again fourth. These varieties cover 93 per cent. of the whole area under First Earlies.

Second Earlies show a substantial increase, the acreage being 19,785, which is over last year's by 2,093, or 11·8 per cent. This is mainly due to Great Scot, which has increased by 1,859 acres to 11,026. British Queen is second, with practically no change. These two varieties account for 85 per cent. of the total.

The area under Maincrops, 89,108 acres, shows a diminution of 1,423 acres. Kerr's Pink, with a slight decrease, stands first with 30,471 acres. King Edward VII shows an increase of no less than 4,712 acres, and takes the second place with 20,146. Arran Chief, with a striking decrease of 5,053 acres, or over 30 per cent., stands third, its acreage being 11,122, or little more than one-fourth of the figure for 1918. Golden Wonder is again fourth, but has lost nearly 1,000 acres. These four varieties, as last year, account for 80 per cent. of the Maincrop acreage. Of the remaining varieties the most interesting is Majestic, which has nearly doubled its area, rising to 5,684 acres. The other varieties that had over 1,000 acres in 1925 show substantial decreases, as do also all the minor varieties except two.

Varieties immune from wart disease covered in all 66,027 acres, or 53·2 per cent. of the total acreage included in the returns, non-immune varieties covered 57,230 acres, or 46·1 per cent., while the unspecified varieties accounted for only 836 acres, or less than one per cent. The proportion of immune varieties has increased steadily from year to year; a full account of the figures for the years 1918 to 1924 was given in the issue of this JOURNAL for January 1925.

The Abstract of the Agricultural Returns printed on pp. 126-133, shows that the total area under all crops and grass amounts to 4,693,170 acres, a decrease of 12,027 acres as compared with 1925, the arable land having decreased by 34,824 acres, while the area under permanent grass is greater by 22,797 acres. The land under rye-grass and other rotation grasses and clover has decreased by 17,538 acres, the decrease in the area under other crops being thus 17,286 acres. The total area under the cereal crops is 1,122,130 acres or 12,734 less than last year. The area under wheat shows an increase of 5,160 acres or 10·6 per cent.

Agricultural Returns for Scotland, 1926.

Barley has decreased by 30,624 acres or 20·0 per cent. and the acreage, 122,297 acres, is the lowest ever recorded, while oats show an increase of 14,078 acres or 1·5 per cent.

Beans show a decrease of 119 acres or 3·5 per cent., while potatoes have decreased by 284 acres or 0·2 per cent. The area under turnips and swedes is less than in 1925 by 5,162 acres or 1·3 per cent., while that under mangolds is practically unchanged. Cabbage shows a decrease of 200 acres or 4·8 per cent., rape a decrease of 108 acres or 0·9 per cent. and flax 288 acres or 38·2 per cent. The area under vetches, tares, &c. for fodder has increased by 1,664 acres or 15·6 per cent., while that under sugar beet has been more than doubled, the increase being 2,156 acres or 144·4 per cent. The decrease in the area under rye-grass and other rotation grasses is 17,538 acres or 1·2 per cent., the area for hay showing an increase of 10,583 acres, and that for pasture a decrease of 28,121 acres. The area under permanent grass is greater by 22,797 acres or 1·5 per cent., the area for hay being greater by 10,013 acres and that for pasture by 12,784 acres.

The area under wheat, barley, oats and potatoes this year is, in round figures, 1,258,000 acres, which is 12,000 acres less than last year and is the lowest aggregate recorded since the statistics were first collected.

The live stock returns show that the numbers of horses, cattle and pigs have decreased, while sheep have increased. Horses used for agricultural purposes show a decrease of 4,602; unbroken horses of one year and above have decreased by 2,898, while those under one year are greater by 776. " Other horses " have decreased by 14, the net decrease in all horses thus being 6,738 or 3·6 per cent. Cows in milk have increased by 8,989 or 2·6 per cent., while cows in calf have decreased by 6,930 or 13·9 per cent.; heifers in calf, however, show an increase of 5,036 or 9·6 per cent. Bulls being used for service show a slight decrease of 166 or 1·0 per cent. The numbers of other cattle of two years and above have decreased by 18,858 or 8·0 per cent., and those of one year and under two by 11,265 or 4·1 per cent.; other cattle under one year have increased by 16,231 or 7·2 per cent. The total number of cattle has thus decreased by 6,963 or 0·6 per cent. Sheep are more numerous than in 1925 by 84,314 or 1·2 per cent. Breeding ewes have increased by 59,384 or 1·9 per cent., while rams have decreased by 63 or 0·1 per cent. Other sheep of one year and above have decreased by 98,062 or 9·4 per cent., but those under one year have increased by 123,055 or 4·2 per cent. The net decrease in the number of pigs amounts to 8,801 or 5·7 per cent. The number of sows has increased by 2,114 or 13·1 per cent., while that of boars is greater by 137 or 7·3 per cent. Other pigs show a decrease of 11,052 or 8·1 per cent.

The returns include statistics of the acreage owned by occupiers of holdings and particulars relating to poultry. These figures are not included in the printed abstract.

The total area of land under crops and grass returned as owned by occupiers of holdings this year amounts to 1,094,706 acres as compared with 993,593 acres in 1925, an increase of 101,113 acres.

The poultry figures are as follows :—

Fowls hatched before 1926	2,340,470
Fowls hatched this year	2,674,375
Ducks hatched before 1926	157,575
Ducks hatched this year	135,009
Geese hatched before 1926	7,114
Geese hatched this year	21,459
Turkeys hatched before 1926	16,269
Turkeys hatched this year	74,260

The returns of labour employed on farms are summarised elsewhere.

Agricultural Conditions in 1926.

Weather.—Except for occasional frosts and falls of snow during the first week of January, and again at the beginning of February, the weather during these two months was generally mild. Rain, however, prevailed in most districts, and was so persistent in some areas that ploughing and other farming operations fell into arrear, while the planting of early potatoes was generally delayed. Low temperatures were experienced in March, especially at the beginning of the month, when snow was frequent. From the middle of March until the middle of April, however, bright and open conditions were general throughout the whole country, with the result that arrears of ploughing were overtaken, and the sowing of oats was begun under very favourable conditions. For the next four or five weeks the weather was both wet and cold and outdoor work was rather interrupted. Changeable weather was general during June and frequent rain interfered with the thinning of turnips, but, taken on the whole, the weather was good for growth and most crops made satisfactory progress. For the first two weeks of July dry sunny weather prevailed in most districts, the mean temperature being well above the normal; during this period those farmers who were in a position to harvest their hay secured the crop in excellent condition. Unsettled weather set in during the latter half of the month and continued for the first three weeks of August, with the result that all harvesting operations were hindered; many of the best fields of grain were laid and twisted, while blight spread rapidly over the potato crop, and in some districts the growth of the tubers was checked. The first part of September was dry and very favourable for harvest, but towards the end of the month the weather broke and the securing and stacking of oats in late districts was much interrupted. At the beginning of October a spell of remarkably warm and bright weather rendered it possible for a large proportion of the potato crop to be lifted under ideal conditions, but the remainder of the month was stormy, unsettled and unusually cold, with the result that the sowing of winter wheat was considerably delayed. During the month of November an excessive rainfall interfered with every kind of outdoor work.

Wheat.—Seeding was rather later than usual and, owing to unfavourable weather, germination was slow; at the end of March the braird was generally backward, and in some cases the fields were thin and patchy. The crop thereafter made vigorous and healthy growth, but stormy, wet weather at the end of the ripening season caused some damage. Harvest was generally completed before the end of September and the crop was secured in good or fair order. Straw bulked well, and in many districts the grain was found to be of good quality, but owing, it is thought, to the short ripening period, or perhaps as a consequence of the cold nights experienced in July, the yield in some districts was disappointingly small and, when threshed out, was found to be below the average. The grain yield per acre for the country as a whole was 20·8 cwt. as compared with 22·3 cwt. in 1925. Rust was reported on some farms along the east coast, while in south-east Perth smut was prevalent where seed had not been pickled before being sown, but otherwise no damage was reported either in consequence of disease or insect pests.

Barley.—Sowing was generally completed before the end of April under favourable conditions. The plants brairded well and developed in a satisfactory manner, but on a few farms the crop was slightly checked by early summer frosts. In most districts the heads filled out well and there were prospects of an unusually good yield; straw, however, was rather soft, and during the boisterous weather experienced in August much of the crop became lodged and twisted so that some of the grain was lost. Cutting, which was rather slow and difficult, began in August and continued with little interruption until the end of September. Where it has been threshed the grain is generally reported to be of good average weight and colour, but in some south-eastern areas the yield is light and the grain of moderate quality. The grain yield per acre for the country as a whole is practically the same as that in 1925. Straw is generally of good length and quality. No reports of damage by disease or insect pest have been received from any part of the country.

Oats.—The sowing of oats was mostly completed before the end of April. Growth was checked to some extent by frosts in May, but the crop made unusually good progress during the summer months. At the beginning of September the grain was ripening quickly in most districts, while on some early farms part of the crop was already cut and stacked. The greater part of the crop was secured in good order about a month earlier than usual, but in consequence of the broken weather towards the end of September the completion of the harvest was protracted, and much of the crop that was brought in late was in poor condition. The colour and quality of the grain are generally stated to be good, while the straw is above the average both in quality and quantity. The grain yield per acre was 15·9 cwt. as compared with 15·5 cwt. in 1925. Comparatively little damage was caused by disease or insect pests, although in the early summer months the leather-jacket grub (*Tipula cleracea*) was prevalent in several localities.

Beans.—In most districts where this crop is grown the weather conditions were suitable and the plants gave early promise of a good yield. Growth was vigorous and healthy and harvest was earlier than usual. Reports from different parts of the country varied considerably, but in most districts the yield and quality were good both as regards straw and pods. In a few fields, however, the crop was rather badly affected by blight, and in these cases the plants failed to pod properly.

Potatoes.—Early varieties of potatoes were generally planted in good order. Frosts about the middle of May, however, checked growth and blight affected the crop in some districts, with the result that the yield in most cases was below the average. Main crops were mostly planted under very favourable conditions during the first half of April. Growth was rapid during June and the first half of July, but wet weather during the latter half of July and the first three weeks of August caused blight to spread very rapidly from one end of the country to the other and growth was prematurely stopped; in the case of some varieties grown on light soils the tubers were afterwards reported to have rotted. The proportion of the crop sprayed would appear to have been very small; in several areas, however, the blight was not serious in its effects, and some varieties were said to be practically free from disease. The lifting of the crop began earlier than usual, and during the first ten days of October a considerable proportion was secured under ideal conditions. The severe wintry weather experienced at the end of October put a stop to the work, however, and on exposed land potatoes near the surface were frosted in some cases. The yield throughout the country taken as a whole was 6·3 tons per acre as compared with 7·0 tons in 1925. The quality generally is good, but it is reported that there is a larger proportion than usual of small tubers.

Turnips.—The weather experienced when turnips were brairding was rather dry, and in consequence growth was at first irregular and slow; some re-sowing was necessary on light soils and in cases where damage had been caused by the turnip fly (*Phyllotreta nemorum*). At the end of June, however, there was a distinct improvement in the condition and prospects of the crop and thinning was in progress in several districts. Growth was slow during July and August and in some cases the crop was reported to be patchy, especially on stiff and heavy land; in many eastern districts "finger-and-toe" (*Plasmodiophora brassicæ*) became very prevalent during this period. The wet weather during the autumn months was favourable for growth and the roots made very satisfactory progress, especially in south-western districts. Later reports on the crop showed considerable variation, those from some eastern areas stating that the roots were only in fair condition, while reports from the south-western counties were satisfactory generally. The yield is estimated at 17·6 tons per acre as compared with 17·2 tons in 1925.

Mangolds.—The weather during the summer months was especially favourable for mangolds, and in almost all districts the roots developed satisfactorily. Little or no damage was caused by pests, but in one or two areas growth was checked somewhat during October by frost. The roots are generally reported to be of good quality. The yield per acre is estimated at 20·6 tons as compared with 18·7 tons in 1925.

Sugar Beet.—The crop was grown on 3,649 acres as compared with 1,493 acres in 1925. In most cases the braird came away strongly, but during the early stages of growth damage was caused in some districts by wireworm (*Agriotes lineatus*) and fly, while in a few other cases farmers found it necessary to plough the crop under owing to the prevalence of weeds. The conditions during June and July were favourable for the development of the roots and the crop made good progress, especially where it had been sown early and the plants had become well established before the hot dry weather in the first half of July; "bolting," however, was common in several areas. During August and September the reports indicated that the condition of the beets varied considerably even in the same locality; on suitable soils the crop has proved generally satisfactory, and in November the yield was estimated at from 13 to 14 tons per acre in one district, while in some other cases the results obtained this year have not been profitable. At the beginning of December consignments of the roots were still being sent to the factory, and it was, in consequence, not possible to ascertain the general sugar-content of the bulbs, but reports received from a few districts where the greater part of the beets had already been despatched showed that the sugar content varied from 16 to 19 per cent.

" *Seeds* " *Hay.*—Owing to an early harvest in 1925 and mild weather in the following autumn months, " seeds " became well established before the winter commenced. At the beginning of March the crop generally had a promising appearance, although in some districts unfavourable weather had considerably retarded growth; weather conditions during the spring and summer months were, on the whole, suitable, and clover was in most cases more abundant than usual. Harvest was practically completed at the beginning of August, and where cut early the crop was secured in excellent condition. Yields more or less below the normal were reported from a few districts, but taking the country as a whole the hay bulked well above the average.

Meadow Hay.—The yield of meadow hay also varied considerably, but in most districts it was found to be above the average and of good quality. Where cutting was not commenced until the latter part of July rain considerably delayed operations, and the work was made more difficult owing to the fact that the crop had become laid and twisted.

Cultivation.—The weather conditions during November were to a great extent unfavourable for outdoor work and in most districts little progress was made with autumn cultivation. Fortunately, however, this year's harvest was completed earlier than usual, and in most districts it was possible to make so early a start with ploughing, manuring and the sowing of winter wheat that the work was well forward before the bad weather began. At the beginning of December the sowing of wheat was completed, or practically completed, in Lanark and south-west Perth, while in Fife, Clackmannan, Kinross and the Lothians the work was fairly well forward; in all the other districts, however, where the crop is generally grown, sowing was more or less in arrear owing to the difficulty of obtaining a good seed-bed.

Live Stock.—Grazing cattle were mostly housed by the end of November, and the reports generally indicate that the stock are in good average condition. Dairy cows are healthy and thriving. The reports on the milk yield vary more or less, but, on the whole, the supplies are fully up to the normal for the winter period. Sheep on arable farms have done well in most localities, but lameness has been unusually prevalent in Central Perth. Hill sheep were reported at the end of November to have made but little progress during the month, owing to the unusually severe and wet weather.

Labour.—The latest reports indicate that the supply of regular and casual labour is sufficient for present needs in most districts. In North-West Lanark, however, there is a scarcity of byremen and milkers, while casual labour is rather short of requirements in Sutherland and Kirkcudbright, and women workers are required in Dumbarton and Renfrew.

SCIENCE AND PRACTICE.

The following extracts and summaries are supplied by members of the staffs of Scottish agricultural colleges and scientific institutions. Full references to the original publications may be obtained on application to the Secretary, Board of Agriculture, York Buildings, Edinburgh.

CROPS AND SEEDS.

Self and Cross Fertilisation in Lolium Perenne, *by T. J. Jenkin, M.Sc., Welsh Plant Breeding Station, Aberystwyth. Journal of Genetics, Vol. 17, No. 1, August,* 1926.—Plants of Lolium perenne (perennial rye-grass), thought to be of economic interest, were selected from amongst various populations. Seed was obtained from them by handcrossing and by selfing. The seed was sown under appropriate conditions and the seedling progenies studied. Comparisons were made between plants which were selfed or inbred from the parent (these are referred to as L.1) and plants raised from seed obtained by crossing (these are referred to as F.1). All the lots were uniformly treated, and the foliage was cut back so as to prevent seed setting. The lots were divided into two sections, which were treated differently as regards the number of cuts taken.

In two instances, where a full comparison was possible, the F.1 exceeded the L.1 by over 100 per cent., while in a third instance the L.1 and F.1 compared as 100 : 172, thus indicating that the F.1 in three instances was the more productive. When F.1 families were compared with each other, it appeared that certain plants were more valuable than others for use as parents when total productivity was considered. The results of the experiments indicated that the omission of some of the early cuts generally made for a higher total yield in a particular season, but it was shown that all F.1 families did not respond equally to such treatment. Self-sterility was one of the greatest obstacles in the way of improvement of grasses. This condition occurred very frequently in Lolium perenne, but occasionally plants were found which were relatively highly self-fertile. By a system of hand-crossing it is thought that it may be possible to eliminate plants which are poor parents.

Evidence has been obtained indicating that some crosses give rise to families which suffered little adverse effect by frequent and continuous cutting; on the other hand, certain families produced better results when early cuts were omitted.

The Organism of Tomato Mosaic, *by Sophia H. Eckerson, Contributions from the Boyce Thomson Institute for Plant Research, Vol. 1, No. 3, May* 1926.—A description is given of various motile organisms which were observed in mosaic plants, especially the one in the tomato. Motile organisms were observed in mottled leaves of all the mosaic plants. Very young not yet mottled leaves of the mosaic plants also contained many tiny, rapidly moving organisms in the mesophyll cells. Several series of young tomato plants had been inoculated with foliage juice from mosaic plants. Twenty-four hours after inoculation, flagellated organisms were found in the leaflets opposite inoculated leaflets, in the vein and in the adjacent mesophyll cells. None was found in other regions. Examinations of the tissue were made various days after inoculation. Ten days after inoculation some of the leaflets showed mottling. Twenty to thirty days after inoculation most of the cells had become filled with melon-seed-shaped spores.

Growth of Seedling in Relation to Composition of Seed, *by Mary E. Reid, Boyce Thomson Institute for Plant Research, Vol. 1, No. 3.*—The experiments described had for their object the study of the total growth-producing value of the food stored in the different seeds, and the relation of varying proportions of these organic foods in altering the shoot to root ratios. The results of the experiments showed that different kinds of seedlings produced very different growth responses when exposed to the same external influences.

Effect of Thiourea upon Bud Inhibition and Apical Dominance of Potato, *by Mary E. Reid, Boyce Thomson Institute for Plant Research, Vol. 1. No. 3.*—In this paper results obtained by treating potatoes of the Bliss Triumph variety with a solution of the above-mentioned compound are described. The seed pieces of each tuber weighed about 25 gm. and each bore one eye. They were soaked one hour in a 3 per cent. aqueous solution of thiourea, and after being rinsed in tap water were planted in soil and stored in a cool place until sprouting began. In addition to thiourea, more than 200 chemicals had been tried, but thiourea was the only one that consistently forced multiple sprouts without causing rotting of the tubers. Emersion in solution of thiourea often produced four or five buds from a single eye of the potato. Solutions of thiourea prevented the apical buds of the tubers from completely inhibiting the growth of basal buds. In some instances the dominance of the apical buds themselves was inhibited. When such inhibited apical buds were cut off from the tuber and planted separately, they started into growth at once.

SOILS.

The Effect of Flooding with Seawater on the Fertility of the Soil. *H. J. Page and W. Williams, Rothamsted Experimental Station, Harpenden, Journ. Agric. Sci. XVI,* 4 (1926).—The authors describe the effects of the flooding of agricultural land with seawater, such as occurred on the banks of the Humber in 1921, as an entire destruction of the tilth of the soil. The result of investigations attribute this—in the light of modern work on the relationship between the physical condition or texture of the soil and the nature of exchangeable bases contained therein—to the replacement of a considerable proportion of the exchangeable calcium of the soil by sodium. The result is that instead of having a friable easily worked calcium soil we have a very plastic unworkable sodium soil.

The natural treatment of such soils would appear to be to add calcium salts in the form of lime or gypsum to replace the sodium, but the authors found that even twelve months after such treatment, although the calcium salts had produced the desired effect to some degree, still the action had not proceeded far enough to produce any noticeable effect on the tilth.

Other methods of reclamation, such as tillage and drainage, are discussed and criticised, and the authors conclude that the most promising method of recovering flooded lands is the establishment of a ley of lucerne, clover, or " seeds " which can be left down for several years.

Some Points about Soil Fertility illustrated from Craibstone Experiments, *by Professor James Hendrick, University of Aberdeen, Transactions Highland and Agricultural Society of Scotland XXXVIII,* 195 (1926). —In this paper Professor Hendrick describes some of the valuable results on manuring and liming obtained at Craibstone as a result of work carried out during the past thirteen years. The ordinary six-course rotation of the Aberdeen district was followed, and precautions were taken, in laying down the plots, to test the uniformity of the fields. The plots were laid down in duplicate or triplicate, and the results, therefore, represent the average of many experiments, and may be taken as a useful guide for treatment of the granitic drift soils of the North of Scotland.

The experiments render a great service to agriculture in showing that certain preconceived notions must be got rid of. For example, although the soils are fairly acid, it has been shown that the application of lime, even in the mild form of carbonate of lime, does not bring about a very obvious improvement. When artificials alone are used, the carbonate of lime as a rule increases the yield, but where dung is used in the rotation the calcium carbonate has a tendency to depress the yield of everything except barley. It is shown, however, to have a beneficial effect in counteracting finger-and-toe in turnips and in discouraging the growth of certain weeds. It is also pointed out that liming may be necessary for the successful growth of such crops as lucerne and sugar beet, and that it probably increases the feeding value of crops in some cases.

It is also shown that, contrary to surmise, phosphates give no marked increase in yield, at any rate on a soil in fairly good heart. This is in agreement with the results of chemical and mineralogical analyses which show a good supply of phosphates in a form which is probably available to plants.

Potash is shown to be unnecessary, and in one case actually detrimental, on a field in good condition, but on another field in poor condition potash gave a marked improvement in potato yield.

The outstanding feature in the experiments is the success of farmyard manure. At whatever point in the rotation it is applied, it has a very beneficial effect on the hay crop, especially in the growth of red clover. In the case of cereal crops, however, artificial manures are found to have almost as good an effect alone as in conjunction with dung—at any rate when the dung is applied to the previous turnip crop.

It is suggested that the main reason for the great success of dung is the nitrogen which it supplies. Craibstone soil has a considerable reserve of potash and phosphates, and the artificial manure which produces the greatest response is nitrogenous manure.

Farmyard manure supplies this, and the humus helps to improve the soil texture.

These experiments, in addition to showing what may be expected from the application of lime and various manures on a soil widely distributed in the North of Scotland, illustrate how dangerous it is to make assumptions based on the study of quite different soils in other parts of the country.

Why are Serpentine and Other Magnesium Soils Infertile? *A. Gordon and C. B. Lipman, University of California, Soil Science, Vol. XXII*, 4 (1926).—Experiments are described which were carried out to investigate the reason for infertility in soils derived from magnesium rocks. The results indicate that in these soils there is a low concentration of certain plant nutrients such as nitrates, phosphates and potassium. The soils also appear to be very alkaline. Although derived from magnesium rocks, the ratio of magnesium to the total concentration of the soil extract was found not to be necessarily high.

These observations coupled with others derived from physiological experiments appear to indicate that the infertility is not due to the toxicity of a large quantity of soluble magnesium (as is the generally accepted theory), but to the high alkalinity and lack of necessary plant nutrients in the soil.

Influence of Sulphur and Gypsum on the Solubility of Potassium in Soils and on the quantity of this Element removed by certain Plants. *O. M. Shedd, Soil Science, XXII*, 5 (1926).—The author carried out a series of experiments to determine the effect of the addition of sulphur or gypsum, sometimes with lime, on the solubility of the potash in samples of soil kept in the laboratory. The amount of potash extracted from the treated soils by wheat or buckwheat seedlings was also determined.

The results show that while considerable amounts of sulphur were oxidised in the soil, especially in the presence of lime, the resulting effect on the solubility of the potash in different solvents varied with the soil types. In general there was an increase in the amount of water-soluble potash in soils treated with sulphur, but varying results were obtained in the gypsum experiments. There appears to be no consistent correlation between the amount of potash extracted by the seedlings and by the different solvents used by the author in his examination of the soils.

On the Influence of Soil Reaction in Practice. *Trénel, M., Has the Soil Reaction in Practical Agriculture really the Influence attributed to it as a result of Scientific Experiments? Zeitschrift für Pflanzenernährung und Düngung, Vol. 4, No. 8*, 1925.—A contrast is made between the conditions of growth in practical agriculture, where optimum growth can be influenced by many different factors, and those obtaining in scientific investigations where all the disturbing factors are eliminated. It was shown in previous experiments that throughout the year the reaction remains fairly constant, particularly in the case of soils rich in colloids, but is less constant in the case of sandy soils poor in colloids. The influence of fertilisers and of soil cultivation was also investigated.

The answer to the question put by the author was based on the results of the numerous acidity determinations carried out by means of the "acidometer" on soil samples from 23 large estates. The results and computations were collected and tabulated very clearly.

These results agree to a certain extent with those gained from scientific experiments, and it seems that we shall be justified in concluding that the yield can be increased by adjusting the reaction of the soil to the kind of plant which it is intended to cultivate. Most of our cultivated plants seem to show an optimum growth at a slightly acid to neutral reaction. As an alkali reaction is just as detrimental to the growth of cultivated plants as a strongly acid reaction, the problem of the dependence of plant cultivation upon soil reaction seems to be not merely a question of "soil acidity" but a question of soil reaction in general.

A New Soil Core Sampler. *Powell, E. B. (Missouri Agr. Exp. Sta.), Soil Science, Vol. XXI. Baltimore, Md.*, 1926.—The author describes a sampler that would take an undisturbed core of soil with the desired dimensions. The sampler consists essentially of two cylinders, one within the other, the outer one being furnished with cutting knives. A diagram of the sampler with a detailed description of its construction and two photographs are given in the article. Anyone especially interested can make arrangements with the Agricultural Experiment Station, Colombia, Mo., U.S.A., to secure blue prints and specifications of this sampler.

FERTILISERS.

The Effect of Lime and Fertilisers on the Potash Content of Soil and Crop. *J. G. Lipman, A. W. Blair and A. L. Prince, Proceedings of the International Society of Soil Science.*—Potash was determined in soils from a number of plots that had received definite fertiliser and lime treatment for a period of 15 years. It was also determined in several crops, or parts of crops, grown on the plots from which the soil samples were taken.

For the series of plots having parallel fertiliser treatment for the limed and unlimed sections, the percentage of potash in the soil was slightly lower, in nearly all cases, for the limed than for the unlimed section.

The fertiliser treatment does not appear to have had very much influence on the potash content of the soil. Such variations as are noted are to be attributed, in the main, to natural variations in the soil or to limitations in the methods of sampling.

There is a consistent variation in the percentage of potash in the corn stalks grown on the limed and unlimed sections and with the different fertiliser treatments.

The average percentage of potash in the stalks from 20 limed plots is, approximately, 0·4 per cent. less than the average for the stalks from 20 limed plots.

The lowest percentage of potash found in the stalks was 0·426 per cent., and the highest 3·208 per cent.

It would appear that a 50 bushel crop of corn (maize), grain and stalks will remove from the soil about 100 pounds of potash. It has been shown that the potash content of some crops, at least, is greatly influenced by heavy applications of potash salts, and this emphasises the importance of carefully stating the conditions under which crops are grown when reporting percentages of plant food constituents in the crops.

Effect of various Methods of applying Fertilisers on Crops and on certain Soil Conditions. *Coe, Dana G. (Iowa State College), Soil Science, Vol. XXI. Baltimore, Md.,* 1926.—Fertiliser applications in direct contact on the ridge or in direct contact in the drill-row with seed are likely to be injurious to the best germination of the seed. Planters designed with fertiliser attachment for direct contact are not advised for use. In place of direct contact it is recommended to use the methods of " above the ridge or drill-row " the " below the ridge or drill-row " and the " sides of ridge or drill-row " method.

ANIMAL BREEDING.

On the Fertility of Stallions. *H. G. Sanders, Jour. Agric. Sci., Vol.* 16, *pp.* 466-491, 1926. *Paper from the School of Agriculture, Cambridge University.*—Two sets of records, for light and heavy horses respectively, have been analysed statistically, with the object of studying some of the factors which affect the percentage of foals left by a stallion in a service season. Firstly, considering the results of analysis for light horses, it was found that there had been a marked decline of fertility, the average mean fertility for the years 1887-1910 being 57·37, and for 1911-1924 being 51·53.

A study of the influence of environment in fertility revealed that the North of England, Devon and Cornwall are high fertility areas, and that Scotland and East Anglia are low fertility areas. It was further shown that differential fertility according to districts was in no way correlated with the average area covered by each stallion in a district.

This analysis shows that the fertility rises as the number of mares served per stallion rises, but, as low fertility stallions will usually have more mares turning to a second and third service, thus tending to level out the actual number of services made by a stallion, the author thinks it would be unwise to assert any further than that fertility does not decline as the number of mares rises.

There is a slight tendency for a stallion's fertility to rise from the time he is three years old till he is thirteen years old. Fertility declines after the age of sixteen years, and this occurs over the whole range and is not caused by a certain number becoming absolutely sterile. Between the ages of six and seventeen years there is little variation in the number of mares served, but at either end of the range the number of mares served is below the average.

Data for heavy horses were not procured previous to 1914. There has been no definite trend in fertility since 1914, the yearly means varying, quite at random, between 56·34 per cent. and 61·11 per cent. It was found that there is a definite positive relation between the fertilities of heavy and light horses in a district, and in heavy horses evidence is again borne out that fertility tends to increase with a rise in the number of mares served.

For both light and heavy horses a marked differential fertility among stallions was obtained. Each individual stallion's percentage returns, in successive seasons, tend towards a constant figure. It must, therefore, be concluded that there are definitely good and bad "getters" of foals.

Fertility in Sheep. *J. E. Nichols, Jour. Minist. Agric., Vol.* 33, *No.* 3, 1926. *Paper from the Animal Breeding Research Department, University of Edinburgh.*—This second report on a study of fertility in sheep from flock records of different British breeds includes data collected for the season 1924-1925. The yield of lambs per hundred ewes, the proportions of multiple births, barrenness and abortion and sex-ratio are given for nine breeds, and further data on the effect of "flushing" have been obtained. It is concluded that variations in fertility are caused by environmental conditions acting on hereditary differences, the most important being those which produce a high proportion of multiple births and a low proportion of barrenness and abortion. Barrenness and abortion are more frequent among the younger ewes and (apart from pathological conditions) are largely due to environmental factors, although hereditary factors may also play a part in determining their incidence. High yields of lambs can be produced by the practice of flushing by reason of the increased reproductive activity of the ewes at the beginning of the period of service induced by the nutritional stimulation following the flush.

Fertility in Southdown Sheep. *J. E. Nichols, Jour. Agric. Sci., Vol.* 16, *Part* 3, 1926. *Paper from the Animal Breeding Research Department, University of Edinburgh.*—Data from 26 flocks, involving a total of 5,014 pure-bred Southdown, are here analysed and discussed. For ewes of all ages the proportion giving birth to twins is closely associated with the total yield of lambs, and while barrenness and abortion may to a certain extent be due to the same causes, it is those factors which cause abortion which also affect the yield by reducing the number of single births rather than the number of multiple births. The low fertility of shearling ewes is due to barrenness through reduced or delayed ovulation.

Meteorological Factors affecting Fertility in Sheep. *J. E. Nichols. Reproduced in the Monthly Crop Weather Reports of the Ministry of Agriculture and Fisheries and Board of Agriculture for Scotland's Agricultural Meteorological Scheme, Vol.* 3, *No.* 1 1926; *by permission from Zeit. f. indukt. Abst. Vererb., Vol.* 43, *No.* 3/4. *Paper from the Animal Breeding Research Department, University of Edinburgh.*—An attempt has been made to trace the influence of meteorological conditions upon fertility in flocks of Cheviot and Blackface sheep kept under the same conditions of nutrition and environment over a period of 14 years. There is a significant difference in fertility between the two breeds and a differential breed response to environmental conditions; in the Cheviot flock the yield of lambs is affected through the proportion of eild ewes, while in the Blackface the yield is probably affected directly. The causes of post-natal mortality are probably the same in both breeds, but the data do not exclude the possibility of a selective elimination of one sex by infantile mortality. There may be some association between high mean temperature at tupping time and high yield in the Cheviot flock, and low yield and high daily range of temperature in the Blackface flock. The mean daily temperature at lambing time is of no importance, but there is significant evidence that a low mean daily range of temperature is associated with a low percentage yield of lambs and a high proportion of eild ewes, and *vice versa*, in both flocks. In the Blackface flock mean daily range of temperature has no effect on the yield of lambs except in so far as it affects eild, but in the Cheviot flock it may have some direct influence on yield of lambs. The number of rainy days is the most important meteorological factor influencing yield of lambs and proportion of eild ewes in both flocks (rainfall in inches has no significant effect), probably through its effects on early post-natal mortality. A high number of rainy days at lambing time is associated with low yield of lambs and high eild and *vice versa*, but while this and other meteorological factors do influence the yield of lambs in both breeds, there being differential responses, the reasons for the differences in the two flocks are due chiefly to inherent breed characteristics.

The Cotted Fleece. *J. A. F. Roberts, Jour. Text. Inst. Vol.* 17, *No* 3 1926. *Paper from the Animal Breeding Research Department, University of Edinburgh.*—The cotted or matted fleece has been studied in this case in Welsh mountain sheep. The matting is due to the shedding of some of the wool fibres composing the fleece, the fine shed ends of such fibres becoming intertwined. The process takes place during winter and spring, but the great majority of cases occur during a limited period which is probably about February. The tendency to produce a cotted fleece is largely constitutional, i.e. is characteristic of the individual sheep. The proportion of sheep affected increases with age, and there are large variations in the number affected in the same flock in different seasons. The evidence points to variable factors which act during a susceptible period on sheep of varying individual susceptibility.

Kemp in the Fleece of the Welsh Mountain Sheep. *J. A. F. Roberts, Jour. Text. Inst., Vol.* 17, *pp.* T274-T290, 1926 (*also in Publication* 59 *of the Brit. Res. Assoc. for the Wool and Worst. Industr.*) *Paper from the Animal Breeding Research Department, University of Edinburgh.*—A description is given of " kemp " fibres both from the point of view of naked eye and microscopic examination. Special emphasis is laid on the mode of growth of kemp, which is animal in its growth, as distinct from other fleece fibres, which grow continuously. It is considered probable that kemp represents a remnant of the outer coat of the primitive sheep. This leads up to a definition of kemp and a method for its qualitative estimation in the fleece. The grading of Welsh wool by the manufacturer depends on two main points, the proportion of kemp and general fineness, and of these kemp is the more important in practice in this breed. There is some discussion of the point of view of the sheep-breeder with regard to kemp, and it is considered probable that the sheep-breeder's belief is an association between kemp and hardiness, and is based on the fact that, on the average, lambs which are well covered at birth have more kempy adult coats than those less well covered. However, it is possible to obtain sheep that have excellent birth coats and yet produce a relatively kemp-free adult coat. This is the desirable type. Certain associations between fleece characters are pointed out.

Colour Inheritance in Sheep. *II. The Piebald Pattern of the Piebald Breed. J. A. F. Roberts, Animal Breeding Research Department, Edinburgh, Jour. Genet., Vol.* 17, *pp.* 77-83, 1926.—A considerable number of flocks of the ancient breed are in existence in this country, their origin being very obscure. Although there is considerable variation in the amount and distribution of the spotting, these sheep breed remarkably true for the piebald character. Crosses with any other breed give only self-blacks, and in further experimental breeding a back cross of the F1 to white gave half-blacks and half-whites, while a back-cross to piebald gave half-blacks and half-piebalds. Piebald sheep, therefore, possess a dominant black factor and a recessive pattern factor.

Inheritance of Soft and Stiff Hair on the Face of Sheep. *C. Wriedt, Zeit Tierz., Vol.* 3, 1925.—The author describes two rams which possessed a on the face, especially on the back of the nose, while other breeds of the same district have stiff hairs in the corresponding areas. Breeding experiments with seven rams of the Rygja breed showed that the genetic difference was a simple one, soft hair being dominant to stiff hair.

Inheritance of a Stiff Hair Tuft on the Rump of Sheep. *C. Wriedt, Zeit. Tierz., Vol.* 3, 1925.—The author describes two rams which possessed a stiff tuft of coarse hair on the rump. Twenty-three offspring included eleven that possessed this feature. It is concluded, therefore, that it behaves as a simple Mendelian dominant, and that both rams were heterozygous.

An Exact Estimation of the Wool and Mutton Production of the Merino Mutton Sheep compared with the East Prussian Blackhead Mutton Sheep. *W. Völtz and Tantzon, Zeit. Tierz., Vol.* 2, 1924.—Among other findings, the authors claim that a calcium carbonate supplement in the diet of the sheep with which they experimented produced a considerable increase in wool production.

On the Presence of Supernumerary Mammary Glands in Cows and on their Functional Activity. *K. J. J. Mackenzie and F. H. A. Marshall, Jour. Agric. Sci., Vol.* 15, *No.* 1, 1925.—In the cases examined, glands were associated with the supernumerary teats. Teats of the lactose content of the urine during lactation indicated that the milk which was being secreted by the supernumerary glands was being resorbed into the blood.

Colour Inheritance in Black-and-Red Friesians × Brown Swiss Cattle Crosses and the Effect of Castration. *A. Staffe, Zeit. Tierz. u.*

Zücht., *Vol.* 2, *No.* 2, 1924.—This paper deals with the coat colour of 75 F1 animals produced by crossing black and red Friesians with brown Swiss cattle and also with 9 black crosses. The uniform colour of the Swiss cattle was dominant to the spotting of the Friesian except for white spotting along the back. The F1 calves were brown in colour at birth, and changed gradually to a glossy black during 4-6 months in the case of males, and 6-9 months in the case of females. Early castration of the males prevented this colour change.

Interpretation of Dairy Pedigrees. *John W. Gowen, Maine Agricultural Station, U.S.A. Bulletin* 318, 1924.—This bulletin is a popular summary of some of the writer's well-known and profound researches into the inheritance of milk yield. It deals with the best manner in which to study the pedigrees of milk recorded cattle. The conclusions drawn are as follows:—

There appears to be little or no influence of inbreeding, of relationship, or of famous ancestors on the production of the progeny of dairy sires. It will be noted that the evidence shows that the inbreeding and relationship which occurs in the ordinary pedigrees as found in pure-bred breeds is relatively small in amount. The evidence from extensive experiments (on small animals particularly) shows that very intensive inbreeding such as mating brother and sister for a number of generations will generally result in the concentration of the prepotency of this animal, but also in a decline of vigour in such inbred animals and a probable reduction in fertility. These last results may, however, be avoided by very careful selections.

It is indicated further that it is desirable to have animals which are registered, because these registration papers show that a definite effort has been made to breed these animals to certain types of production, and because this definite effort tends to make these animals pure for these types of production; such animals transmit increased milk yields and butter-fat percentages to their offspring more frequently than an animal of unknown breeding with a probable mixed ancestry.

It is further shown that the parents and grandparents, sisters and half-sisters, and to some extent cousins, are the important relatives on which to base an estimate of the productive worth of an animal. As a pedigree goes beyond three or four generations, the ancestors in it get so far removed from the animal pedigreed that the effect of any worthy ancestor, even though pure for high production, is diluted so much by the other ancestors in coming down through the generations that its effect on the animal pedigreed is so slight as to be of little or no value as a prediction of the progeny's probable production.

It is further shown that the factors on which greatest dependence may be placed in reading a pedigree are the recorded performances of the dam, full sisters and half-sisters. Next to these come the recorded performances of the grandparents.

To this record the writer adds the records of the progeny, as the author's studies have shown these records important in indicating the progeny performance of any pedigreed animal. A pedigree of this type is the unvarnished record worthy of a careful consideration of any breeder either reading or writing pedigrees.

Report for 1925 on the Investigation of the Pork-Producing Qualities of the Pig. *Nils Hansson and Sven Bengtssar. Stockholm*, 1926.—Mr. E. T. Halnan, of Cambridge University, has given a resumé of the results of this Swedish investigation into the production of bacon pigs for the British market. This appears in the *Journal of the Ministry of Agriculture* for November (vol. 33, pp 770-773, 1926). The investigation covered a period of about three years, and 464 pigs were examined at various stages of life and death. The type of pig approximates to our Large White; it includes a native type also.

Evidence was obtained of very considerable differences in the inherited qualities of various families and individuals. It was also shown that the preferred type for export was the long-bodied pig, with a thin layer of fat on the back. This type of pig, however, only dressed out at 62·4 per cent. bacon for export, whereas the rather more chuffy type, short-bodied, with thick back fat, yielded 64·4. This emphasises the need for a higher price for the required type of pig, otherwise it would pay the breeder better to breed a type which does not suit the market conditions. Is not this one of our troubles?

The same appears to hold good as regards the age for slaughter. Back fat measured 1·5 inches in the case of pigs around 195 lbs. live-weight, and 1·7 inches when 219 lbs. Forty-nine per cent. of pigs at 195 lbs. average live-weight gave first quality bacon as compared with 32 per cent. around 200 lbs., and only 21 per cent. of pigs around 220 lbs. These figures are rather surprising considering how small are the differences of weight. In this country they would almost all fall into one group.

Gilts give a better percentage of first quality bacon than do boars, the females being distinctly better as regards the development of belly bacon and hams. Pigs with a long body and deep sides tended to grow far more quickly and deposit less fat than the short-bodied type. These are but very brief results of a painstaking and very useful enquiry.

ANIMAL NUTRITION.

The Relative Utilisation of Feed Energy on Maintenance, Body Increase and Milk Production of Cattle. *Forbes, Fries, Braman and Kriss, Journ. Agri. Research*, 33, *No.* 5, 1926.—The investigations reported in this paper comprise three series of experiments conducted from 1921 to 1923 dealing with the efficiency of the milk cow in terms of energy to utilise feeding stuffs especially for milk production in comparison with maintenance and body gain. The utilisation of feed energy in milk production is here considered in relation to that portion of the feed which is available for milk production after deducting the nutritive requirements of maintenance and any such body gain as may have occurred. The milk energy is regarded as net energy utilised in the production of milk.

It was found that in a series of respiration calorimeter studies of the energy metabolism of cows, both in dry condition and in lactation, and on different planes of nutrition, the average rates of utilisation of the net energy of the ration for maintenance, lactation and body increase were found to be as 1 for maintenance, 0·985 for lactation and 0·761 for body increase. The author believes that more extensive evidence will doubtless modify this apparent relationship, but accepting it provisionally, it is of interest and consistent, from a teleological point of view, that with a lactating female the rates of efficiency of utilisation of food for maintenance of the life of the mother and for the production of milk for the offspring are apparently alike, while the economy of use for body growth is at a distinctly lowered rate.

The Influence of Diets of Fresh and Treated Cows' Milk on the Calcium, Phosphorus and Nitrogen Metabolism of the Young Pig. *Magee and Harvey, Biochem. Journ., XX., No.* 4, 1926.—This paper gives an account of metabolic experiments to test the effect of diets of raw, heated and sour milk on the calcium, phosphorus and nitrogen metabolism of the young pig. In a previous article by the authors it was reported that as a result of heating there was a progressive loss of soluble calcium from the milk. Other workers have shown, on the other hand, that the souring of milk causes a rise in the soluble calcium.

The conclusions from the experiment are as follows :—

A young pig kept under experimental conditions on a diet of cows' milk and cereals showed signs of rickets after 30 days. The addition of a soluble calcium salt to the diet of cereals and milk enabled the animals fed on it to remain in a thriving condition for 60 days.

On a diet of cereals and milk the retention of calcium, phosphorus and nitrogen was lower with heated milk than with fresh or sour milk.

The addition of soluble calcium to a ration containing heated milk raised the retention of calcium, phosphorus and nitrogen by more than the weight of the calcium added.

Reduction of the soluble calcium of the diet increased the urinary phosphorus and nitrogen.

It is suggested that heat has a detrimental effect on the nutritive value of milk, and that one of the important contributing factors is the reduction in the amount of soluble calcium.

The Toxicity of Salt for Chickens. *Mitchell, Card and Carman, Bull.* 279, *University of Illinois Agri. Experiment Station*, 1926.—There is a common belief that chickens are very readily poisoned by common salt, and the experiments quoted in this bulletin were undertaken to determine the maximum percentage of salt that may be fed to growing chickens without harmful results, the maximum single dose of salt that a chicken can tolerate and the smallest dose that would cause death.

For the experiment 75 chickens from three breeds were used. Fifty chickens were given a basal ration of yellow corn, bran, dried buttermilk, steamed bone meal and ground limestone containing 1, 2, 4 and 8 per cent. of salt. Twenty-five other chickens were used in determining the maximum single dose of salt that an adult chicken can tolerate.

It was found that chickens could be raised from nine to twenty-one weeks of age on rations containing as high as 8 per cent. of salt with no apparent detrimental effects. While it took some time for the chickens to become accustomed to such a salty ration, they soon learned to eat it in amounts sufficient to promote the rate of growth approximately the same as that of chickens fed on the basal ration. When the salt was mixed in the feed, a daily intake of 6 to 8 grams of salt per bird appeared to have no harmful effect on the birds that were nine weeks old or older. Salt put directly into the crop in two equal doses amounting to 12 to 16 grams per day was quickly fatal in the case of birds weighing 2 to 4 pounds each. Salt given in solution twice daily proved to be more toxic than equal amounts consumed in the feed. The minimum lethal single dose of salt for birds weighing from 3 to 5 pounds was found to be about 4 grams per kilogram of body weight.

Mineral and Vitamin Requirements of Pigs. *Bohstedt, G., and others, Ohio Agricultural Experiment Station, Bull* 395, 1926.—This lengthy bulletin gives a review of eight experiments conducted during the last four years on the mineral and vitamin requirements of pigs.

The basal ration for these experiments consisted of white corn, wheat middlings, linseed meal and salt, and had a very low ash content. The following are some of the conclusions drawn from these experiments :—

Vitamins and Minerals lacking in Basal Ration.—The basal ration used, or a ration composed of grains and seeds and their products, is too low in certain vitamins, as well as in both the quantity and quality of the ash, to permit normal growth and continued health. The basal ration appeared to contain both vitamins A and D in too limited amounts for the proper development of the animals. The addition of yeast, either when fed dry or when left to ferment the feed in a moist condition, made no appreciable difference in the effects of the ration. Vitamin B therefore does not play a significant role.

Protein and Fibre apparently not Factors in Rickets and Osteoporosis.—The first three experiments showed conclusively that the proteins and fibre in the basal ration are not prominent factors in the problem of so-called stiffness in pigs. The proteins of the ration were not quite adequate for optimal growth.

Ground Limestone superior to Calcium Carbonate due to deficiency of Iron in Basal Ration.—Calcium was definitely shown to be deficient in the basal ration. Even although calcium carbonate was added, this combination appeared to lack iron in amounts sufficient for the needs of growing pigs. When inorganic iron, for example, ferric oxide, was added much improvement in the growth and condition of the animals followed. There appeared to be a sufficiency of phosphorus in the basal ration. Ground limestone, known to contain at least small amounts of other minerals besides the large amount of calcium, was consistently the most effective single addition to the basal ration. This has reference to both gains in live-weight and to development of bones. Calcium carbonate added to the basal ration did not cause much improvement in growth or well-being over that on the basal ration alone.

Cod Liver Oil : A Growth Stimulant.—Fractures of bones were common in pigs fed on cod liver oil with the basal ration unless some calcium salt was also fed. When this was done most rapid and uniform growth resulted, undisturbed by bone fractures or respiratory trouble. This showed that both suitable minerals and vitamins are necessary for health and proper growth of bones as well as other body tissues.

Blood Meal Detrimental in Rations Used.—Commercial blood meal fed with the basal ration, while often accounting for large gains in weight early in the feeding period, nevertheless was responsible for much stiffness and paralysis. Such a ration produced the poorest bones in these experiments. Investigations into the nutritional properties of blood meal revealed the fact that this by-product was nearly devoïd of vitamins A and B, deficient in ash, and seemingly deficient in the quality of its protein. A digestion experiment with pigs showed that high degrees of temperature used in the process of manufacture had an unfavourable effect on the digestibility of the protein of blood meal.

Investigations of the effect on Swine of Fish Meal containing large amounts of Salt. *Rasenack, O., Arch. Wiss u. Prakt., Tierheilk.*, 52, 1925, *No.* 4. *E.S.R.* 55, *No.* 1, 1926.—In studies of the effect of large amounts of salt in fish meal on swine, sixteen pigs averaging 30 to 40 lbs. were used, the feeding period lasting from 11 to 70 days. The pigs were each given 100 grms. of fish meal containing 5·48 per cent. of salt per day. The amount of salt was increased for some of the animals up to 100 grms. per day for one pig by mixing additional salt with the fish meal.

The results of the experiment were somewhat irregular, but it appeared that from 5·84 to 10 grms. of salt per day were not injurious. Of four pigs receiving 15 grms. of salt daily, two showed no injury, while the other two showed slight injury on the seventh and twelfth days, but recovery followed and no other ill effects were observed. Other animals were given 17·5, 20 and 25 grms. of salt each per day in the fish meal without injury, but larger amounts tended to be toxic, and 75 and 100 grms. daily caused death.

The Food Capacity of Cattle. *Murray, J. A., Journal Agri. Sci., XVI, Pt.* 4, 1926.—The amount of food which an animal can consume per unit of time is not unlimited. For the purpose of this article the " food capacity " is taken to be the amount of total dry matter consumed when the animal is offered as much as it cares to eat. This has been estimated from the results of a variety of experiments collected for this purpose by the author.

The evidence quoted shows that the food capacity of steers is subject to a nearly uniform acceleration of 40 lb. per month from birth up to the age of 12 or 14 months, after which it remained approximately constant. It cannot therefore bear any simple relation to the live-weight of the animal. In the case of steers the average constant rate of consumption was about 18 lbs. of total dry matter per head throughout the period from one to four years of age. In the case of milk cows it is probably about twice as great, namely, from 30 to 40 lbs.

The author maintains that the food capacity of steers has been much exaggerated by various scientific writers. In Kellner's Tables it seems to be implied that the capacity varies as the live-weight, and that it may be as much as 64 lbs. per head per day, about three and a half timse as much as was found in the experiments under review.

Digestibility Trials with Poultry: (1) The Digestibility of English Wheats, with a Note on the Digestibility of Fibre in Sussex Ground Oats. *Halnan, E. T., Journ. Agri. Sci., XVI, Pt.* 3, 1926.—Fundamental work of great importance is being carried out at Cambridge on the nutrition of poultry, and in this article the results of digestibility trials with English wheats and oats are reported. A review of the literature on this subject reveals the fact that there is considerable variation in the digestibility coefficients for crude protein, fibre and ether extract. The author considered it desirable, therefore, to carry out digestibility determinations of known varieties of English wheats, in order to ascertain how far such variations could be attributed to different varieties of wheat having been used.

Experiments were carried out with Little Joss Wheat and Yeoman II Wheat, and these gave closely concordant results for all nutrients other than ether extract. The results obtained support the view that the digestibility of crude fibre by poultry is negligible. Except in the case of crude fibre and ether extract, poultry appear to be able to digest wheat as efficiently as other farm animals. Poultry are, however, distinctly inferior in their capacity to digest crude fibre and ether extract.

The results of the present experiment show general agreement with previous work except in the case of protein, where the digestibility coefficients are distinctly higher than those hitherto recorded. The explanation of this result may possibly be sought for in the improved methods used in the estimation of uric acid and ammonia.

Digestibility trials on Sussex ground oats showed that the digestibility coefficients of crude fibre fluctuated between 2·5 and 11·9 per cent., with an average of 7·6 per cent. In digestibility trials with whole oats other workers have found average digestibility coefficients of 11·7 and 8·1 per cent. The fluctuations in the present experiment are not abnormal, therefore, but illustrate the fact that poultry digest crude fibre with difficulty. The average digestibility coefficient of crude fibre in whole oats based on 16 trials is 9 per cent. The author concludes that it is quite evident, therefore, that the grinding of the fibre in the preparation of Sussex ground oats does not improve the digestibility of the fibre.

DAIRYING.

Rancidity in Sweetened Condensed Milk. *Rice, F. E., J. Dairy Science*, 9, 1926.—Rancidity in sweetened condensed milk is not caused by the common milk bacteria, by moulds, by bicarbonate of soda or by the metallic salts of iron, copper or zinc, but by the enzyme lipase, which occurs in raw milk. This enzyme is destroyed by heat in the regular factory process, but when any unheated milk gets into the batch through some error, the enzyme hydrolises part of the butter fat, liberating lower fatty acids such as butyric acid, thus producing the rancid flavour. Lipase from the pancreas produces typical rancidity when added to sweetened condensed milk. As little as 0·3 per cent. milk containing lipase may induce rancidity.

Vitamin B in Evaporated Milk. *Adams, Dutcher and Combs, J. Dairy Sc.*, 9 (4), 379.—The authors conclude from animal experimentation that vitamin B is not readily destroyed by heat, and only under unusual conditions would one expect the vitamin B deficiency of commercial evaporated milks to be due to methods of manufacture.

Semi-solid Butter Milk. *Creamery and Milk Plant Monthly, Aug.* 1926. —Large quantities of skim milk formerly wasted or inefficiently used are being converted into a marketable product by a number of companies using a process recently perfected by the U.S. Dept. of Agriculture. One company has sold more than a million pounds of this skim milk product during last year. Briefly, the process consists in fermenting skim milk with a mixed culture of a yeast and a high-acid producing organism of the *B. bulgaricus* type. An acidity of 2 per cent. lactic acid can thereby be induced which, when concentrated in the ratio of 3 : 1, gives the finished product an acidity of 6 per cent. An acidity of 2 per cent. removes the difficulties formerly experienced in concentrating skim milk in the vacuum pan, and the 6 per cent. acidity in the finished product prevents the finished product from spoiling. The product keeps well.

Concentrated sour skim milk—often called semi-solid buttermilk—is a pasty semi-fluid product. As a poultry food it is mixed with water or with dry mash. It has proved useful for baby chicks (dilution of 1 : 8), for laying hens (1 lb. to 1 lb. dry mash), and for pigs.

Irradiated Milk. *Zeit. ges. fobys. Ther., Vol.* 31, *No.* 6.—In extolling the virtues of milk irradiated with ultra-violet rays, Halac and Nassau, two German physicians, attribute part of the beneficial effect of the treatment to the supposed destruction of injurious germs. The authors further show that by feeding with milk that has been irradiated for only a short time (45 secs.) it is possible within two or three weeks to cure rickets and tetary in infants.

Iodised Salt and Milk Secretion. *Stiner, Schwaz. med. Wockschr.*, 670. —Cows which are given iodised salt (used in Switzerland as a preventive against endemic goitre) give milk which is more abundant and richer in fat than that of control animals.

Composition of Creamery Butter. *Echles, Keithley and Combs, Bull.* 223, *Univ. of Minnesota.*—The analysis of a large number of samples of American creamery butter showed that the fat content was higher and the salt content lower in exhibition than in market butter. The butters which scored highest had a higher fat content and contained smaller quantities of salt than the lower scoring butters.

Relative Value of Winter and Summer Milk. *Chem. Abstr.*, 20, 1430.—The vitamin A content of farm foods diminished during the winter months. Vitamin A is slowly oxidised when foods are stored. Hay and carrots become deficient as sources of the A factor as winter progresses. Hence milk and other dairy products also become deficient in vitamin A. This deficiency leads to a decreased rate of growth in children during winter.

Discoloration of Soft Cheese by Tin-foil Wrappers. *Neiesleben, Molk. Ztg., No.* 34, 1926.—Wrappers used for protecting soft cheeses consisting of thin parchment paper and tin-foil often become discoloured and in turn discolour the cheese surface. This discoloration is shown to be caused by impurities in the tin-foil, and especially to sulphides of iron and copper.

Starters and Starter-Making. *H. H. Sommer, Inter. Assn. of Milk Dealers.*—The general principles in starter-making that should guide the manufacturer of butter and cheese may be summarised as follows :—

1. Select a culture that contains not only a vigorous type of the common starter organism (*Str. lacticus*), but also associated organisms which are largely responsible for flavour production (*Str. citrovorus* and *Str. paracitrovorus*, both of which frequently occur in high grade commercial cultures).
2. Select the best quality of milk for inoculating the starter.

3. A high pasteurising temperature is always safe, but is especially necessary in milk of poor quality.

4. In order that the starter organisms may predominate, a large inoculum is always preferable, especially in milk of poor quality.

5. Temperature control is important in order to obtain the proper balance between the desired organisms, and to control the growth of undesirable organisms. A temperature of 68 to 70° F. seems to be most satisfactory.

The Vitamin B requirement of the Calf. *S. I. Bechdel, C. H. Eckles and L. S. Palmer, Jour. Dairy Sc., Vol.* 9, *No.* 5, 1926.—It was found that calves would grow normally to maturity and produce normal offspring when fed a ration that contained an insufficient amount of vitamin B to support growth in rats. If the calf does require vitamin B, then it is probably synthesised by micro-organisms in the digestive tract.

The milk produced by cows fed on a ration deficient in vitamin B is appreciably, though not markedly, reduced in its vitamin B content.

Factors for adjusting Milk and Butterfat Records of Register of Merit Jersey Cows to a uniform Age Basis. *M. H. Fohrman, Jour. Dairy Sc., Vol.* 9, *No.* 5, 1926.—On studying 14,571 Jersey milk records it was found that there was an increase in production up to six years of age. From this to 10½ years the records were fairly uniform and then declined.

Raising Calves on the Minimum Amount of Milk. *R. N. Davis and W. S. Cunningham, Ariz. Agr. Expt. Sta., Bul.* 111, 1925.—Forty-three calves, divided into three groups, were fed to 153 days of age. Lot I received whole milk until 10 days of age, and then the milk was replaced by a gruel composed of 2 parts maize meal, 4 parts wheat middlings, 2 parts oat flour, 1 part linseed meal, 0·5 part blood meal, 0·2 part ground bone meal, and 0·2 part salt. The milk was entirely replaced by the gruel when the calves were 40 days of age. Lot II was fed a commercial calf meal in place of a home-made mixture. Lot III received a full allowance of whole milk until 30 days of age, when half of it was replaced by the home-made mixture. From 60 days of age until the end of the trial this lot received one quart of milk daily. All lots had access to lucerne hay and a mixture of wheat bran, rolled barley and linseed oil meal.

Lot III, whole milk, gained 1·60 lbs. per head daily throughout the trial, though the feed cost was high. Lot I, home-made mixture, had an average daily gain of 1·32 lbs., while that for Lot II, commercial calf feed, was 1·27 lbs.

INSECTS AND PESTS.

Bees and Fruit-Tree Spraying. *N. E. M'Indoo and C. S. Demuth, U.S. Dept. Agr., Dept. Bull. No.* 1364, *May* 1926.—The spraying of fruit trees with poisonous solutions has become so common a practice that any ill-effects produced by it must have wide importance. On this account a series of definite experiments have been carried out in various parts of the United States to test whether hive-bees, which are the chief fertilisers of apple-blossom, suffered from the sprays used in protecting foliage and blossom from insects. Groups of trees in an orchard were sprayed with various arsenical mixtures and the results observed. In general it was found that bees worked equally well on trees sprayed in full bloom as on unsprayed ones. The results in so far as they showed the effect upon the bees of arsenic varied considerably in the different experiments. Thus when trees were sprayed before the blossoms opened or after the petals had fallen, bee mortality was negligible. Even when the full blossom received the arsenical spray the effects were very different, owing partly to unfavourable weather in some cases. An extreme was the Winthrop experiment, where unusual mortality was observed on the second day after the bees had access to sprayed flowers, and where the heavy mortality continued as long as the sprayed flowers lasted, and in some of the colonies until all the bees had died. As the normal time for spraying occurs when about 90 per cent. of the petals have fallen, observations were made on the bees frequenting normally sprayed trees. Here, it is gratifying to find, no injury happened to the bees, and arsenic occurred only in a very small percentage. No arsenic was found in samples of pollen taken from these hives, and of twelve samples of partially ripened honey analysed from several hives, even where the bees had died, only one contained arsenic and that merely a trace.

Damage caused by Oak-Eggar Moth.—In a short note in the *Scottish Naturalist* (1926, p. 162), Mr. R. J. Rowat records a curious example of damage caused by the hairy caterpillars of the oak-eggar moth. He noticed on a hillside in the neighbourhood of Amulree near Dunkeld, a large red patch of vegetation which had the appearance of having been burned. Investigation showed that about three acres of blaeberry bushes had been stripped of their leaves for some distance from the tips of the shoots, the exposed surfaces having as a consequence become brown. Many of the caterpillars were seen on the bushes and were observed at work on the leaves. Although these caterpillars are known to feed upon low bushes, such as blaeberry, damage to the extent seen at Amulree has not been noted hitherto.

Ox Warbles in America and their Control. *U. S. Dept. Agr., Dept. Bull. No.* 1369.—Cattle grubs or ox-warbles of the genus *Hypoderma* are abundant throughout the greater part of the United States and southern Canada, as they are in Britain, but across the Atlantic the presence of the American bison affords an additional host for one species, *H. lineatum.* The yearly loss to the hide, tanning and leather industries of the United States caused by ox-warbles is reckoned at about £1,000,000 stg.; but the loss caused by this damage in addition to the loss of quality in cattle due to physical irritation caused by the presence of the larvæ and mental irritation caused by the flies during the egg-laying period, brings the total yearly loss of the people of the United States to a figure approaching £10,000,000 stg. The Bulletin referred to discusses in detail the life histories of the different species of ox-warble, and proceeds to deal with the natural control of the insects and the means which have been devised for artificial control. Of the washes, powders and ointments which have been employed, amongst the most effective are :—derris used as a wash, as an ointment or as a powder; iodoform used as an ointment; pyrethrum applied as an ointment; benzol and carbon tetrachloride injected into the grub cysts; fine tobacco employed in powder form and nicotine dust applied dry.

Experiments devised to deter the ox-warble fly from depositing eggs on the legs of cattle, by wading the animals through insecticides and repellants in wading troughs, were not successful in preventing egg-deposition.

A practical method of control appears to be the systematic treatment of all infested cattle in the neighbourhood, either by extraction of the larvæ or by insecticides. All infested cattle must be treated at intervals which must not exceed 35 days, the first treatment being given before the earliest larvæ have matured and left the host, otherwise a new generation may have been set going.

War and Insecticides. *F. J. Brinley in Jour. Agr. Research, Washington, Vol.* 33, 1926.—During and since the conclusion of the war, the Chemical Warfare Service of the U.S. War Department has developed many new and interesting chemical compounds, with a view to their possible use in attack and defence. The author made extensive, but scarcely intensive, experiments to discover whether any of these materials might be used as insecticides, some promising to be of value as contact poisons, others as stomach poisons. In order to obtain comparable results he tested each chemical against tent-caterpillars, one-third to one-half grown; and a subsequent test, made upon bean plants, showed whether the chemical did harm to the host plant. Of the very many substances tried it was found that most of the poisons were disqualified because when they were of sufficient strength to kill the caterpillars they also harmed the plants. The final conclusion reached was that diphenylamins arsenious oxide as a stomach poison was equal in deadliness to lead arsenate, that it was not injurious to plants, and that it showed some promise as a contact insecticide.

MISCELLANEOUS.

Italy: Travelling Cinema for Agricultural Instruction.—In consequence of the good results obtained from the courses of agricultural instruction given with the help of cinematographic projections in numerous centres of Latium and in the province of Grosseto, on the initiative of the Opera Nazionale dei Combattenti, this institution will extend the same experiment to other regions of Italy beginning with Sardinia. The Opera Nazionale has had special motor lorries built, completely equipped for the projection of films in the open air, each fitted with its own dynamo, for special use in localities where the electric light is not yet installed.

STATISTICS.

PRICES of AGRICULTURAL PRODUCE, FEEDING STUFFS and FERTILISERS in September, October and November 1926.

Average Prices of Live Stock in Scotland.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	September.			October.			November.		
	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality
FAT STOCK:—									
Cattle—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.
Aberdeen-Angus ...	65 0	59 1	44 7	64 9	58 9	43 6	66 5	60 1	43 0
Cross-bred (Shorthorn)	60 7	53 11	39 6	59 9	52 11	37 11	60 5	52 8	36 10
Galloway	56 9	52 5	...	54 6	49 11	..	56 11	50 6	...
Ayrshire	59 5	50 7	36 8	59 6	52 3	35 4	59 9	51 9	36 0
Blue Grey	57 0	...	...	52 9	...	...	...	...	...
Highland	...	...	...	...	...	...	...	...	...
Veal Calves	per lb. d. 13¼	per lb. d. 9¼	per lb. d. 5½	per lb. d. 12	per lb. d. 8½	per lb. d. 5	per lb. d. 13	per lb. d. 8¾	per lb. d. 5½
Sheep—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot	13	12	9½	12½	11¼	9	12½	11¼	9¼
Half-bred	12¾	12	7¼	12½	12	6¾	12	11¾	7½
Blackface	12½	12	9	12	11¾	8¼	12	11½	8½
Greyface	13¼	12¼	8	13	11½	7¼	12¾	11½	7⅝
Down Cross	12¾	12	7	12½	11½	6	12½	11¼	6⅛
Pigs—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs	14 6	13 6	...	14 4	13 4	...	14 5	13 6	...
Porkers	14 11	14 0	...	14 11	14 0	...	15 0	14 1	...

Average Prices of Live Stock in Scotland—*continued.*

Description.	September.			October.			November.		
	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality
STORE STOCK:—									
CATTLE—	Per head.	Per head.	Per head	Per head.	Per head.	Per head.	Per head	Per head	Per head
Aberdeen-Angus:	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Yearlings	17 17	14 11	13 8	18 0	15 6	13 12	17 18	14 18	13 0
Two-year-olds ...	24 15	19 13	...	23 17	18 19	...	23 16	19 0	16 8
Cross-bred (Shorthorn):									
Yearlings	16 13	14 1	12 16	16 15	14 8	12 7	16 11	13 12	11 16
Two-year-olds ...	23 4	18 8	16 10	22 7	18 0	12 18	22 7	18 5	16 3
Galloway:									
Yearlings	17 8	11 0	...	17 5	...	...	16 18	13 0	...
Two-year olds ...	23 8	19 0	...	23 0	19 0	...	..	20 10	...
Ayrshire:									
Yearlings	11 3	...	...	13 0	12 0	...	...	...	...
Two-year-olds ...	...	...	...	19 15	16 0	...	...	...	..
Blue Grey:									
Yearlings	...	...	.	...	...	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	...	...	...
Highland:									
Yearlings	11 7	9 12	7 0	13 11	9 19	8 3	12 17	11 8	9 4
Two-year-olds ...	14 5	12 5	11 10	17 5	13 18	12 8	15 18	14 0	12 6
Three-year-olds .	17 5	14 5	12 0	21 1	17 13	16 0	21 10	17 6	15 12
Dairy Cows—									
Ayrshire:									
In Milk	31 10	24 13	12 0	31 17	23 12	12 8	31 14	23 6	12 0
Calvers	30 5	23 8	15 2	31 3	23 12	15 4	30 0	22 16	15 1
Shorthorn Cross:									
In Milk	34 11	27 11	23 18	35 17	28 5	22 0	35 8	27 0	...
Calvers	32 17	24 10	17 15	33 11	24 0	17 3	34 4	24 2	17 4
Sheep—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Cheviot Hoggs ...	72 11	61 4	52 0	...	...	...	...	...	...
Half-bred Hoggs ...	75 9	60 6	53 3	67 6	50 3	...	...	...	...
Blackface Hoggs ...	...	...	...	48 4	40 1	31 9	...	...	...
Greyface Hoggs ...	61 8	56 3	49 11	...	54 4	...	...	...	...
Down Cross Hoggs	...	...	...	...	...	...	...	...	...
Pigs—									
(6 to 10 weeks old)	57 2	40 10	...	55 2	41 5	...	49 2	35 0	...

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	September.			October.			November.		
		Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF :—		per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
Home-fed—										
Bullock or Heifer ...	1	9¼	9½	11	9¼	9⅛	11	9⅛	8½	11
	2	9	8⅞	10⅛	9	...	10	8¾	...	10
Bull	1	7¼	7⅝	6¾	7	7½	7	7	7⅜	7
	2	6¾	7	5¾	6½	7	6	6¼	6½	6
Cow	1	6⅜	5¾	6⅜	6⅛	6	6⅝	6	5½	6½
	2	5⅞	5	5⅜	5⅞	...	5⅝	5⅝	...	5½
Irish—										
Bullock or Heifer ...	1	...	...	8⅜	...	...	8⅝	8¼	...	8⅛
	2	...	...	7⅜	...	...	7⅝	8	...	7⅛
Bull	1	...	...	5¾	...	...	5⅞	...	...	6
	2	...	...	5	...	...	5½	...	...	5½
United States & Canadian—										
Killed at Birkenhead ...	1	...	...	7½	..	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	...
Killed at Glasgow ...	1	...	...	8⅜	...	...	8½	...	. .	8⅛
	2	...	...	7⅜	...	...	7½	...	...	7⅛
Argentine Frozen—										
Hind Quarters ...	1	6	6	...	6	6	...	5⅜	5⅜	...
	2	5¾	5¾	...	5¾	5½	...	5	...	...
Fore ,, ...	1	4⅛	4⅛	...	4¼	4⅜	...	4⅛	4⅜	...
	2	...	...	...	...	4	...	...	4¼	...
Argentine Chilled—										
Hind Quarters ...	1	6⅞	6⅝	6⅝	7½	7¼	7¼	6⅜	6	5¾
	2	...	6¼	6⅛	7¼	7	6¾	...	5¾	5¼
Fore ,, ...	1	4⅜	4⅛	4⅛	4¾	4¼	4½	4⅜	4⅛	4¼
	2	..	3⅞	3⅝	4⅜	4	4	...	4	3¾
New Zealand Frozen—										
Hind Quarters ...	1	...	...	5½	...	...	5⅜	...	...	5¼
	2	...	..	4½	...	...	4⅜	...	...	4¼
Fore ,, ...	1	...	...	3¼	...	...	3¾	...	...	3¾
	2	...	...	...	...	...	...	...	...	...
MUTTON :—										
Hoggs, Blackface ...	under 60 lb.	13	11¼	11⅛	12¼	10¾	10¼	11½	10⅛	9⅝
	60 lb. & over	12	10½	10⅝	11¼	...	9¾	11	...	9⅛
,, Cross	under 60 lb.	13	11¼	11⅛	12¼	10¾	10¼	11½	10⅛	9⅝
	60 lb. & over	12	10⅝	10⅛	11¼	...	9¾	11	...	9⅛
Ewes, Cheviot	1	9¼	8⅛	7⅜	8¼	6¾	6¾	7	6	6¾
	2	8¼	...	6⅜	7⅝	...	5⅞	6½	...	6⅛
,, Blackface ...	1	9¼	8⅛	7¼	8¼	6¾	6⅜	7	6	6½
	2	8¼	...	6¼	7⅝	..	5½	6½	...	5¾
,, Cross	1	7	7¼	6¼	6¼	6⅜	5⅝	5	5¾	6
	2	6	...	5½	6	...	5⅛	...	...	5½
Argentine Frozen ...	1	...	...	5½	...	...	5½	...	...	5⅛
	2	...	...	4½	...	...	4½	...	...	4⅛
Australian ,, ...	1	...	5½	...	...	6	...	...	5⅝	...
	2	...	5	...	...	5½	...	...	5⅛	...
LAMB :—										
Home-fed	1	13⅝	12⅝	11⅜	12½	11¾	11⅛	...	10⅜	10¼
	2	...	11¼	10⅜	...	...	10	...	...	9¼
New Zealand Frozen ...	1	...	9⅝	9¼	...	10½	9⅛	...	10⅞	9⅛
	2	...	8	8¼	...	10	8⅝	...	10⅛	8⅞

AVERAGE PRICES OF PROVISIONS AT GLASGOW.

(Compiled from Reports received from the Board's Market Reporter.)

Description.		Quality.	September.	October.	November.
			s. d.	s. d.	s. d.
BUTTER:					
Irish Creamery	per cwt.	1	161 0	154 3	153 3
,, (Unsalted)	,,	1	165 10	163 9	164 3
Australian	,,	1	168 6	..	154 8
Canadian...	,,	1	160 0	152 3	149 6
Danish	,,	1	183 5	184 6	179 9
,, (Unsalted) ...	,,	1	189 0	189 6	185 0
Friesland (Unsalted) ...	,,	1	177 2	181 9	178 6
New Zealand	,,	1	172 0	159 6	156 6
,, (Unsalted)	,,	1	175 10	162 6	159 0
Siberian	,,	1	...	142 0	138 3
Swedish	,,	1	171 2	169 3	169 9
CHEESE:					
Cheddar	,,	1	90 0	95 9	101 9
		2	80 0	82 0	82 0
Cheddar Loaf	,,	1	96 10	100 6	112 0
Dunlop	,,	1	86 5	88 6	92 0
		2	77 2	79 0	84 0
Canadian...	,,	1	90 2	90 3	91 6
New Zealand (Coloured)	,,	1	89 5	91 9	90 6
,, (White)	,,	1	92 7	91 6	91 6
BACON:					
Ayrshire (Rolled) ...	,,	1	171 7	172 0	169 0
Irish (Green)	,,	1	154 0	146 3	142 9
,, (Dried or Smoked)	,,	1	164 0	156 3	152 0
,, (Long Clear) ...	,,	1	164 7	158 6	155 0
Wiltshire (Green) ...	,,	1	157 7	152 6	146 6
,, (Dried or Smoked)	,,	1	168 10	162 6	156 0
American, Long Clear Middles (Green)	,,	1	129 0	127 0	124 6
,, Short Clear Backs...	,,	1	126 10	124 3	125 0
,, Sides	,,	1	120 0	...	...
Canadian, Sides	,,	1	121 0	107 6	106 9
Danish, Sides	,,	1	128 10	119 6	118 0

Description.		Quality.	September.	October.	November.
			s. d.	s. d.	s. d.
HAMS:					
Irish (Smoked)	per cwt.	1	232 0	202 0	202 0
		2	216 0	189 6	187 6
American, Long Cut (Green)	,,	1	150 0	151 0	150 0
American, Short Cut ...	,,	1	141 7	135 3	133 3
EGGS:					
Country	per doz.	1	2 3	2 7	3 4
		2	2 1	2 5	3 2
Irish	per 120.	1	18 3	23 5	29 3
		2	16 10	22 0	27 11
,, (Cold Stored) ...	,,	1	15 3	16 2	18 0
		2	14 4	15 2	15 10
,, (Duck)	,,	1	15 5	17 8	20 3
		2	14 4	16 2	19 0
Belgian	,,	1	15 6	18 9	21 0
		2	...	...	...
Canadian...	,,	1	...	19 0	19 5
		2	...	18 6	19 0
Chinese	,,	1	13 2	...	...
		2	12 2	...	...
Danish	,,	1	17 8	21 8	27 9
		2	16 7	20 8	25 9
Dutch	,,	1	15 10	18 7	20 3
		2	15 4	...	19 0
,, (Duck)	,,	1	14 3	14 9	15 11
		2	...	...	15 0
Polish	,,	1	12 4	12 11	14 7
		2	11 11	12 3	13 11
Russian	,,	1	13 2	15 10	17 5
		2	...	14 8	16 2
Swedish	,,	1	16 2	21 0	26 11
		2	...	...	25 3

Average Prices of First Quality Fruit and Vegetables at Glasgow.

(Compiled from Reports received from the Board's Market Reporter.)

Description.		September.	October.	November.
Fruit:—				
Apples—		s. d.	s. d.	s. d.
British:				
Bramley Seedling	... per cwt.	28 0	26 0	...
King	... ,,	...	26 3	24 0
Lord Derby ...	... ,,	28 0	25 4	26 0
Imported:				
Californian ...	... per case.*	15 9	13 0	...
Other American	... per barrel.§	18 0	20 3	24 0
Canadian . .	... ,,	16 0	21 4	*10 6
Blackberries ...	... per lb.	0 3	0 3	..
Grapes, Alicante...	... ,,	1 0	1 8	2 0
,, Gros Colmar	... ,,	...	3 9	3 3
,, Muscat ..	... ,,	..	6 3	7 6
Pears, Californian	... per case.**	10 0	9 10	...
Vegetables:—				
Beans, Scarlet Runner	... per lb.	0 3	0 3	0 2½
Beet	... per cwt.	7 4	7 0	5 4
Brussels Sprouts...	... ,,	28 0	23 0	16 0
Cabbage, Coleworts	... per doz.	1 1	1 1	2 3
,, Red ...	... ,,	4 0	3 3	2 4
,, Savoy ..	... ,,	2 0	2 0	1 11
Carrots	... per cwt.	7 0	6 2	5 8
Cauliflowers—				
Broccoli, *Cornish*	. per doz.	2 6	3 6	5 6
,, *Other British*	,,	2 11	2 9	...
,, *French*	... ,,	...	...	6 0
Celery	.. per bunch.	2 5	2 3	2 8
Cucumbers ..	... per doz.	5 3	5 3	...
Greens	... ,,	...	0 9	0 10½
Leeks ...	... per doz. bunches.	3 0	2 9	2 6
Lettuce, Cos. ...	...per doz.	1 2	1 4	3 0
,, Cabbage	... ,,	1 2	1 4	3 0
Onions, Dutch ...	.. per bag.‡	5 8	5 9	6 0
,, Valencia	... per case.†	10 0	9 9	11 0
Parsley	... per cwt.	16 10	16 0	14 0
Parsnips	.. ,,	10 0	8 3	8 0
Rhubarb	... ,,	6 0	6 0	...
Tomatoes, *British*	... per lb.	0 6	0 7½	0 7
,, *Channel Islands*	,,	0 3½	0 4	0 4½
,, *Canary* ...	... ,,	...	0 3½	0 5½
Turnips	... per cwt.	2 8	2 4	2 0
Vegetable Marrows	... per doz.	3 6	3 4	3 0

* 40 lb. (approx.). ** 20 lb. (approx.). † 9 stone (approx.).
‡ 7½ stone (approx.). § 1 cwt. (approx.).

Average Prices of Potatoes at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Market.	Quality.	First Earlies.	Second Earlies.	Late Varieties. Red Soils. Langworthy and Golden Wonder.	Late Varieties. Red Soils. Other.	Late Varieties. Other Soils. Langworthy and Golden Wonder.	Late Varieties. Other Soils. Other.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
September.							
Dundee per ton.	1	...	3 11 0	...	...	...	...
Edinburgh ,,	1	...	3 19 0	...	...	...	...
Glasgow ,,	1	...	3 15 0	..	...	...	4 1 0
October.							
Dundee ,,	1	..	4 0 0	...	...	...	5 0 0
Edinburgh ,,	1	...	5 0 0	...	...	...	...
Glasgow ,,	1	...	4 16 0	...	...	7 10 0	5 3 0
November.							
Dundee ,,	1	...	..	...	...	...	6 3 0
Edinburgh ,,	1	...	...	...	.	.	5 16 0
Glasgow ,,	1	.	...	10 0 0	...	8 5 0	6 3 0

Average Prices of Roots, Hay, Straw, and Moss Litter at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Market.	Quality.	Roots. Carrots.	Roots. Yellow Turnips.	Roots. Swedes.	Hay. Rye Grass and Clover.	Hay. Timothy.	Straw. Wheat.	Straw. Barley.	Straw. Oat.	Moss Litter.
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
September.										
† Dundee ... per ton.	1	...	20 0	...	105 0 (a) 89 0 (b)	...	86 0	...	79 0	51 0
‡ Edinburgh ,,	1	..	...	...	88 6 (a) 87 6 (b)	...	66 3	50 0	61 0	39 0
‖ Glasgow ,,	1	...	...	...	72 0	77 0	45 0	...	48 9	32 6
October.										
† Dundee ... ,,	1	...	19 6	25 0	105 0 (a) 90 0 (b)	...	82 6	...	68 9	51 0
‡ Edinburgh ,,	1	...	...	..	97 6 (a) 90 0 (b)	.	65 0	50 0	55 0	45 0¶
‖ Glasgow ,,	1	...	...	...	70 0	75 0	45 0	...	45 0	32 6
November.										
† Dundee ... ,,	1	...	15 0	20 0	105 0 (a) 99 0 (b)	...	60 0	..	60 0	51 0
‡ Edinburgh ,,	1	...	...	...	97 6 (a) 92 6 (b)	...	62 6	50 0	55 0	45 0¶
‖ Glasgow ,,	1	...	...	..	70 0	75 0	45 0	...	45 0	32 6

† Quotations for Straw, baled and delivered.
‡ ,, ,, delivered loose in town.
‖ ,, baled Hay and Straw f.o.r.

(a) Baled and delivered.
(b) Delivered loose.
¶ Dutch.

Average Prices of Feeding Stuffs at Glasgow and Leith.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	September. Glasgow.	September. Leith.	October. Glasgow.	October. Leith.	November. Glasgow.	November. Leith.
	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Linseed Cake—						
Home	11 10 0	11 8 0	11 11 3	11 8 9	12 5 0	11 15 0
Foreign	10 13 0	10 7 0	10 10 0	10 6 3	11 8 9	10 18 2
Decorticated Cotton Cake	10 6 0	...	10 5 0	...	10 1 3	...
Undecorticated Cotton Cake—						
Bombay (Home-manufactured)...	...	6 6 0	...	6 0 0	6 15 0	6 8 9
Egyptian (do.)	6 5 0	6 0 0	6 12 6	...	7 7 6	...
Palmnut Kernel Cake	8 6 8	..	8 0 10	...	8 15 10	...
Coconut Cake ...	9 15 0	...	...	...	9 12 6	...
Groundnut Cake, Undecorticated—						
37 per cent. Oil and Albuminoids	7 17 6	...	7 13 9	...	7 13 9	...
40 per cent. do.	8 0 6	7 12 0	7 18 9	7 7 6	7 18 9	7 3 9
Maize Germ Cake—						
Home	9 18 0	..	9 18 9	...	10 15 0	...
Foreign	9 10 0	...	9 13 4	...	10 8 9	...
Maize Germ Cake Meal	10 16 0	...	10 7 6	8 13 2	11 3 4	9 8 2
Bean Meal	12 19 6	12 0 0	13 6 3	12 1 3	13 15 0	12 12 6
Maize Meal—						
Home Manufactured	9 6 0	8 15 0	9 5 8	8 17 6	9 16 11	9 5 0
South African Yellow	8 16 0	8 11 0	9 1 3	...	9 15 0	...
Do. White ...	8 15 6	...	8 18 9	8 10 0	9 14 5	8 13 9
Rice Meal	6 8 0	...	6 7 6	...	6 10 0	...
Locust Bean Meal .	8 19 5	8 8 6	9 3 2	8 13 9	9 15 0	9 6 11
Locust Beans (Kibbled and Stoned)	...	7 10 0	...	7 15 0	...	8 11 11
Maize Gluten Feed (Paisley) ...	8 10 0	...	8 10 0	...	8 17 6	...
Maize ...	†8 3 2	8 0 0	†8 4 5	8 2 6	†8 18 9	8 10 0
	‡7 18 9	...	‡8 8 9	...	‡9 7 6	...
Oats, Canadian— (No. 2 Feeds)	8 19 5	...	9 0 0	...	...	...
,, Plate	8 1 0	...	8 2 6	...	9 1 11	...
,, Home (New)	8 17 0	8 8 0	8 6 3	8 1 3	9 3 9	8 5 0
,, ,, (Old)	10 10 0	...	10 11 3	..	10 13 9	...
Barley (Feeding) ...	9 13 9	9 0 0	9 8 9	8 2 6	10 5 0	8 10 0
Barley (Bran) ...	8 17 0	...	9 0 0	..	9 3 9	...
Malt Culms... ...	6 15 0	...	6 11 3	...	7 5 8	...
Distillery Mixed Grains - Dried	8 6 6	8 14 0	7 18 9	8 10 0	8 13 2	8 13 9
Brewers' Grains— Dried	...	6 16 6	7 7 6	6 15 0	8 6 3	7 4 5
Distillery Malt Grains —Dried ...	7 8 9	...	7 10 0	...	8 5 0	...
Wheat—						
Middlings (Fine Thirds or Parings)	9 14 0	8 3 0	10 0 0	8 7 6	10 7 6	8 15 0
Sharps (Common Thirds) ...	6 13 6	6 5 0	6 10 0	6 8 9	7 6 11	7 8 9
Bran (Medium) ...	6 1 0	6 0 0	6 8 2	6 5 0	7 15 0	7 10 0
,, (Broad) ...	6 5 0	6 17 6	6 13 2	7 1 3	7 18 9	8 5 0
Feeding Treacle ..	6 10 0	6 13 6	6 11 3	6 12 6	6 18 9	6 10 8
Crushed Linseed ...	24 8 0	...	23 5 0	...	22 17 6	...
Fish Meal	19 2 0	17 12 0	19 7 6	18 5 0	21 12 6	19 15 0
Beans—English ...	12 1 3	...	12 4 5	...	12 12 6	...
Sicilian	11 16 0	...	12 10 0	...	12 15 0	...
Rangoon, White	10 1 11	...	9 18 2	...	10 4 2	...

† Plate. ‡ American, No. 2 Mixed.

Average Prices of Fertilisers at Glasgow and Leith.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Guaranteed Analysis.	September. Glasgow.	September. Leith.	October. Glasgow.	October. Leith.	November. Glasgow.	November. Leith.
	%	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Nitrate of Soda ...	N. 15½	13 0 0	13 0 0	12 10 0	...	12 10 0	...
Nitrate of Lime ...	N. 13	11 15 0	...	...	...	...	...
Sulphate of Ammonia (Neutral and Granular) ...	N. 20·6	11 7 0	...	11 9 0	...	11 16 0	11 16 0
Superphosphate ...	S.P. 30	2 10 0	...	2 15 0	...	2 15 0	2 13 2
,,	S.P. 35	2 15 0	...	3 0 0	...	3 0 0	2 18 2
,,	S.P. 38	3 0 0	...	3 5 0	...	3 5 0	...
Bone Meal—Home	N. 5, I.P. 40	9 0 0	...	8 5 0	7 15 0	8 8 9	7 15 0
,, ,, —Indian	N. 3¾, I.P. 45	9 15 0	..	9 10 0	7 15 0	9 17 6	7 15 0
Steamed Bone Flour	N. 1, I.P. 60	6 10 0	...	6 10 0	6 0 0	6 10 0	6 0 0
Basic Slag	T.P. 24	*2 7 6	...	*2 7 6	...	*2 7 6	...
,, ,, ...	,, 26	*2 11 6	...	*2 11 6	...	*2 11 6	...
,, ,, ...	,, 28	*2 15 0	...	*2 15 0	...	*2 15 0	...
,, ,, ...	,, 30	*3 0 0	...	*3 0 0	...	*3 0 0	..
,, ,, ...	,, 36	..	...	...	2 19 0	...	2 19 0
,, ,, ...	,, 38	...	...	...	3 2 0	...	3 2 0
,, ,, ...	,, 40	...	...	...	3 5 0	...	3 5 0
Sulphate of Potash (on basis of 90 per cent. sulphate of potash)	Potash 48·6	10 2 6	...	10 2 6	10 0 0	10 2 6	10 0 0
Muriate of Potash ... (on basis of 80 per cent. sulphate of potash)	,, 50	8 5 6	...	8 2 6	8 0 6	8 4 11	8 0 6
Potash Salts ...	,, 20	3 2 6	...	3 2 6	3 1 0	3 2 6	3 1 0
,, ,, ...	,, 30	4 8 0	..	4 8 0	4 8 0	4 8 0	4 8 0
Kainit—In bags ...	,, 14	2 15 6	...	2 15 6	2 14 0	2 15 6	2 14 0
Ground Mineral Phosphate—Finely Ground ...	I.P. 60	2 10 0	...	2 10 0	...	2 17 6	...
Tunisian	I.P. 56	...	...	...	2 5 0	...	2 5 0
,, ...	I.P. 75	..	...	...	3 15 0	...	3 15 0

Abbreviations:—N. = nitrogen; S.P. = soluble phosphate; I.P. = insoluble phosphate; T.P. = total phosphate.

* Carriage paid (4-ton lots) to Ayrshire and Renfrewshire; quotations for delivery in Lanarkshire 2s. per ton higher.

Statement showing the Acreage under each Variety of Potatoes in Scotland in 1926.

Variety.	Acres.
A. First Earlies.	
1. America *	11
2. Arran Rose *	30
3. Dargill Early *	80
4. Di Vernon *	30
5. Immune Ashleaf * ...	96
6. Snowdrop (including Witch Hill) *	110
7. Beauty of Hebron (including Puritan) ...	148
8. Duke of York (including Midlothian Early and Victory)	1,358
9. Eclipse (including Sir John Llewelyn) ...	2,006
10. Epicure	9,294
11. May Queen	213
12. Myatt's Ashleaf Kidney	17
13. Ninetyfold	189
14. Sharpe's Express ...	1,482
15. Sharpe's Victor	57
16. Other First Earlies not specified above ...	79
Total First Earlies ...	15,200
B. Second Earlies.	
17. Ally *	815
18. Arran Comrade * ...	578
19. Catriona *	51
20. Edzell Blue *	298
21. Great Scot *	11,026
22. Katie Glover *	76
23. King George V. * ...	604
24. British Queen (including Pioneer, Macpherson, Maid of Auchterarder, Scottish Standard, English Beauty, etc.) ...	5,786
25. Royal Kidney (including Queen Mary)	402
26. Other Second Earlies not specified above ...	149
Total Second Earlies	19,785
C. Maincrops.	
27. Sutton's Abundance (including Admiral, Balmuir, Bloomfield, Culdees Castle, Kerr's New White, Laing's Prolific, Lomond, Twentieth Century, Osborne Seedling, Just in Time, etc.) *	1,362
28. Arran Victory *	557
29. Bishop *	73
30. Champion *	1,209
31. Crusader *	393
32. Early Market *	108
33. Golden Wonder (including Peacemaker) * ...	9,586
34 Irish Queen *	547
35. Kerr's Pink *	30,471
36. Langworthy (including Maincrop and What's Wanted) *	641
37. Lochar *	89
38. Majestic *	5,684
39. Rhoderick Dhu * ...	568
40. Templar *	34
41. Tinwald Perfection * ...	851
42. White City (including Carnegie) *	49
43. Arran Chief	11,122
44. Evergood	197
45. Field-Marshal	2,385
46. General	66
47. King Edward VII. (including Red King) ...	20,146
48. Northern Star (including Ajax, Allies and Aeroplanes)	134
49. President (including Iron Duke and Scottish Farmer)	205
50. Up-to-Date (including Dalhousie, Factor, Glamis, Beauty, Scottish Triumph, Stephen, Table Talk, Laing's Imperial, etc.)	2,023
51. Other Maincrops not specified above ...	608
Total Maincrops ...	89,108
Total Area Classified, ...	124,093
Acreage Not Included, ...	17,771
Total Acreage Grown, ...	141,864

Notes.—(1) The following districts are excluded:—In the county of Inverness, Skye, Harris, North and South Uist; in the county of Ross and Cromarty, Western, South-Western, Lewis.
(2) Returns showing a total area of less than one acre under potatoes are not tabulated.
(3) Varieties marked thus * are immune from Wart Disease.

ABSTRACT OF AGRICULTURAL RETURNS FOR SCOTLAND, 1926.

Collected 4th June 1926 (and comparison with 1925).

CROPS.

Distribution.	1926.	1925.	Increase.		Decrease.	
	Acres	*Acres.*	*Acres.*	*Per Cent.*	*Acres.*	*Per Cent.*
Total Area (excluding Water)	19,069,683	19,069,683	..	..	..	..
Total Acreage under all Crops and Grass (*a*)	4,693,170	4,705,197	..	..	12,027	0·3
Arable Land	3,194,585	3,229,359	..	..	34,824	1·1
Permanent Grass (*a*) — For Hay	166,257	156,244	10,013	6·4	..	..
Permanent Grass (*a*) — Not for Hay ..	1,332,378	1,319,594	12,784	1·0	..	..
Permanent Grass (*a*) — Total ..	1,498,635	1,475,838	22,797	1·5	..	..
Wheat	53,777	48,617	5,160	10·6	..	..
Barley (including Bere)	122,297	152,921	..	..	30,624	20·0
Oats	940,073	925,995	14,078	1·5	..	..
Mixed Grain	1,072	1,971	..	..	899	45·6
Rye..	4,911	5,360	..	..	449	8·4
Beans (to be harvested as Corn)	3,290	3,409	..	..	119	3·5
Peas	430	457	..	..	27	5·9
Potatoes	141,871	142,155	..	..	284	0·2
Turnips and Swedes	390,778	395,940	..	..	5,162	1·3
Mangolds	1,108	1,117	..	..	9	0·8
Cabbage	3,960	4,160	..	..	200	4·8
Rape	12,499	12,607	..	..	108	0·9
Vetches or Tares, for Seed	185	196	..	..	11	5·6
Vetches, Tares, Beans, Peas, Mashlum, etc., for Fodder	12,317	10,653	1,664	15·6	..	..
Sugar Beet	3,649	1,403	2,156	144·4	..	..
Carrots	314	275	39	14·2	..	..
Onions	141	139	2	1·4	..	..
Flax	465	753	..	..	288	38·2
Small Fruit	7,811	7,189	622	8·7	..	..
Rye-grass and other Rotation Grasses and Clover — For Hay	413,680	403,097	10,583	2·6	..	..
Rye-grass and other Rotation Grasses and Clover — Not for Hay ..	1,071,299	1,099,420	..	..	28,121	2·6
Rye-grass and other Rotation Grasses and Clover — Total	1,484,979	1,502,517	..	..	17,538	1·2
Other Crops	2,483	2,372	111	4·7	..	..
Bare Fallow	6,125	9,063	..	..	2,938	32·4
Orchards (*b*)	1,264	1,163	101	8·7	..	..

LIVE STOCK.

	1926.	1925.	Increase.		Decrease.	
	No.	*No.*	*No.*	*Per Cent.*	*No.*	*Per Cent.*
Horses used for Agricultural purposes (including Mares for Breeding)	132,050	136,652	..	..	4,602	3·4
Unbroken Horses (including Stallions) — One year and above ..	18,987	21,885	..	..	2,898	13·2
Unbroken Horses (including Stallions) — Under one year ..	6,590	5,814	776	13·3	..	..
Total	157,627	164,351	..	..	6,724	4·1
Other Horses	21,068	21,082	..	..	14	0·1
Total of Horses	178,695	185,438	..	..	6,738	3·6
Cows in Milk	357,315	348,326	8,989	2·6	..	..
Cows in Calf, but not in Milk	42,868	49,798	..	..	6,930	13·9
Heifers in Calf	57,263	52,227	5,036	9·6	..	..
Bulls being used for Service	17,203	17,369	..	..	166	1·0
Other Cattle :—Two years and above ..	217,214	236,072	..	..	18,858	8·0
,, ,, One year and under two ..	265,635	276,900	..	..	11,265	4·1
,, ,, Under one year	240,330	224,099	16,231	7·2	..	..
Total of Cattle	1,197,828	1,204,791	..	..	6,963	0·6
Ewes kept for Breeding	3,115,271	3,055,887	59,384	1·9	..	..
Rams to be used for Service in 1926	86,292	86,355	..	..	63	0·1
Other Sheep :—One year and above	947,645	1,045,707	..	..	98,062	9·4
,, ,, Under one year	3,053,926	2,930,871	123,055	4·2	..	..
Total of Sheep	7,203,134	7,118,820	84,314	1·2	..	..
Sows kept for Breeding	18,275	16,161	2,114	13·1	..	..
Boars being used for Service	2,012	1,875	137	7·3	..	..
Other Pigs	125,132	136,184	..	..	11,052	8·1
Total of Pigs	145,419	154,220	..	..	8,801	5·7

(*a*) Excluding Mountain and Heath Land used for grazing (9,710,181 acres in 1926, as compared with 9,643,996 acres in 1925).

(*b*) Any Crop or Grass grown in Orchards is also returned under its proper heading.

ACREAGE under WHEAT, BARLEY (including BERE) and OATS in each COUNTY on 4th June 1926, with COMPARISON for 1925.

COUNTIES.	Wheat.		Barley (including Bere).		Oats.	
	1926.	1925.	1926.	1925.	1926.	1925.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
ABERDEEN ...	60	18	14,494	19,753	185,425	183,620
ARGYLL	...	...	1,049	1,211	15,562	15,397
AYR	854	858	144	233	39,480	39,367
BANFF	...	...	6,338	7,770	47,424	46,602
BERWICK	1,464	1,194	13,029	15,637	28,169	28,149
BUTE	...	1	9	10	4,712	4,739
CAITHNESS ...	...	...	544	612	28,993	29,694
CLACKMANNAN ...	316	205	93	202	2,882	2,931
DUMBARTON ...	388	465	4	17	6,689	6,695
DUMFRIES ...	32	44	64	306	36,841	37,434
EAST LOTHIAN ...	4,846	4,228	13,269	15,259	16,293	15,795
FIFE	12,223	10,933	11,016	14,719	44,861	41,804
FORFAR	10,086	9,824	13,890	17,588	57,862	54,322
INVERNESS ...	33	...	4,121	4,540	29,327	29,737
KINCARDINE ...	1,046	899	6,979	9,542	31,516	29,351
KINROSS	240	152	65	166	6,707	6,664
KIRKCUDBRIGHT...	37	8	10	51	21,643	22,119
LANARK	1,896	1,830	75	77	37,195	36,497
MIDLOTHIAN ...	5,372	5,060	3,752	4,814	21,105	20,501
MORAY	430	380	7,905	9,645	25,356	24,159
NAIRN	...	67	2,008	2,309	6,502	6,209
ORKNEY	...	...	3,454	3,678	32,519	32,751
PEEBLES	...	...	47	93	5,899	5,870
PERTH	7,377	6,461	2,793	3,860	67,779	67,382
RENFREW ...	1,562	1,490	2	7	9,755	9,503
ROSS & CROMARTY	692	599	6,506	7,522	31,759	31,015
ROXBURGH ...	443	352	7,634	9,225	24,286	24,228
SELKIRK	...	...	156	229	3,781	3,758
SHETLAND ...	...	...	603	623	6,174	6,244
STIRLING	1,827	1,502	568	920	17,985	17,798
SUTHERLAND ...	...	...	248	291	7,294	7,431
WEST LOTHIAN ...	2,494	2,035	1,291	1,841	10,636	10,438
WIGTOWN	59	12	137	171	27,662	27,791
TOTAL ...	53,777	48,617	122,297	152,921	940,073	925,995

ACREAGE under BEANS, POTATOES, and TURNIPS and SWEDES in each COUNTY on 4th June 1926, with COMPARISON for 1925.

COUNTIES.	Beans.*		Potatoes.		Turnips and Swedes.	
	1926.	1925.	1926.	1925.	1926.	1925.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
ABERDEEN ...	11	11	7,403	7,553	79,870	81,405
ARGYLL	4	16	2,904	2,871	4,946	4,762
AYR	204	196	8,636	8,605	7,204	7,006
BANFF	28	31	1,725	1,744	19,395	19,829
BERWICK	220	156	2,430	2,573	20,061	20,593
BUTE	19	10	1,061	1,088	1,236	1,235
CAITHNESS ...	...	...	1,180	1,225	10,900	11,051
CLACKMANNAN ...	228	242	353	401	752	727
DUMBARTON ...	3	11	2,196	2,276	1,411	1,354
DUMFRIES ...	...	4	3,200	3,296	14,861	14,789
EAST LOTHIAN ...	79	75	7,931	8,076	12,535	12,405
FIFE	220	248	16,831	16,981	20,633	21,349
FORFAR	14	17	18,554	17,828	29,372	30,341
INVERNESS ...	...	...	5,236	5,255	8,940	8,998
KINCARDINE ...	15	10	4,356	4,529	15,010	15,088
KINROSS	...	...	1,196	1,233	2,229	2,210
KIRKCUDBRIGHT	3	7	1,297	1,359	9,288	9,335
LANARK	...	4	5,290	5,172	9,490	9,203
MIDLOTHIAN ...	13	2	6,313	6,438	9,523	9,579
MORAY	24	23	1,524	1,585	13,336	13,358
NAIRN	...	...	284	261	3,761	3,777
ORKNEY	...	...	2,263	2,204	13,152	13,329
PEEBLES	...	...	306	301	2,797	2,889
PERTH	706	763	17,424	17,474	23,594	24,046
RENFREW	27	61	3,068	2,967	2,029	1,977
ROSS & CROMARTY	10	...	7,318	7,150	13,521	13,732
ROXBURGH ...	37	20	1,142	1,188	16,346	16,818
SELKIRK	...	...	147	147	2,079	2,152
SHETLAND ...	...	...	2,033	2,042	1,006	991
STIRLING	1,355	1,384	3,108	3,181	3,751	3,572
SUTHERLAND ...	...	...	1,088	1,108	2,588	2,649
WEST LOTHIAN ...	24	28	2,522	2,506	3,064	3,187
WIGTOWN	46	90	1,552	1,538	12,098	12,204
TOTAL	3,290	3,409	141,871	142,155	390,778	395,940

* To be harvested as corn.

ACREAGE under RYE-GRASS and other ROTATION GRASSES and CLOVER, and under PERMANENT GRASS in each COUNTY on 4th June 1926, with COMPARISON for 1925.

COUNTIES.	Rye-grass and other Rotation Grasses and Clover.				Permanent Grass.			
	For Hay.		Not for Hay.		For Hay.		Not for Hay.	
	1926.	1925.	1926.	1925.	1926.	1925.	1926.	1925.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
ABERDEEN ...	52,669	50,751	238,796	238,720	246	553	42,525	39,708
ARGYLL	12,589	12,170	14,608	15,952	15,109	15,346	55,953	56,026
AYR	28,489	28,210	45,045	50,960	23,320	22,369	154,378	150,687
BANFF	10,551	9,980	59,587	60,824	223	194	11,050	9,501
BERWICK ...	11,897	10,682	49,831	50,869	2,537	1,894	57,235	55,643
BUTE	2,370	2,442	5,833	5,265	439	330	9,543	9,935
CAITHNESS ...	9,971	10,097	28,585	26,745	955	805	23,563	25,859
CLACKMANNAN	1,399	1,275	1,784	1,216	1,193	1,036	5,922	6,635
DUMBARTON ...	5,304	5,316	4,970	6,368	2,654	2,570	21,740	20,586
DUMFRIES ...	20,506	19,614	48,459	48,942	20,154	18,424	98,492	99,977
EAST LOTHIAN	9,558	8,276	16,862	16,466	1,228	1,114	23,342	24,482
FIFE	26,296	26,132	27,784	30,159	4,180	3,261	72,266	72,174
FORFAR	23,041	22,055	60,743	63,261	1,244	1,212	27,237	25,739
INVERNESS ...	11,451	11,293	21,441	22,044	9,438	8,989	58,191	57,337
KINCARDINE ...	13,128	13,200	34,172	35,255	516	172	10,600	9,108
KINROSS ...	3,024	2,971	6,369	7,447	791	408	12,398	11,959
KIRCUDBRIGHT	10,902	10,401	51,266	47,421	13,441	12,762	73,203	77,447
LANARK ...	31,057	31,906	33,637	35,376	14,882	13,613	103,921	104,740
MIDLOTHIAN ...	10,963	11,857	16,318	15,374	1,808	1,602	40,861	40,624
MORAY	6,093	5,832	34,329	34,446	212	277	7,564	7,400
NAIRN	1,623	1,691	9,416	9,368	9	39	1,583	1,427
ORKNEY ...	11,432	10,173	29,252	30,166	580	698	14,520	13,878
PEEBLES ..	2,329	2,309	9,882	11,329	1,233	1,277	27,498	26,049
PERTH	32,912	32,596	58,902	62,171	12,544	11,167	92,408	91,995
RENFREW ...	8,438	9,120	5,256	6,591	6,889	6,684	45,086	43,840
ROSS AND CROMARTY ...	12,864	12,504	33,431	35,696	3,334	2,692	27,392	25,642
ROXBURGH ...	10,706	9,068	47,910	49,960	6,659	6,656	58,373	57,912
SELKIRK ...	1,331	1,108	7,144	6,832	1,811	2,417	12,687	12,785
SHETLAND ...	1,395	1,343	480	666	2,015	1,871	11,018	11,264
STIRLING ...	10,807	10,688	8,631	10,149	8,281	7,719	53,364	52,964
SUTHERLAND ...	4,498	4,509	5,677	5,799	1,550	1,540	8,000	7,484
WEST LOTHIAN	6,814	6,573	4,768	5,228	1,131	1,160	21,935	22,137
WIGTOWN ...	7,273	6,955	50,131	52,355	5,651	5,393	48,530	46,650
TOTAL ...	413,680	403,097	1,071,299	1,099,420	166,257	156,244	1,332,378	1,319,594

Number of Horses, Cattle, Sheep and Pigs in each County on 4th June 1926, with Comparison for 1925.

Counties.	Horses.*		Cattle.		Sheep.		Pigs.	
	1926.	1925.	1926.	1925.	1926.	1925.	1926.	1925.
	No.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
Aberdeen ...	24,248	24,889	177,8 3	174,109	264,434	254,795	17,161	15,821
Argyll ...	4,800	5,029	55,014	52,977	722,761	716,098	3,808	4,159
Ayr	7,664	8,135	106,481	106,762	368,959	364,838	10,170	11,237
Banff	7,059	7,254	44,764	43,637	82,359	74,016	4,846	4,114
Berwick ...	4,177	4,316	23,277	23,941	370,961	360,261	3,453	4,060
Bute	1,063	1,112	8,522	8,796	39,527	39,212	567	670
Caithness ...	4,546	4,707	20,141	19,809	161,516	152,122	1,696	1,415
Clackmannan	574	586	3,708	3,398	12,990	12,832	888	995
Dumbarton ...	1,426	1,582	13,281	13,256	72,428	66,942	862	1,088
Dumfries ...	5,946	6,302	68,209	68,528	575,877	570,973	9,319	9,497
East Lothian	3,164	3,279	11,917	15,256	141,888	151,481	3,508	3,931
Fife	8,158	8,551	42,261	45,398	123,087	125,300	6,380	7,573
Forfar... ...	8,246	8,498	47,329	48,917	188,231	189,247	5,961	6,334
Inverness ...	7,333	7,593	46,992	46,030	500,905	507,887	1,966	1,895
Kincardine ...	4,193	4,228	26,592	26,559	61,945	61,201	2,862	2,895
Kinross ...	995	1,056	6,188	6,378	33,443	32,394	713	766
Kirkcudbright	4,229	4,470	57,852	58,110	393,004	383,599	11,858	13,103
Lanark ...	6,685	7,173	69,906	70,798	235,224	238,534	6,260	6,800
Midlothian ...	3,265	3,438	16,405	17,864	184,183	178,989	12,619	14,021
Moray	4,077	4,229	24,142	24,305	49,857	51,941	3,343	2,951
Nairn	1,151	1,195	6,604	6,642	14,728	15,561	687	600
Orkney ...	5,584	5,699	31,649	30,441	40,789	34,892	2,126	1,725
Peebles ...	854	961	7,010	7,355	212,260	205,810	524	500
Perth	10,751	11,240	68,843	67,714	625,171	627,799	7,511	8,208
Renfrew ...	2,277	2,446	24,645	25,622	41,249	38,714	2,744	2,719
Ross and Cromarty ...	6,001	6,238	40,498	40,435	294,463	291,246	3,001	3,105
Roxburgh ...	3,523	3,553	22,814	24,289	567,655	564,355	2,887	3,576
Selkirk ...	536	566	3,857	3,962	193,969	191,497	380	525
Shetland ...	2,425	2,615	11,550	11,450	152,508	146,544	196	260
Stirling ...	3,758	4,001	31,709	33,198	123,648	120,685	2,052	2,524
Sutherland ...	1,938	2,060	9,774	9,766	202,501	203,992	482	560
West Lothian	1,961	2,126	10,891	11,754	21,211	20,735	1,252	1,714
Wigtown ...	5,020	5,224	57,190	57,335	129,403	124,328	13,337	14,879
Total ...	157,627	164,351	1,197,828	1,204,791	7,203,134	7,118,820	145,419	154,220

* Horses used for agricultural purposes, mares for breeding, and unbroken horses (including Stallions). "Other Horses" on agricultural holdings are not included; the total for these in Scotland is given in the summary table on p. 126.

ACREAGE of CROPS and NUMBER of LIVE STOCK in each COUNTY DISTRICT of SCOTLAND on 4th June 1926.

County	District of County	Wheat.	Barley (including Bere).	Oats.	* Beans.	Potatoes.	Turnips and Swedes.	Rye-grass and other Rotation Grasses & Clover. For Hay.	Rye-grass and other Rotation Grasses & Clover. Not for Hay.	Permanent Grass. For Hay.	Permanent Grass. Not for Hay.	† Horses	Cattle.	Sheep.	Pigs.
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	No.	No.	No.	No.
ABERDEEN	Aberdeen	58	4,310	18,093	..	1,728	9,525	7,672	25,629	2	3,676	2,799	20,341	13,638	3,886
	Alford	..	427	16,492	..	320	7,642	4,958	22,285	38	5,954	2,198	17,322	44,176	860
	Deer	..	1,647	41,982	7	2,078	16,246	12,854	47,665	118	9,426	5,366	33,977	38,364	3,626
	Deeside	2	1,384	15,003	..	488	6,872	5,632	18,477	31	5,738	2,090	15,669	49,468	1,039
	Ellon	..	2,079	26,820	..	931	11,945	8,050	36,174	26	5,299	3,090	25,445	40,010	2,342
	Garioch	..	2,321	23,729	..	672	10,477	5,804	32,155	6	4,095	3,279	23,443	18,290	1,697
	Huntly	..	501	15,495	4	355	6,257	2,692	22,258	21	5,442	2,050	12,937	37,962	1,196
	Turriff	..	1,825	27,811	..	831	10,906	5,007	34,153	4	2,895	3,376	23,679	22,526	2,515
ARGYLL	Ardnamurchan	..	..	403	..	217	41	532	136	1,136	2,006	143	2,868	62,748	27
	Cowal	..	..	1,238	..	238	427	1,132	905	1,515	6,215	328	4,136	140,729	169
	Islay	..	..	3,780	..	538	1,140	3,204	2,901	1,694	17,036	979	9,948	65,350	640
	Kintyre	..	432	4,597	4	399	2,093	1,978	8,369	1,094	12,390	1,234	13,456	119,065	1,958
	Lorn	..	..	2,002	..	597	539	2,482	781	4,323	5,800	735	9,359	169,987	364
	Mid-Argyll	..	..	1,582	..	351	454	1,735	914	2,995	7,632	528	7,399	100,346	403
	Mull	..	617	1,960	..	564	252	1,526	602	2,352	4,874	853	7,848	64,536	247
AYR	Ayr	126	22	10,535	85	1,787	1,793	8,179	13,479	6,719	40,209	1,923	28,445	108,208	3,046
	Carrick	22	106	9,349	35	3,675	2,811	5,455	12,411	4,173	34,232	1,870	22,519	187,615	2,951
	Kilmarnock	399	2	9,921	26	1,044	1,251	7,998	10,507	6,439	42,362	2,018	30,139	31,276	3,067
	Northern	307	14	9,675	58	2,130	1,349	6,857	8,648	5,989	37,575	1,353	25,378	41,860	1,106
BANFF	Banff	..	5,634	26,768	28	1,227	11,704	5,970	34,213	63	2,488	4,141	27,534	24,071	3,458
	Keith	..	704	20,656	..	498	7,691	4,581	25,374	160	8,562	2,918	17,230	58,288	1,388
BERWICK	Eastern	482	4,904	8,870	134	1,193	6,599	3,867	14,822	542	17,470	1,409	7,474	96,434	1,329
	Middle	790	6,824	9,472	77	839	7,679	5,302	13,503	880	21,708	1,636	8,953	128,658	1,401
	Western	192	1,301	9,827	9	398	5,783	2,728	21,506	1,115	18,057	1,132	6,850	145,369	723
BUTE	Arran	..	5	2,306	19	622	431	1,095	2,275	323	4,844	545	4,027	29,394	292
	Bute and Cumbrae	..	4	2,406	..	439	805	1,275	3,558	116	4,699	518	4,495	10,133	275
CAITHNESS (not divided)		..	544	28,993	..	1,180	10,900	9,971	28,585	955	23,563	4,546	20,141	161,516	1,696
CLACKMANNAN (not divided)		316	93	2,882	228	353	752	1,399	1,784	1,193	5,922	574	3,708	12,990	888
DUMBARTON	Eastern	322	..	3,453	..	1,031	647	2,973	2,096	1,255	9,519	732	6,057	13,117	598
	Western	66	4	3,236	3	1,115	764	2,331	2,874	1,399	12,221	694	7,224	59,311	264
DUMFRIES	Annan	..	11	12,164	..	1,011	4,843	6,107	13,218	3,151	16,532	1,740	16,035	53,779	2,041
	Dumfries	32	46	8,944	..	1,009	3,366	4,332	12,189	2,456	14,511	1,284	13,684	54,366	2,570
	Langholm	..	1	2,133	..	164	966	1,478	2,647	8,306	7,918	414	5,063	124,176	411
	Lockerbie	..	6	8,096	..	597	3,508	4,731	12,716	6,000	26,439	1,446	17,739	150,854	1,467
	Thornhill	..	..	5,504	..	419	2,178	3,858	7,689	5,241	33,092	1,062	15,688	192,702	2,830

* To be harvested as corn.

† See Note on p. 130.

Acreage of Crops and Number of Live Stock in each County District of Scotland on 4th June 1926.

County and District of County.		Wheat.	Barley (including Bere).	Oats.	* Beans.	Potatoes.	Turnips and Swedes.	Rye-grass and other Rotation Grasses & Clover. For Hay.	Rye-grass and other Rotation Grasses & Clover. Not for Hay.	Permanent Grass. For Hay.	Permanent Grass. Not for Hay.	† Horses	Cattle.	Sheep.	Pigs.
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	No.	No.	No.	No.
East Lothian	Eastern	1,440	5,434	5,213	19	3,315	4,661	3,212	7,192	547	8,359	1,176	3,989	70,282	971
	Western	3,406	7,835	11,080	60	4,616	7,874	6,346	9,670	681	14,983	1,988	7,928	71,606	2,537
Fife	Cupar	3,859	3,559	14,686	25	5,947	7,205	7,297	13,051	504	16,117	2,358	11,533	46,819	1,614
	Dunfermline	1,161	432	7,901	98	1,791	2,502	4,705	2,685	1,498	22,279	1,366	8,629	25,458	1,494
	Kirkcaldy	2,498	2,032	10,345	8	3,568	4,064	6,382	5,199	907	15,118	1,997	10,020	21,436	1,849
	St. Andrews	4,705	4,993	11,929	89	5,525	6,862	7,912	6,849	1,271	18,752	2,437	12,079	29,344	1,423
Forfar	Arbroath	2,794	4,082	10,365	..	4,333	6,099	4,719	10,292	314	3,539	1,702	9,163	9,820	1,019
	Brechin	2,200	4,758	18,574	14	4,328	9,221	7,217	19,640	226	7,430	2,421	13,947	70,819	1,574
	Dundee	2,605	1,921	10,780	..	4,700	5,657	4,549	10,237	341	3,880	1,678	9,447	17,804	1,751
	Forfar	2,487	3,129	18,143	..	5,193	8,395	6,556	20,524	363	12,388	2,445	14,772	89,788	1,617
Inverness	Inverness	..	1,523	7,495	..	419	4,153	2,967	10,049	349	4,929	1,374	7,039	40,946	865
	Aird	32	67	5,685	..	475	2,502	2,856	5,847	359	4,915	967	5,550	45,923	739
	Badenoch	..	38	3,797	..	176	1,616	2,143	4,151	1,210	9,708	674	4,744	97,454	232
	Lochaber	1	..	972	..	443	207	1,253	370	2,459	2,839	337	4,806	135,705	116
	Skye	..	3	5,123	..	1,377	345	1,962	863	3,445	5,329	990	10,424	123,779	7
	Harris, N. & S. Uist ..	..	2,490	6,255	..	2,346	117	270	161	1,616	30,471	2,941	14,129	57,098	7
Kincardine	Laurencekirk	298	1,177	9,726	..	1,444	4,094	3,416	9,488	275	2,415	1,040	6,192	22,733	716
	Lower Deeside	..	837	3,699	..	733	1,730	1,989	3,610	1	624	575	3,476	1,092	737
	St. Cyrus	650	1,525	6,147	11	1,089	2,963	2,491	6,089	19	2,190	765	3,889	12,860	380
	Stonehaven	98	2,234	8,195	4	829	4,137	3,551	8,952	213	4,159	1,133	8,541	16,385	676
	Upper Deeside	..	1,206	3,749	..	261	2,086	1,681	6,033	8	1,212	680	4,494	8,875	353
Kinross (not divided)		240	65	6,707	..	1,196	2,229	3,024	6,369	791	12,398	995	6,188	33,443	713
Kirkcudbright	Eastern	..	5	9,065	..	880	3,686	4,690	16,308	3,896	24,652	1,594	12,910	71,244	4,176
	Northern	..	4	1,758	..	111	721	795	4,607	2,937	9,164	429	5,676	143,467	730
	Southern	37	..	8,880	..	233	4,050	4,409	28,240	4,923	27,799	1,829	26,633	92,819	6,587
	Western	..	1	1,940	3	73	831	1,006	2,111	1,685	11,538	377	5,633	85,474	415
Lanark	Lower Ward	802	4	3,748	..	1,295	586	2,797	1,348	2,851	6,777	759	4,762	1,286	3,228
	Middle Ward	1,047	67	16,557	..	2,142	3,311	16,221	11,267	7,040	51,606	3,212	35,238	31,354	1,831
	Upper Ward	47	4	16,890	..	1,853	5,593	12,039	21,022	4,991	45,588	2,714	29,911	202,584	1,201
Mid-Lothian	Calder	1,454	519	6,175	..	1,699	1,778	3,574	2,094	555	13,377	887	5,123	38,333	2,835
	Gala-Water	289	1,054	5,709	12	359	3,610	1,539	10,760	379	14,259	689	3,352	98,769	397
	Lasswade	1,377	1,457	5,422	1	1,723	2,695	3,285	3,138	768	8,858	926	4,064	37,768	1,629
	Suburban	2,302	722	3,799	..	2,532	1,440	2,565	276	111	4,367	763	3,866	9,318	8,258
Moray (not divided)		430	7,905	25,356	24	1,524	13,336	6,093	34,329	212	7,564	4,077	24,142	49,857	3,343
Nairn (not divided)		..	2,008	6,502	..	284	3,761	1,623	9,416	9	1,583	1,151	6,604	14,728	687

* To be harvested as corn.

† See Note on p. 130.

ACREAGE of CROPS and NUMBER of LIVE STOCK in each COUNTY DISTRICT of SCOTLAND on 4th June 1926.

County	District of County	Wheat.	Barley (including Bere).	Oats.	* Beans.	Potatoes.	Turnips and Swedes.	Rye-grass and other Rotation Grasses & Clover. For Hay.	Rye-grass and other Rotation Grasses & Clover. Not for Hay.	Permanent Grass. For Hay.	Permanent Grass. Not for Hay.	† Horses	Cattle.	Sheep.	Pigs.
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	No.	No.	No.	No.
ORKNEY	Mainland	..	1,014	17,962	..	1,199	6,706	6,396	15,919	367	7,820	3,075	16,669	17,623	1,080
	North Isles	..	2,159	9,823	..	737	4,675	3,487	9,588	155	5,541	1,803	10,862	17,455	843
	S. Ronaldshay & Walls	..	281	4,734	..	327	1,771	1,549	3,745	58	1,159	706	4,118	5,711	203
PEEBLES (not divided)		..	47	5,899	..	306	2,797	2,329	9,882	1,233	27,498	854	7,010	212,260	524
PERTH	Blairgowrie	2,151	1,196	15,698	..	5,227	6,312	6,719	15,243	581	13,619	2,267	13,404	58,660	2,057
	Central	674	106	14,721	1	3,454	4,637	7,068	14,205	1,625	17,492	2,242	13,439	129,568	1,324
	Highland	..	52	6,374	..	780	2,520	4,741	6,012	2,413	14,860	1,236	9,340	188,796	1,064
	Perth	4,156	1,266	21,349	274	6,307	8,057	9,569	16,209	2,157	28,102	3,121	19,600	70,542	2,231
	Western	396	174	9,637	431	1,656	2,068	4,815	7,233	5,768	18,335	1,885	13,060	177,605	835
RENFREW	First or Upper	917	..	4,363	2	1,153	923	3,965	1,702	4,186	22,669	1,070	12,028	13,626	1,261
	Second or Lower	645	2	5,392	25	1,915	1,106	4,473	3,554	2,703	22,417	1,207	12,617	22,623	1,483
ROSS & CROMARTY	Black Isle	66	2,216	6,991	..	783	3,879	3,158	8,993	110	2,347	1,204	6,526	17,235	797
	Easter Ross	581	1,232	9,899	..	1,620	5,126	4,184	12,898	454	6,531	1,702	9,271	79,197	1,212
	Mid Ross	45	934	8,913	10	687	4,152	4,004	11,040	797	6,343	1,537	8,765	76,258	944
	S.-W. and Western	..	14	1,763	..	610	189	1,379	354	1,567	2,519	355	4,045	70,867	35
	Lewis	..	2,110	4,193	..	3,618	175	189	146	406	9,652	1,203	11,891	50,906	13
ROXBURGH	Hawick & Liddesdale	..	37	3,261	..	155	1,789	1,536	5,269	3,518	12,445	539	5,292	188,547	391
	Jedburgh	39	1,324	7,334	1	248	4,526	3,175	16,741	1,460	17,140	1,075	6,784	159,030	609
	Kelso	309	5,374	8,102	34	555	6,686	4,020	15,832	817	14,683	1,223	6,735	145,654	1,223
	Melrose	95	899	5,589	2	184	3,345	1,975	10,068	864	14,105	686	4,003	74,424	664
SELKIRK (not divided)		..	156	3,781	..	147	2,079	1,331	7,144	1,811	12,687	536	3,857	193,969	380
SHETLAND	Mainland	..	592	5,009	..	1,640	884	1,032	388	1,419	8,056	1,590	8,824	116,670	144
	North Isles	..	11	1,165	..	393	122	363	92	596	2,962	835	2,726	35,838	52
STIRLING	Central	782	196	7,193	748	1,198	1,558	3,628	3,164	4,664	18,939	1,655	12,444	42,591	790
	Eastern	954	364	6,190	588	890	1,155	3,832	2,248	1,788	16,247	1,131	8,664	6,589	607
	Western	91	8	4,602	19	1,020	1,038	3,347	3,219	1,829	18,178	972	10,601	74,468	655
SUTHERLAND (not divided)		..	248	7,294	..	1,088	2,588	4,498	5,677	1,550	8,000	1,938	9,774	202,501	482
WEST LOTHIAN	Bathgate	263	187	5,412	..	643	1,190	3,373	2,695	751	13,014	962	6,314	8,237	270
	Linlithgow	2,231	1,104	5,224	24	1,879	1,874	3,441	2,073	380	8,921	999	4,577	12,974	982
WIGTOWN	Machars	56	104	10,208	33	312	4,275	4,713	19,535	4,472	30,914	2,255	27,112	72,839	3,173
	Rhins	3	33	17,454	13	1,240	7,823	2,560	30,596	1,179	17,616	2,765	30,078	56,564	10,164

* To be harvested as corn.

† See Note on p. 130.

BOARD OF AGRICULTURE FOR SCOTLAND,
EDINBURGH, 28th *December* 1926.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE
By J. Skinner & Co., Ltd., Thistle Street, Edinburgh.

(6288.) Wt. 10701/848. 1500+48, pp. 113-133. 1.27. J.S.&Co.,Ltd. G. 19.

The Scottish Journal of Agriculture.

VOL. X.—No. 2.] APRIL 1927. PRICE 1s. NET.

AGRICULTURAL EDUCATION, 1890-1926.

Sir A. D. HALL, K.C.B., LL.D., D.Sc., F.R.S.

THOUGH foundations like the Fordyce Lectureship at Aberdeen, the Professorship at Edinburgh, the Sibthorpian Professorship at Oxford and the Royal Agricultural College at Cirencester possess a greater antiquity, the organisation of agricultural education in Britain began only about 1890, when local authorities for the first time became possessed of funds that could be applied to technical education.

The history of the development that followed has not infrequently been written; instead of again setting out the machinery it may perhaps be permitted to one who has been associated with the movement from its start to review the aims and methods which have led to its present position. A three-fold division in the work is generally recognised. At the head come the colleges, associated with the universities in Scotland and Wales and in the majority of cases in England. The function of the colleges is to give a long course education in the principles and practice of agriculture, extending as a rule over three years and leading up to a degree or diploma. The students taking these courses are of two classes. Either they have some prospect of capital and intend to farm, or, if without immediate capital, wish to qualify as managers of farming businesses. On the other hand a large proportion are seeking posts of a teaching or administrative character under the Departments of Agriculture, the local authorities, the Indian and Colonial governments, or industrial enterprises overseas. There are of course others, but in the main college students fall into these two categories of farmers and public officers.

It was hardly realised at first that the educational requirements of the two groups of students are distinct. A common course of instruction was laid down for all, and this course happened to be more calculated to produce the officer than the practical farmer. It was doubtless inevitable that science should dominate the field of view when the agricultural colleges first drew up their curricula. The cultivation of the soil is only explicable on the basis of physics, the making of manure and the use of fertilisers rests upon a knowledge of chemistry, botany is needed to explain the principles of seed selection, the methods of the breeder and feeder are made intelligible by the physiologist and the geneticist, while disease both in animals and plants can only be dealt with on scientific lines. Progress in the technique of farming could only be made by scientific investigation, therefore the farmer must be trained to understand such work. These considerations weighed with the men who guided the movement for agricultural education, most of whom were themselves engaged in scientific work. Landowners and farmers were the motive power behind the demand, but they perforce left the formulation of the methods to the professed educationists.

It is little wonder therefore that science should be dominant in the courses of instruction and in the schemes for examination that were then laid down; indeed in the earliest regulations for the diploma examination at Cambridge, agriculture itself did not find a place. As long as agriculture was regarded as applied science time had to be found for chemistry, botany and zoology, and to a less degree for physics and geology and veterinary medicine, while other specialists like the meteorologists and the bacteriologists put in claims that some knowledge of their subjects was also indispensable to the farmer. There were other fields into which the manifold activities of the farmer must stray; bookkeeping, building construction, surveying and engineering were regarded as part of his necessary equipment, nor could the opinion be resisted that he should have some knowledge of law. With the further division of the sciences into pure and agricultural, the earlier examinations began to resemble an obstacle race in the number and variety of the fences to be taken, even if none of them were very high.

Gradually it began to be realised that this scheme of instruction was more calculated to turn out a Jack-of-all-trades than a master, a sciolist rather than a farmer. It suited the diligent youth who wanted to qualify as a teacher or an official because it enabled him to talk with some intelligence upon any and every question that might be raised in connection with farming, but it bore hard on the man with a practical bent who was intent upon the land. It may freely be granted that the farmer may put to use not only the fullest instruction in agricultural chemistry or botany, but even a more limited acquaintance with the other sciences. The right kind of mind will find opportunities to get value out of any information, but as many things that are lawful may not be expedient, so a scheme of education has to consider what time is available for instruction and what is most essential to cover in that time. The teacher must often content himself with indicating the existence of knowledge that is useful, leaving the student to read for himself. Even when instruction can be given with profit it may not be desirable to enforce the acquisition of an examination standard. True education trusts more to stimulus than to tests. Consequently this conception that the course of construction must embrace all the scientific and technical subjects that bear on agriculture has been generally dropped; only the N.D.A. Examination is still faithful to the old ideal.

Time being thus limited so that selection must be exercised in the list of subjects in which instruction can be given, we must define the aim of our education in order to obtain some principle upon which to make the selection. We have already divided agricultural students into two categories, those who are expecting to become farmers and those who want posts as teachers or officials. We can make a further division in this latter category; some students are going to be scientific teachers or expert advisers—agricultural chemists, mycologists, entomologists and the like; others are going to teach agriculture or advise upon it, e.g. the future county organisers. It is universally agreed that men of the former class should begin their training with a degree course in science. The agricultural chemist needs a more thorough foundation of pure chemistry than he can obtain in any agricultural course; he must acquire his applied science and his contacts with agriculture after graduation. It follows that the agricultural college need not consider the scientific teacher in designing its course leading to degree or diploma. He should come from the university after graduation to the agricultural college to work in its laboratory at his special subject, and will take such classes in its general course as may suit his needs. Thus the course that the agricultural college has to provide should be primarily agricultural, to meet the needs of students who are going to practice farming, or to teach or to advise about farming.

Now what can be done in the way of teaching farming? Hitherto we have generally regarded farming as consisting in growing crops and in raising stock, and the teaching consisted as a rule in describing crops and stock and the methods followed by typical good farmers.

Stephens' "Book of the Farm" has long provided the sort of material given in lectures on agriculture, and East Lothian farming has been the model put before agricultural students, sometimes even without reference to local systems. The practices were described as typical good farming, there were certain "rules of good husbandry" which must not be departed from. Now, without in any way belying the excellence of these methods nor even their widespread applicability to all sorts and conditions of farming, it is becoming more and more recognised that all agriculture is governed by economic considerations. No style of farming is good in itself, absolutely; it is only good in relation to the prevailing conditions of soil, climate and markets, and the test of goodness is that it is likely to yield a profit under the circumstances. It is here that we approach the real point of teaching agriculture as distinguished from learning by apprenticeship; it must be critical, not merely imitative. In the old days a young farmer grew up amid the practices of his father or went as a pupil to a recognised good farmer. Thus he assimilated the tradition, and as long as the conditions under which he had to carry on that tradition were not markedly different, and he was a reasonably hard-working and observant human being, experience made a capable farmer of him. But the tradition is no longer all sufficient; not only have scientific discoveries made the farmer in part dependent upon knowledge that cannot be acquired on a farm, but the economic conditions of the industry have changed and are changing so rapidly that the tradition has to be reviewed. For example the East Lothian farming took its shape when wages were about half their present level, but when barley and oats sold for not less than they do to-day. Norfolk farming, after readjusting itself from the great depression down to 1895, proceeded on a basis of a sack of wheat being about equal to a week's wages; clearly the old routine will not answer nowadays when the relation between labour costs and returns has changed so greatly.

With the alteration in the position of the farmer, in that it is no longer enough for him to follow the old methods, the character of his training must alter. A farmer is essentially a manager of a business, and he can only manage efficiently if he is able to check his costs of production against the prices he is likely to receive. A skilled manager has a clear perception of the costs that should be involved in each stage of his production, and as the main item in these costs is labour, an item too which is under control, the manager must know with some exactitude how much labour the process will pay for. We cannot follow upon a farm the stages of production as we can in a cotton mill; soil and climate induce variations and the mixed output of the farm make a complete sorting out of the expenditure impossible, but though standardisation of farming is impossible we can yet arrive at some general figures that will guide the manager. For example a milk producer might have before him some such figures as the following for the costs of production of a gallon of milk :—

	d.
Labour	1·5
Home-grown food	3·5
Purchased food	3·2
Replacement	2·1
Carriage	1·1
Sundries	0·5
	11·9

He should know how to obtain comparable figures for his own dairy; it is not to be expected that he will get the same figures as we have quoted, but where there are serious divergencies it is up to him to ask himself why and to trace the causes. Figures of this kind become particularly valuable when they have been worked out for two or three consecutive years; then the manager begins to have some idea of what is due to the lay-out of the farm, what may have been caused by special but controllable features,—e.g. the milking capacity of the herd, average gallonage per cow per year, and what is immediately susceptible to better management,—e.g. wasteful feeding or purchase of expensive feeding stuffs.

But to return to education, how are we to set about making a manager of this type? It is pretty clear that no college course can give a student all the knowledge of the kind that he will require, but instruction can open his eyes to its value, to the power it will give him, and can show him how to acquire the knowledge for himself. To take an example, the teacher of agriculture when he came to the potato crop used as a rule to describe with approximate dates the successive operations of one of the well-known Dunbar growers. A description of the leading varieties would be followed by a resumé of some of the experiments with fertilisers, showing for example the value of potash in increasing the yield, and the relative merits of kainit or sulphate of potash. Reference to other experiments on the effect of sprouting and the value of "Scotch" seed would lead on to a discussion of spraying and Bordeaux mixture. The fault I have to find with such teaching of agriculture is that I could give it myself, and I am a scientific man and not a practical farmer. If I am called upon to control or even to be answerable for a farm growing potatoes, I find that sort of knowledge of little immediate service in the primary problem of getting the potatoes grown cheaply and efficiently. My scientific knowledge of spraying and seed and manuring may be useful and lucrative to the farmer, but only if he knows this primary business of growing. Consequently I look to the teacher of agriculture to give his students just the sort of knowledge that I as a scientific man am ignorant of. What I conceive to be the method the teacher of agriculture might follow would begin with a description of the routine of a big Lothian or Lincoln grower, the sort of man who is disappointed with less than 10 tons to the acre, but it must be a full description that details men and horses employed, hours worked and acreage covered at each operation. All the outgoing costs should be set out. In comparison there should then be described the routine of another grower who adopts certain alternative methods, omits one or includes another, or who does a third in a different way. Here the opportunity for criticism and discussion comes in, why because of soil or season one operation can be omitted or another has to be added? We are all familiar with accounts of the costs of growing a particular crop, in which every operation that is ever carried out for that crop is included at a price which itself includes a profit. Let us have therefore real figures. Lastly I should want another set of figures—those of the potato grower who cannot aim at big results, but who has to be content with 6 tons to the acre and to cut his costs accordingly.

Somewhere earlier in the course of instruction I should want a discussion of the prime basis of the figures given—the cost of a day's horse labour, &c. Somewhere later in the course I should want a discussion of the other big factor—the organisation of the strength of men and horses so that it will be available at the right times. And lastly, in the final stages of the course, there must be some considerations of the conditions of soil, market and transport, that will make it worth while to grow a potato crop at all. As I see it these elements of managership are teachable in a college; they are the framework of method into which a young farmer can henceforward begin to fit his own experience and thereby continue to improve his practice. The essence of such teaching is that it is critical; it tries not so much to say "This is the right way," as "There are different ways of doing the same thing, let us consider which answers best." It is unnecessary to go further; from the illustration given it will be seen that agriculture itself, apart from agricultural science, will involve a severe course of instruction, based throughout upon figures of ascertained costs. The method may be simple and dogmatic in the first year, perhaps only a description of operations and a handling of accounts of a single farm, but towards the end of a course the student should be considering the economics of systems of farming, the relation of turnover to capital, the cost of credit, and other questions that will press upon him in his working life.

I do not underrate the importance of a training in science, but the kind of agricultural instruction I have been outlining with its double aspect—technical and economic—must have first place in the curriculum, and I would make it thorough, even if some of the scientific courses have to be treated more lightly. The object after all is not to make of the farmer a practising man of science, but to teach him to understand scientific writings and put him in touch with the accessible sources of information. The scientific teacher—e.g. of agricultural chemistry—should review his course from the point of view of what is essential to the manager of land and what is material only to the agricultural chemist; he must select and must often be content to indicate that there is a good deal unsaid which may be found in such a book or paper.

It may be expected that the agricultural colleges will more and more design their courses of instruction to provide a thorough training in agriculture, laying stress upon its economic aspects as well as upon the applications of science. The agricultural colleges can, however, provide for but a fraction of the number of farmers who should receive some technical instruction. The majority of farmers' sons and young people intending to farm cannot afford the time nor are able to make use of a three year college course, or even of the alternative course of two years' duration which some colleges give. To meet the wider demand in England and Wales the system of Farm Institutes is in vogue, these being in effect minor colleges, generally residential, giving a winter course of instruction of about six months' duration. The Farm Institute is not a continuation school for youths of 15 or 16; its students should be young men of 18-25 who have had a few years of farming. Many Institutes have farms attached to them, rather for their value as demonstration centres for the benefit of the farmers of the county than for the part the farm can play in the teaching of a short winter course. With six months only available for study the student cannot afford to spend much time on so-called practical work,—i.e. on manual operations; these should have been learnt before he comes to the Institute. In some districts it is necessary to introduce the pupils, even coming from the farms, to better methods, but as a rule the Institute farm has to provide demonstrations of management—e.g. of the feeding and care of a herd producing grade A milk or the rationing of pigs and poultry, and the central feature of the course must be the class-room instruction in such things as cannot be learnt upon the home farm. In so restricted a course the greatest care has to be taken in selecting the subjects. There ought to be room for a course in general science which should introduce the student to the ideas of chemical change, and after some study of air and water, burning and breathing, lead on to simple considerations of the growth of a plant and the processes by which an animal lives. It may be contended that this elementary science course should constitute a larger fraction of the institute course than science does in the long course, because it is the key which will open so many ways to further study. Without just this foundation knowledge it is not possible to read the technical books or even articles in the agricultural press with understanding. In a short course there is not time to impart knowledge, only to suggest where and how it can be found; the student must be stimulated to look for things himself afterwards. The keeping of a simple cash account of a farm must be learned, to which may be added approximate workings out of such costs as those of producing a gallon of milk or a pig of marketable age. It will often be found desirable to set aside a regular hour for farm calculations, translations of percentages into lbs. per acre, seed required for a given field, the construction of balanced rations and so forth. For the rest the course in agriculture will occupy most of the time; it cannot be so critical as a college course, nor so much illustrated by actual accounts, but even if it is mainly descriptive, every opportunity should be taken of insisting on the economic criterion for each operation. It has, however, to be kept in mind that the Farm Institute course must aim at being complete in itself—it is not a preparation for the college course.

As alternatives to Farm Institute courses some colleges, as in Scotland, give short courses of a month or six weeks' duration, equally intended for men who have left school for some years and have worked on the farm. It is of course impossible to do more than skim over any subject during a six weeks' course; to make it effective it should have been prepared for by day or evening classes near the student's home, and each course besides its general work should deal with some special subject,—e.g. management of grass land or milk production. In this way the student who attends three or four of these courses may cover a good deal of ground, and if he is also encouraged to read between times may accomplish a very systematic education. Something is gained by bringing the young farmer to the college; it is often an impressive institution with libraries and museums, the student comes in contact with men who are authorities in their subject, the atmosphere if less intimate than that of the Farm Institute can be more stimulating. After all stimulus is the living thing in education, to excite a man to find out something for himself. That sticks and goes to the making of a man.

It is unnecessary here to discuss extension work in country side, by lecture, courses, day or evening classes, discussion societies, reading and correspondence circles—the many devices to assist the young farmer who cannot or who is not at first willing to leave the farm. But I cannot leave the subject without some reference to what is at present the most neglected side of rural education, and that is the study of the manual operations of the farm. It is not only a matter of the prevalence of inferior workmanship in many districts, especially in some parts of England, and of the dying out of the old skilled craftsman, it is the much more serious question of making labour efficient under modern conditions and able to earn modern rates of wages. Some of the old fine arts of the farm are too expensive to-day, just as a prize ploughman may be wasting time in his desire to get his work just so. The problem is at bottom one for the farmer. He has to justify his position as master by leading his team, and he will not get good work unless he shows that he knows good work and that he is thinking of the conditions that will allow of good work. Most of our farming routine was worked out when labour cost less than half of what is paid to-day; the operations have to be revised so as to economise that labour. Sometimes the economy has to be effected by the use of machinery and similar labour-saving devices, and that use has to be taught. Many farmers have given up tractors because of the repair bill and the depreciation account; how many have taken the trouble to get their driver educated to the use and care of his machine? Even purely manual operations like rick building or turnip hoeing are susceptible to speeding up, if some thought is given to the instruction of the younger workers in the right stroke and to the organisation of the team to work together. It is too much the custom to leave these things to the foreman or grieve or even to the men themselves, and many a youngster grows up on a farm without a word of instruction to show him how to do a job quickly and economically. Local authorities do hold classes in some of the more special operations like hedge laying, thatching or draining, but much more might be done and ought to be done if labour is to be brought into the position of earning modern wage rates. One hears of better things in Scotland, but over much of the Midlands and South of England the work on the farms is indifferent and wasteful, and little effort is being made to improve it. This improvement must originate with the farmer; he has to do the thinking, to stimulate the interest of the men, to see that better work meets with due reward. That better work can be done may be seen from the way cow keepers have responded to milk recording and clean milk competitions, which have introduced a new atmosphere of efficiency and keenness in the management of many herds, just because results are seen and personal responsibility becomes apparent. If the farmer has to take the initiative on his own farm and with his own men, so also farmers' organisations can do much by joining forces with the local education authorities, arranging classes and competitions, and arousing the interest that leads to farmers giving their younger men facilities for getting instruction. This question of more efficient work upon the farm calls for the more serious consideration at the present time. The modern farmer, as a manager, has a triple duty. He has to decide the policy of the farm, what shall be grown, where and how it is to be sold; he has to organise the application of labour—men, horses and machines—upon the farm, and the efficiency of the labour will largely depend upon the skill with which it is organised; and lastly, he has to ensure by instruction, by encouragement and goodwill, that each unit of labour, as an individual, is efficient and is pulling his weight. The teachers of agriculture have their part to play in studying labour-saving organisation; there are opportunities for much valuable investigation of the time that is spent and that can be saved in carrying out even the most ordinary routine of the farm. No one to-day can lay down a scheme of instruction or the method of improvement, but if all who are connected with agriculture will take up the question in earnest, will enquire, try experiments, and endeavour to secure the interest of their men, the collective effect upon the prosperity of agriculture will be great.

Without doubt agricultural education has made an enormous advance in Britain during the thirty-five years on which I can bear witness. It is not merely that farmers who have received instruction are now scattered all over the country and are making good, are indeed leaders in their own districts, but the general body of farmers are now convinced of the value of education and are prepared to make some effort to gain it for their successors, even if they feel that the opportunity is gone for themselves. This spirit will be encouraged if the men who are responsible for education, whether as local authorities, administrators or teachers, will recognise that the methods in vogue are far from being final, and that the experience we have acquired should keep leading us to readjustments of our machinery to meet the needs of the working farmer.

THE ORGANISATION OF GERMAN AGRICULTURE.

Dr. AXEL SCHINDLER,
General Secretary of the German Council of Agriculture.

[TRANSLATED.]

OWING to the density of the population and the small extent of land available for agricultural purposes in Germany, it is necessary that agriculturists should make great efforts to obtain the maximum return from the land, and this necessity has been considerably increased since the war by the loss of the agricultural provinces of Posen and West Prussia. The agricultural organisation of Germany has been influenced by these circumstances. The more complicated and difficult the process of production becomes, the greater are the demands on the several agricultural organisations, and the greater the need for the formation of organisations devoted to special agricultural interests.

There is a distinct division in the work of the agricultural organisations of Germany; some of these take an interest in general agriculture and others confine their attention to one branch only.

In the first place, there are quite a number of these organisations important to agriculture in general; these, however, differ fundamentally both in the purpose for which they are intended and in the scope of their work. These organisations have three particular aims which may be mentioned here :—

(1) the technical promotion of agriculture;
(2) the economic promotion;
(3) the political representation of agricultural interests.

From these three standpoints a short statement of the work of the organisation of German agriculture, so far as it deals with agricultural questions *in general,* will be given in the following notes.

Technical Organisation.—The promotion of agriculture in its technical aspects is the special business of the Agricultural Chambers. As these, however, take quite a distinctive place in the framework of German agricultural organisation, they are reserved for consideration later.

There are several independent associations which are interested in this side of organisation. In the first place the German Agricultural Society is perhaps the greatest independent agricultural association in Europe which occupies itself chiefly with the question of the technical requirements of agriculture. Founded in the year 1885 by the well-known engineer, Max Eyth, its business is to further agriculture in all its branches. In its statutes it is expressly provided that political and economic discussions, claims and negotiations of any kind are outside its scope. The Society's business affairs have always been carried on with punctilious regard to the principle laid down by the founder. Never, even in times of the most violent controversies in agriculture and in other economic groups, has the German Agricultural Society taken any part in disputes. The success of this strict withdrawal from the heated contests of politics is very apparent. In spite of all losses and set-backs which the Society experienced as a result of the war and the economic ruin of Germany, it has become in its work more than ever the leader of German agriculture. To-day more than 30,000 farmers have joined it and the membership increases steadily. It is specially significant to note the composition of its membership; in spite of the differences which often arise between large farmers and small holders, between landed proprietors and farmers, and between employers and employed, all these groups without exception are represented in it, and work together in perfect harmony, as they are all at one in their endeavour to perfect their business technically according to the most recently acquired scientific knowledge.

This Society tries to accomplish its work in many different ways. A large machine is needed if one actually wishes to succeed in advancing agriculture as a whole. The administrative buildings consist of two large houses, and the scientific collaborators and official staff, exclusive of those who give honorary service, number nearly 400 persons. These are engaged in departments dealing with manures, feeding stuffs, seeds, cultivation, stock-breeding, machines and implements, management, fruit and vine culture, and colonial agriculture. The object of each of these departments is clear from its designation and reference will be made here only to the work of the management department. Here the financial results, as shown in the books, of a large number of agricultural units are examined. On receiving the knowledge required by this department, the other departments can alter and improve upon the methods of production proposed by them. The work of each of these separate departments is in one way a *scientific* one. With painstaking work, lasting, it may be, for many years, they try to find out by scientific experiments new facts, and to make progress in the technique of agricultural production These experiments are then tested on land offered by members for the purpose. The other work of each department is mostly of an *educational* character. It is a matter of putting into practice in the widest area those results and that knowledge which have been proved to be reliable and correct.

Along with this normal work prizes are offered regularly for the best animals, products and implements, competitive tests of work by agricultural machines are undertaken, and, finally, the buying of seed and other important products is conducted. Well known even in foreign countries are the yearly "D.L.G. Exhibitions." Every year there is a large agricultural show in a different place in the German Empire, at which the agriculturists exhibit the results of their new methods of production, and the sellers of agricultural requirements advertise their new improvements and inventions. The value of these exhibitions cannot be over-estimated, despite the occasional serious losses incurred by the Society holding them,—e.g. the Travelling Exhibition held in the year 1925 in Stuttgart resulted in a deficit of 300,000 marks. The number of visitors, which on many days approaches 50,000, bears witness to the interest which these annual exhibitions arouse. In addition, every February the Society arranges a course of instruction in agriculture; this course lasts about a week and is held in Berlin. At this the number of visitors is so great that the appearance of the 4-million town is distinctly influenced by it.

The Society is a leader, and indeed stands almost alone, among private organisations in the technical promotion of general agriculture; but the Union of Agricultural Experimental Stations in the German Empire has perhaps a claim to be mentioned here. The members of this body are the separate State Experimental and Control Stations or those inaugurated by the Agricultural Chambers. These occupy themselves with the examining of seeds, manures and feeding-stuffs, and with experiments in soils, plant-growth, &c.; they also work at the same time in the common interests of agriculture. As, however, the several experimental stations are mainly organs or departments of the Agricultural Chambers, they will be referred to along with them.

Economic Organisation. — The economic promotion of German agriculture is the work in the first place of the Co-operative Organisations. On the basis of the last publications of the several great Co-operative Unions, one is justified in the assumption that about 35,000 agricultural unions exist in Germany. With the help of these associations the farmers in the first place buy co-operatively the articles necessary for their business, and secure for themselves in this way the advantages which the purveyors are ready to allow to large purchasers. This procedure renders possible at the same time a thorough control of the quality of agricultural requirements. Whilst for example a single farmer would comparatively seldom cause a consignment of manure to be examined by an agricultural control station, the management of the association would always do so in the interests of its members. The second great task of these associations consists in selling to the best advantage the products raised by their members. The associations take charge of corn, cattle and other agricultural products, themselves act as the trader, and sell in their own name. The profits of the association thus gained, after deduction of the costs of administration and organisation, are distributed among its members. In general there is no claim for monopoly in German agricultural co-operative trade; to each member is rather left the option either to sell through the association or privately. From these two principal functions—the buying of agricultural necessities and the selling of agricultural products—there follows necessarily a third field of activity, namely, the department for the arrangement of *credit*. In normal times the associations have almost always been able to grant their members aid in the form of credit. The sums accumulated in German co-operative trade before the war represented a capital strength which had considerable influence on the money market.

The principle of co-operation is also carried out in the intercourse of associations with each other. The separate associations are connected with large associations called Head or Central Associations, whose scope of operations extends over the separate provinces and which have their headquarters in the capital of the province. This connection renders possible the wholesale disposal of agricultural products by the acquisition of warehouses and stores, mills, breweries and distilleries.

Decrees which provide for the creation of large Revision Unions for the special purpose of maintaining the business and political interests of German co-operative associations as against other undertakings have led to the creation of efficient head organisations by the connecting up of these large Unions. The most important of these head organisations is the Imperial Union of German Agricultural Associations, which has been in existence since the year 1883. Its functions are the promotion and extension of agricultural co-operation, the safeguarding of common interests, especially in legislation and administration, advising the affiliated unions and associations in all legal and economic questions, and finally the collection and presentation of statistics of associated trade. Its units consist chiefly of the principal associations of the several provinces and territories. Along with the several branches created for the fulfilment of these tasks the Union carries on the German Agricultural Co-operative School, which during the winter months holds courses for associated officials, an associated insurance company, and finally an employees' welfare bank. It represents the interests of nearly 21,000 agricultural associations.

There also exists the General Union of Raiffeisen's German Co-operative Societies. Its task lies in the promotion of the small and medium sized farmers' co-operative societies and their representation both at home and abroad, in supervising the managers of the affiliated unions, and in the preservation of the principles of Raiffeisen, the founder of this kind of co-operative society; finally it is concerned with the furtherance of the people's welfare, especially with reference to moral and spiritual things. The Raiffeisen co-operative unions of the provinces and districts and the German Raiffeisen Bank—an agricultural central lending Bank for Germany—are units of this union. The business interests of the associates are looked after by the Economic Union of the Raiffeisen trade centres, which carries out the wholesale buying for the central trade centres in the different provinces and districts. There exist separate branches for co-operative societies, for dairy work, for electricity societies, vintners' unions, for the work of revision, insurance, legal questions, taxation, and for the examination of printed publications. The union includes about 9,000 agricultural co-operative societies, whose members are mostly occupiers of small and medium-sized farms.

In addition to these two great co-operative organisations there exist a few other unions which have been founded more especially in connection with political unions. Thus the Imperial Land Union, the Association of German Farmers' Unions, and finally the German Farmers' Confederation, which will be treated in the following section, have started their own co-operative unions. These unions are, however, of relatively minor importance.

Political Organisation.—All efforts, however, to further the improvement of agriculture scientifically and technically, and to procure all possible advantages for its products in the province of buying and selling, must be entirely ineffective if the general economic policy pursued by the State does not imbue agriculture with sufficient vitality. The organisations treated in the two first sections, therefore, if the fruits of their activity are to be of material value to agriculture, require to be supplemented by powerful political organisations. German agriculture had lately to turn its attention more particularly to this requirement as, by the political overthrow, it has not only lost considerably in political influence, but in addition its interests have been entirely neglected by the established governments, which have been mostly industrial or favourable to consumers.

After the revolution and upon the establishment of the first government of the new State, which was hostile to agriculture, the most noticeable reaction was the amalgamation of the former Alliance of Husbandmen with the German Land Alliance into the Imperial Land Alliance or Union. The Imperial Land Alliance, which strives for the union of all persons interested in the preservation and promotion of German agriculture, is an agricultural institution on national and Christian foundations regardless of party politics. Its aim is to guard the political and cultural interests of all German agricultural workers, to ensure for agriculture its full right to equality of treatment and to increase agricultural productiveness; especially does it seek to provide agriculture with representation suitable to its importance in all corporations elected by the public. Its units may be political associations or individuals,—the latter, however, only in those parts of the country in which corporate bodies do not act.

The number of units of this organisation amounts to far over a million. In view of the assertion that the Alliance stands chiefly for a representation of the interests of large landed property, the fact must be noted that nearly half of the members connected directly or through sub-organisations with the Alliance represent the businesses of small and medium-sized farmers. The endeavour of the managers of the Alliance to consider the interests of the medium-sized and the small holders is shown by the fact that at least two-thirds of the assembly representatives must belong to the medium-sized farmers and the small holders. The funds necessary for carrying on the work of the Alliance are raised by members' contributions, each member contributing according to the extent of ground he cultivates. A powerful organisation with numerous branches and consequently plenty of means is in a position to exercise an important influence in political life. So the Imperial Land Alliance has never yet allowed any draft of a bill or any measure proposed by the Government to pass without endeavouring to influence it in a way favourable to agriculture. Although it is not represented in the Imperial Parliament by a party of its own, but has its deputies distributed over the several conservative parties, the Imperial Land Union, in quite a number of separate States, has built up its own Land Union branches, which are sure of the adherence of a large portion of the agricultural community. In political corporations the Imperial Land Union is ever ready for action when the interests of agriculture are concerned. Its provincial and local sub-organisations devote themselves to their work with the same zest in their several districts.

Less important in numbers, but in certain parts of the Empire quite as influential as the Imperial Land Union, is the Association of German Farmers' Unions. It depends for support on the adherence of holders of medium-sized and small farms. The units of this organisation are unions and corporations only, not individual persons. It works in the same spheres in which the Imperial Land Union carries on its activities. Of course the association, as well as the members which represent it, have not generally the same political point of view as the Imperial Land Union. As the members for the most part profess the Roman Catholic religion, there exists a close connection between them and the German Central Party (Roman Catholics).

The Imperial Land Union and the Association of German Farmers' Unions are the greatest independent organisations which represent the political interests of German agriculture. They may of course differ in the way they regard questions of details now and then, but in the great struggle which German agriculture is making at present for its recognition and for the consideration of its life interests, both bodies fight shoulder to shoulder. The common cause forces them together, no matter whether they are large or small owners, Protestant or Catholic, arable or dairy farmers.

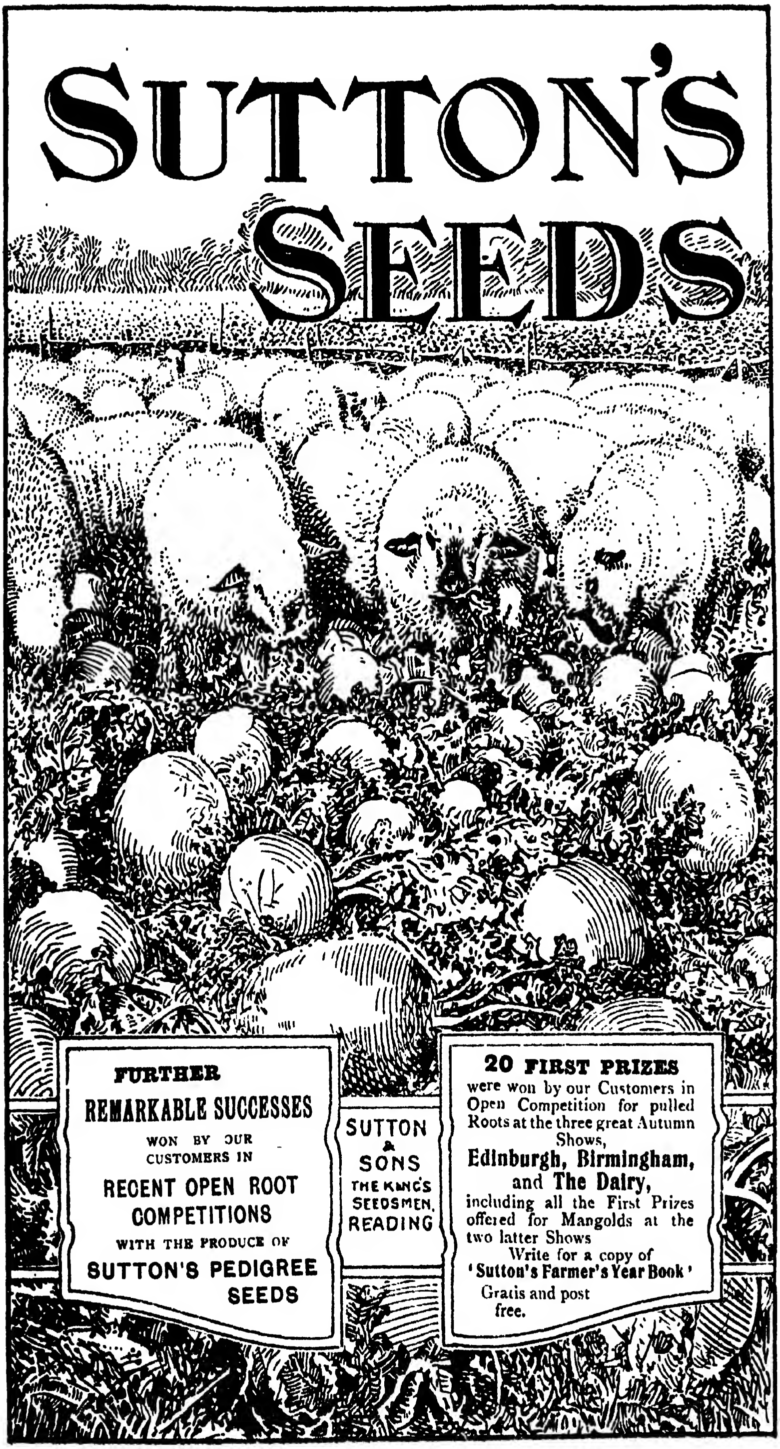
In addition to these two leading organisations there are also a great many smaller bodies, which, however, are not important. We may here name the German Farmers' Union, a club of very small owners whose quarrel is in particular about agricultural large holdings.

Attention may now be directed to still another body, already mentioned, which, with reference to the scientific as well as to the political interests of German agriculture, has come in recent years more and more into the foreground, namely, the Agricultural Chambers. With the exception of purely co-operative activity, there is probably no department in agriculture in which these Chambers are not interested. They are distinguished from the organisations of which we have treated so far by this, that they have not been founded by the voluntary joining up of members, but have been created by law. The oldest Chamber of Agriculture which exists in Germany was created in the year 1824 in the free and Hanseatic city of Bremen. In the past century the creation of these societies in Germany was very slow, but under pressure of conditions resulting from the war, the work of Chambers of Agriculture has now been regulated by law in all German States. (In Bavaria they are not called Chambers of Agriculture but Farmers' Chambers.) According to the Prussian law concerning Chambers of Agriculture which was published on 30th June 1894, amended on 16th December 1920 and completed on 22nd May 1923, the duties of Chambers of Agriculture are defined thus :—

> "To guard the general interests of the affairs of agriculture and forestry in their district, and to this end to promote all minor organisations for the improvement of rural landed property, especially the formation of a further corporate organisation of the farming industry.
>
> "Further, the Chambers of Agriculture shall support the administrative authorities in all questions concerning agriculture and forestry by furnishing actual reports and giving opinions. They shall not only identify themselves with such measures of legislation and administration as touch the common interests of agriculture or the special agricultural interests of the districts concerned, but they shall also co-operate in all measures which have to do with the organisation of rural credit and other work for the common welfare.
>
> "The Chambers of Agriculture, moreover, shall promote the technical progress of agriculture by suitable measures. To this end they are in fact specially authorised, if they so desire, to take over the institutions, the entire property, and also the rights and duties of the existing Agricultural Central Unions, to attend to their suitable utilisation and administration, and to enter into organic union with the existing local branches, as well as to support in the execution of their tasks other unions and co-operative societies which have the good of agriculture at heart.
>
> "The Chambers of Agriculture shall, when the rates of exchanges and markets are being fixed, co-operate in the administration and fixing of the market prices with special reference to cattle markets."

This gives a very wide scope for the activity of the Chambers of Agriculture, whose duties thus include more than all those undertaken voluntarily by the private organisations already mentioned.

The formation of the Chamber of Agriculture is decided by the voting of almost all the farmers domiciled in the department in question. Every German can vote who has reached his


SUTTON'S
SEEDS
FURTHER
REMARKABLE SUCCESSES
WON BY OUR CUSTOMERS IN
RECENT OPEN ROOT COMPETITIONS
WITH THE PRODUCE OF
SUTTON'S PEDIGREE SEEDS
SUTTON & SONS
THE KING'S SEEDSMEN,
READING
20 FIRST PRIZES
were won by our Customers in Open Competition for pulled Roots at the three great Autumn Shows,
Edinburgh, Birmingham, and The Dairy,
including all the First Prizes offered for Mangolds at the two latter Shows
Write for a copy of
'Sutton's Farmer's Year Book'
Gratis and post free.

twentieth year, who possesses the rights of a citizen, and who, as his principal occupation, for at least a year, either as owner, usufructuary or tenant, has worked land used for tilling or for forestry, or who practises husbandry as a secondary occupation. There is no distinction in the voting powers of the sexes, and voters have equal voting rights regardless of the size of their business; persons are excluded from voting who are bankrupt, or whose land is liable to compulsory sale or compulsory administration. All persons who are entitled to vote, who have reached their twenty-fifth year, and who, for at least one year, have lived continuously in the district of their Chamber are eligible for election, as also are former electors who for a space of 15 years have been eligible within the district. The elections take place every six years. Every three years half of the representatives, according to a succession fixed by the Statutes of the Chambers of Agriculture, retire, but the retiring members are again eligible for re-election later. The election is a proportional election. On the retiral of a member the next in order immediately steps into the Chamber. If after the election any circumstance should arise which would have excluded a councillor from being entitled to stand for election, his membership expires automatically. From these decisions it follows naturally that every independent farmer, except a few managers of quite small businesses, is entitled to vote and is himself eligible.

Thus the farmers elected under the supervision of the provincial and parish administrations compose the Chamber of Agriculture. This has in turn to appoint a president and a deputy (in Prussia for three years) who, for the most part, must also be farmers, and, like the ordinary members, perform their duties as honorary members. The president and his deputy, with three other members chosen from the Chamber, compose the Board of the Chamber of Agriculture. The Chamber itself chooses an additional member for each ten members. In this way it is made possible for countrywomen, for people specially noted for their work in agriculture, and especially for representatives of agricultural science, to get a place in the Chamber and take part in its work.

In accordance with the wide scope of its work prescribed by law, the Agricultural Chamber forms special committees, to which those of its members are elected who show a special interest in the individual questions. Thus, for example, one of the greatest German Agricultural Chambers—that for the Province of Brandenburg—set up the following committees: business procedure; auditing and political economy; publications; customs, tariff, trade and commerce, exchanges and markets; credit, co-operative and insurance work; schools and institutions; breeding of horses and cattle; dairy work; breeding of sheep; breeding of pigs; epidemics and veterinary work; land cultivation; forestry; machinery; fishing; keeping of bees and poultry; fruit-growing; horticulture; the care of the home; workers' interests; land agents; bookkeeping and management.

In a number of recently formed Agricultural Chambers the agricultural labouring class has representatives, and the employee's right to vote and eligibility are regulated by law; but in the districts where only employers find a place in the Chamber, regulations are made whereby the co-operation of the employees' organisations is secured. This procedure has worked satisfactorily, and the co-operation between employers and employed goes on almost entirely without friction.

For the accomplishment of such comprehensive tasks an extensive staff is needful. These are appointed by the president of the Board of the Agricultural Chamber according to the rules laid down for State officials. At the head of the management of an Agricultural Chamber stands the Director, at the head of each separate department, a manager. These again have along with them, according to the importance of the department, a staff of workers, who in the higher posts must all have had a college education. The Chamber of Agriculture for the Province of Brandenburg, here cited as an example, has no less than 400 officials and employees. Although the size of the building is conditioned by the size of the staff, there are connected with and belonging to the Agricultural Chamber many scientific laboratories in which investigations are carried on, and the control and testing of fertilisers, feeding-stuffs, seeds, &c. is undertaken. Moreover, it controls experimental farms where scientific experiments are carried out practically, and finally—although this is not so everywhere—the Agricultural Schools are the property of the Chamber who appoint, pay and supervise the Directors and agricultural instructors.

Such a machine naturally requires a considerable amount of money. The Chamber makes a preliminary estimate in each business year of the sum required to defray the anticipated costs, and obtains the money needed for that purpose from the farmers entitled to a vote, according to the size of their holdings. These contributions to the Agricultural Chambers are similar to taxes, only they are not levied by the Government but by each individual Chamber according to its estimates. These contributions must be paid by each farmer, or they are enforced in the same way as arrears of taxes. The Land Courts certainly have the right, when the contributions seem to them too high, to send the estimate back to the Agricultural Chamber for further consideration. They may not, however, erase or lessen separate items, but only state that the rate on the whole budget is too high.

The budget of the Chamber of Agriculture for the Province of Brandenburg closed its business year 1925-26 with an expenditure amounting to 5,083,000 marks, a sum which may be regarded as most moderate, considering the wide scope of its work. In all, 3,612,000 hectares were estimated as taxable, so there was paid to the Agricultural Chamber a sum of 1·41 marks per hectare of cultivated land. Except for the right of supervising the budget, the Agricultural Chambers are not subordinate to the control of the Government, but they are obliged to grant entrance to their meetings to Members of Parliament and to allow them to speak if desired.

In the German Empire there are 41 Agricultural Chambers, but not all, of course, so large as that for the Province of Brandenburg; their range of work and their size depend on the size of their district.

In effect, this organisation based on agricultural self-government represents to-day one of the most influential factors in the technical promotion and in the political representation of German agriculture, so that in every department it already exceeds in importance all the other organisations dealt with in this article.

It is not expedient that each of the 41 different Agricultural Chambers should transact its business direct with the authoritative departments of the States or with the Central Government. Therefore the Chambers have created for themselves covering organisations. These consist in the first place of the greater separate States. Thus the representative of all Prussian Chambers of Agriculture is the Prussian Head Chamber of Agriculture, which negotiates with the Prussian Government, while in Bavaria it is the Bavarian Land and Peasants' Council.

Besides this, all German Agricultural Chambers have established a representative committee which looks after their interests in connection with the Imperial Government. This is the German Council of Agriculture, which was founded in the year 1872. Its aim is to promote agricultural interests in the whole of the German Empire, and where these run the risk of being injured by Imperial legislature or by regulations and measures of the Imperial administration, to make representations to the Imperial Government or to put proposals before the Imperial Parliament. Its headquarters are in the Imperial capital, and it is the chief organ of agricultural self-government in the German Empire. Its units are the several Agricultural Chambers. Each of these Chambers in proportion to its numbers and financial standing sends a number of members. The total number of members nominated by the Chambers amounts to 90. These elect the president and a standing committee which has to decide on all important questions. The committee is authorised to choose from the domains of science four extraordinary members, who are authorised to enter the German Council of Agriculture as voting members. The work to be undertaken is apportioned to the several Agricultural Chambers in accordance with the ground cultivated and represented by them, and according to the number of those working in agriculture, horticulture, cattle-breeding and fishery as their principal occupation.

It is evident that, owing to fundamental differences in the systems of agriculture practised throughout the country, technical matters cannot very well be dealt with centrally by the German Council of Agriculture, but must be left largely to the several Agricultural Chambers. Besides, there is already in existence in the German Agricultural Society a body one of whose functions it is to undertake such work. Thus the German

Agricultural Council is occupied chiefly with questions of agricultural policy, and takes here a decidedly leading position beside the Imperial Land Union and the Association of German Farmers' Unions. Its staff, who are appointed by the Board, have five departments to attend to :

1. General politics, scientific colleges, and credit affairs;
2. Taxation and general economic questions;
3. Trade and customs policy. This department comprises not only foreign but also the whole home trade, marketing and trade statistics.
4. Commerce and publications;
5. Business management. This department works up the results of the bookkeeping departments of the several Agricultural Chambers in a scientific manner, and thus furnishes the material for forming an estimate of the existing economic situation of German agriculture.

Besides these departments a few more services have been established which, in regard to their management, are under the German Council of Agriculture, but which possess a certain degree of self-government. These are the business and taxation service; the publications department, which examines the daily papers and all publications in connection with agriculture and sees that, if necessary, any statement they contain is corrected or amplified; and the department for the publication of prices, which collects all material of importance for showing the tendency of the markets, and collects prices, statistics of production, provisions and shipping, and makes these accessible to the agricultural community in the clearest and quickest method possible, usually in the press or by wireless.

Compared with the structure of an Agricultural Chamber the staff of officials and budget of the German Council of Agriculture are astonishingly small. As its tax district extends over the whole of the ground used for agricultural purposes in the German Empire, only a sum of ¾ pfennig per hectare falls to its share. The organisation requires less external machinery since it rests on the firm foundation of the Agricultural Councils, and with their help can in a short time receive explanations and information on every question. Of what great use practically this co-operation between head and branch can be the following example demonstrates.

The Department of Agriculture in America took years to obtain the statistics of land under cultivation, of harvests and crop production, and of the provisions in the hands of the farmers, because they had to approach separate farmers direct from Washington and ask them for their co-operation. These statistics were obtained in Germany in little more than half a year through the department for the reporting of prices, because it was only necessary to inform the several Agricultural Chambers, who declared themselves ready to co-operate. The Agricultural Chambers then chose from their districts those farmers whom they considered reliable and capable, and—what is even more important for the value of statistics and their practical application —typical of the farmers in their districts. In this way great promptitude and reliability were attained.

The legal representation of agricultural interests has proved of great benefit. It appeared at first that a certain competition would arise between the private organisations and these legal corporations, but soon a successful division of interest was made in the case of political representation of interests, and a mutual agreement reached. Private organisations dependent on the free will of their members must, as follows from their nature, consider the wishes of separate groups of members much more than do corporations whose means are levied on the basis of lawful compulsion. Therefore the independent agricultural organisations are somewhat sharper and more radical in their demands, whilst the Agricultural Chambers in their resolutions must confine themselves chiefly to essentials. For this reason, and also because the Agricultural Chambers do not regard it as their work to influence the votes for legislative bodies, a division of labour between the councils and the independent organisations in all important questions was instituted in a short time; thus the legally constituted bodies work out and explain the essential requirements, and the independent associations enter the political arena and fight for the attainment of these requirements. This division of labour has proved most successful and advantageous, and to it is due in great part the success which agriculture so far has been able to attain.

Thus the system of agricultural organisation as existing in Germany is not only logically and clearly separated into departments, but is also adapted for the purpose, and for long has satisfied all needs so far as agriculture *in general* is concerned. There are people who assert that there is an over-organisation not justifiable in these hard times; but it was indeed the terrible crisis in which agriculture, along with the whole economic fabric of Germany, was involved after the war, that was the cause of landlords refusing to pay their contributions for every apparently purposeless organisation, and superfluous societies have consequently disappeared.

Besides these *general* bodies, there are many *special* organisations which have chiefly to look after the interests of the employers, and which are united in the Economic Unions of Land and Forest Employers; to this are opposed those employees who belong to the Central Union of Agricultural Labourers, to the Imperial Agricultural Labourers' Union and to the German Agricultural Labourers' Association. Further, there are for the several special branches other organisations which deal with horticulture, animal breeding, plant culture, fisheries, &c., and which achieve successful results in their own particular lines. These organisations usually work together with the respective departments of the Chamber of Agriculture and the other principal agricultural unions.

SOME PROBLEMS OF THE LANARKSHIRE STRAWBERRY INDUSTRY.

C. W. WARDLAW, Ph.D.,

Botany Department, University of Glasgow.

Early history of the industry.—As far as one can gather the strawberry industry in Lanarkshire began with some small plantings of strawberries at Hamilton and Uddingston about the year 1869, or perhaps a year or two earlier. From there plants were taken to the Carluke district sometime about 1872, so that the Clyde Valley industry proper starts from that time. The varieties grown in these early days were "The Countess" (Viscountess Haricourt de Theurry), "Elton Pine," and "Black Prince." "The Countess" appears to have been a great favourite, and those with long experience in the trade hold that for flavour, cropping and healthy plants it is the best variety Scotland has ever known. "Elton Pine" also seems to have been a berry of some merit, and "Black Prince" was an early fruit very suitable for jam-making. Needless to say, in the first plantings, no one ever dreamt of the full possibilities of the industry. It soon became apparent, however, that strawberry growing in the Clyde Valley was a fruitful source of income, and from that time onwards the acreage under strawberries increased rapidly. In this early and marked success we are able to see some of the seeds of subsequent disaster, in so far as it seems probable that many fields, whether thoroughly suitable or not, were used for strawberry cultivation.

In the early days of the industry the berries were sent to Glasgow from Uddingston packed in square hampers (eight baskets of 10 lbs. each), the horse 'bus being the usual means of transport at that time. About 1878 strawberries were auctioned for the first time in the Glasgow Fruit Market. Side by side with the rapid growth of the industry the local manufacture of jam began.

The cultivation of the strawberry in the earliest days in the Clyde Valley seems to have been very good. The ground was all dug, thoroughly cultivated, and after planting, the beds were gone over with the spade so that a fine surface was worked up. Those who saw the first fields say that some of the varieties such as "The Countess," from the point of view of good healthy plants, were very striking indeed. Five varieties, "The Countess," "Elton Pine," "Wellington," "Wizard," and "Black Prince," in order of merit, were all good healthy varieties and good croppers, but all have declined in the district and are now seldom seen.

With regard to the quality of the crops, it appears that both the plants themselves and the crop of berries were better than now, especially in the case of "The Countess." This is most probably due to the fact that the plants received more attention and were more heavily manured. It might be asked if there was any trace of disease in the early days. As far as one can gather there was a slight trace of a disease in one field, and it was thought that this was due to the fact of the soil being exhausted of some necessary mineral. The question of manure also came up at this time, but there seem to be no definite results on record of this investigation.

Much interest naturally attaches to the variety "John Ruskin," as it is one of the most widely cultivated and badly diseased varieties at the present time. This variety appears to have been introduced about 1900 (or earlier). It had hard corky fruits, and altogether was a rather poor variety. Its hardy resistant nature, and its early ripening, however, attracted growers to it, and the general opinion is that both with regard to size and flavour this variety has gradually improved.

The usual rotation towards the close of last century was four crops of strawberries with an intervening crop of potatoes. One other point of interest is that during the latter part of last century lime-burning was commonly carried out in the district —an industry now defunct.

Little need be said of the history of the industry in more recent years. During the war the land probably suffered considerably in the matter of cultivation. Then in various districts from 1920 to 1922 the present strawberry disease made its appearance and spread rapidly, till finally at the present time the industry is in a somewhat perilous state.

In the last number of the JOURNAL and in "A Report for the Use of Growers" the author set out his preliminary findings with regard to the cause of the disease. It was pointed out that under unfavourable soil conditions the plants became unhealthy and less resistant, and thereby became liable to attack by parasitic soil fungi. The disease may be due to fungal agency in a general way without necessarily being referable to one parasite in all cases. The main factor involved then is the general health of the plant. Such considerations as health of the plant and soil conditions raise questions of the widest possible kind, and call for research work of a far-reaching nature. It is proposed here to discuss briefly some of the more important questions and problems which must be considered and solved if the industry is again to be placed on a proper and secure footing. These observations, then, are being made in the hope that those associated with the industry will lend assistance with a view to solving the general problems which the outbreak of disease has brought into prominence.

As the result of observation in the field and discussion with the growers the investigator might well be dismayed with the vastness of the task with which he is confronted. In the first place, the disease has arisen only within the last six years or so! Again a number of varieties are attacked, and finally, the disease may occur on a wide range of soils, from sandy silts to clays. A further difficulty lies in the fact that whilst the disease is commonest on land long under strawberries, it has also been found on land recently broken out of fallow. It is clear, therefore, that speculation from one set of facts alone will not lead to a general cure of the disease. What is required is a series of thorough investigations. On the author's premisses that soil conditions are not what they ought to be, and further that the general health of the plant is the central point in the whole discussion, such investigations would overlap at points, and a general understanding would be more easily reached.

There is, of course, considerable diversity of opinion among growers themselves as to the cause of the disease, and many special cases are quoted which do not make matters any more easily understood. Some broad aspects of public opinion, however, might be stated as follows :—

> Cultivation is not so good as it used to be, and the plants do not receive the same attention. The plants are not so kindly treated as they used to be in the matter of farmyard manure. The ground is not always worked under the best conditions. A general need is felt for the introduction of some better varieties. Opinion is divided on the subject of lime, and one is told of fields broken out of fallow and never limed for forty years, though bearing strawberries and other crops most of the time. Neither the general appearance of the fields nor cropping are as good as formerly.

In a broad way, and subject to modification, these are some of the general admissions of growers in the Clyde Valley. Further observations of interest are that the rather milder winter conditions during recent years have not been so favourable to soil sanitation as the crisp frosty conditions experienced in former years; that the heavier Lanarkshire soils require rather careful handling, and it is not always easy to work the land under the most favourable weather conditions; and finally, that it appears that some of the fields showing disease were never really suited to strawberry cultivation at all.

Some problems.—The more important problems of the Lanarkshire strawberry industry fall into three groups which are all closely inter-related, viz. :—

> The plant and its cultivation.
> The soil and its improvement.
> Possible parasites and their elimination.

The plant and its cultivation.—Concerning the plant and its cultivation accurate information is required on the following points :—

1. What are the best conditions for strawberry growing in Lanarkshire?
2. What are the best varieties to cultivate from the point of view of general health, resistance to disease, cropping, supply of runners and marketing?
3. Are the methods of cultivation in use the best methods?

PLATE 1.

FIG. 1.—Healthy roots in a well-drained and well-ventilated pot.
FIG. 2.—Diseased roots in a pot where drainage and ventilation were poor

PLATE 2.

Healthy root from pot 1, and diseased root from pot 2.

[*Photos by D. M. Filshill.*

4. What are the best sources of obtaining plants, and what are the best methods for keeping up the supply of young plants?

Careful experimental tests are required regarding the choice of new suitable varieties. It is suggested also that new methods of handling and laying out the plants might be tried. The point that the writer wishes to make in particular with regard to this section is that here is an instance where the practical grower can be of great help by collecting accurate and careful knowledge of the life-habits of different varieties, and by pooling such information to the advantage of the whole industry.

The soil and its improvement.—The wide question of soil condition and treatment is one which requires the combined activities and efforts of both research workers and growers. Investigation is wanted on the following points, about which there appears to be very little public information in circulation :—

1. The nature of the various soils of the Lanarkshire strawberry area as revealed by soil survey and mechanical analysis.

2. Chemical analysis, with special reference to the question of starvation of such essential substances as potassium, phosphorus, nitrogen, magnesium, &c. The Long Ashton experiments have already given a very good lead in this line of work. It remains to carry out similar work with special reference to Lanarkshire conditions, and to apply the results.

3. A survey to determine the lime requirement of the soil, in the author's opinion, deserves careful attention. It is only necessary to remark that in the Valley there is, in some quarters, a prevailing idea of unknown origin that strawberries do not like lime. Growers are divided on this point, but in actual practice very little lime is used, cases being quoted of fields that have never been limed.

4. The question of humus is also of great importance, whether the soil be a clay or alluvial silt. In all these cases the incorporation of additional humus would be advantageous. In the present state of the industry, however, both lime and manure are items causing a considerable outlay, and it is suggested that investigation should be made into other cheap sources of those most necessary materials.

5. It has been shown that certain plants attain to their maximum development only when certain special chemical substances are present,—e.g. boric acid in the case of the broad bean, and some other leguminosæ. It is still an open question whether or not some similar principle may be operative in the case of the strawberry.

6. Coupled with the last suggestion, there is the further possibility of the presence of certain substances in the Lanarkshire soils which are toxic to the strawberry.

7. Other questions requiring attention are those of drainage and soil sanitation in general.

The points mentioned in this section may be included under the general title of soil condition. It is clear that some of the problems can be tackled only by the expert in the laboratory, but others are decidedly in the hands of the growers.

Possible parasites and their elimination.—The question of disease has many aspects and the actual diagnosis of a disease is necessarily a matter for expert investigation. On the other hand it has been pointed out that (excepting perhaps virus diseases) disease is largely bound up with choice of plants, their general health and the soil conditions under which they are growing. Careful observation and recording, therefore, on the part of the field worker can be of the very greatest service in arriving at a general understanding of those circumstances in which the disease appears and proves most dangerous.

It is now fairly well understood that the Lanarkshire strawberry disease is not a specific disease always occurring in the same way. An obvious corollary is that the same cure will not be equally effective in all cases. In view of this it is clear that the growers must endeavour to understand all the general circumstances attendant on the disease, so that they may apply suitable remedial measures to their own particular type of land. It will not be enough to wait for expert investigation to explain every circumstance. The grower must be a willing collaborator, and this he can best do by setting himself the questions and problems set forth here, and by applying them to his own particular affairs.

Observations on strawberry cultivation.—Unfortunately it is not yet possible to prescribe any definite specific curative treatment beyond general advice, such as attention to soil condition, selection of good stock and treatment of plants. What is really required is special information with reference to Lanarkshire conditions. It is, however, of value to consider the recommendations which have been made with regard to strawberry cultivation elsewhere.

In certain Bulletins specially compiled for growers by the Bureau of Agriculture in Washington, U.S.A., on the subject of strawberry cultivation, there are some observations which may well be summarised here. The application of the general principles involved may safely be left to the growers themselves.

1. As the strawberry is easily injured by poor soil drainage, soils must be selected on which water never stands. This will apply in particular to low-lying poorly drained land.

2. Such water-logging in winter in periods of heavy rain will leave the plants weakened and stunted. Disease of all kinds will be at its worst under such conditions.

3. Strawberries may do well on a wide variety of soils, either light or heavy. In all cases, however, those soil

types which are most easily worked and with the greatest humus content are generally preferred.

4. The preparation of the land for the planting of strawberries should be complete and thorough.

5. The soil should be abundantly supplied with humus when the plants are set, either by making adequately heavy applications of manure, or, previous to planting, by growing and turning under one or more green manure crops. A liberal supply of humus is particularly important because of its effects upon the productiveness of the soil and its moisture-holding capacity.

6. The soil should be in a high state of fertility and put into thorough condition by thorough cultivation.

7. In American districts where the drainage is poor the plants are commonly set on ridges, 3 to 12 inches above the furrows which separate them. Such methods of ploughing as will form suitable ridges and furnish good drainage should be employed.

8. After the strawberries are planted it is necessary to keep the soil in good physical condition, and to maintain the roads and alleys in such a state as to allow of good drainage in the beds.

9. Local conditions largely govern the length of time during which a field may be profitable. This will depend on such factors as the quantity of humus in the soil and the prevalence of weeds and diseases.

10. The use of fertiliser is of course very much a local question. A crop of berries removes considerable quantities of nitrogen, phosphorus and potash from the soil, but many soils are so well supplied with plant foods that crops may be grown for a long time provided the physical condition is good. If therefore the soil is kept in a satisfactory condition by the addition of humus and by frequent tillage, and if the moisture supply is suitably regulated, the strawberry fields will not require the same quantities of foodstuffs.—(Extracts from Farmers' Bulletin No. 1026, U.S.A.)

Strawberry varieties.—The choice of suitable varieties is obviously one of fundamental importance to the whole industry. To be of real value, tests must be continued for several years, in order that the behaviour of the varieties in relation to climate, soil changes, &c. may be noted. In the selection of a variety it should be determined whether it is really suited to the climate. Second in importance to climatic requirements is the question of soil requirements. The selection of varieties in this matter is largely related to their rooting properties, and the capacity of different roots for removing water from the soil. Such difficulties will be solved by careful observation of soil type and growth characters of the different varieties. What is wanted is a tabulated statement of the behaviour of the different varieties in the Lanarkshire fruit-growing districts.

A feature of the strawberry industry as of other agricultural industries is the decline or running out of varieties, and Lanarkshire has already provided considerable experience of this. Other things being equal, however, on purely botanical and genetical grounds, there is no known reason why a variety should run out in the absence of disease. Where good cultivation has been constantly maintained in parts of America, and where the disease factor has been kept in hand, a number of varieties have persisted as good croppers over a long number of years. As a rule, where the yields of certain varieties have decreased markedly within a comparatively few years, various reasons for the decline may be assigned, such as susceptibility to disease. If the fertility of the soil is maintained and if varieties resistant to disease are set, and if reasonable care is exercised in propagation, no degeneration is likely to occur.—(Farmers' Bulletin No. 1043, U.S.A.)

Canadian methods.—A report on strawberry cultivation is also issued by the Department of Agriculture of the Province of British Columbia. The general principles emphasised in this work may be briefly summarised as follows, omitting the detailed observations concerning the special conditions in that province. The essentials for success are :—

1. Strawberries will thrive on a great variety of soils, but they succeed best on a fertile, well-drained, moisture-holding sandy loam soil.

2. Owing to the high water content of the strawberry, certain conditions governing moisture supply are essential. As most of the feeding roots are fairly near the surface it is necessary that moisture should be conserved in the uppermost layers. This is best achieved by thorough tillage. While a plenteous moisture supply is needed during the fruiting season especially, it is also an absolute necessity to provide perfect drainage for the strawberry plantation during the winter months. Strawberries will not stand "wet feet" during the dormant season.

3. Strawberry cropping should form part of a rotation in which the soil is brought into the best possible tilth before the strawberries are planted. The report states that it is advisable to select a piece of ground that has been in a hoed crop the previous year, and, if possible, in clover the year before that. The land should be ploughed, cross-ploughed, double-disked and harrowed thoroughly.

4. Emphasis is also laid on obtaining a good stock of healthy plants with good vigorous growth. In selecting the ideal type of plant it has been found that a medium-sized plant, with a well-developed root system, will in most cases give the best result. Some growers adopt the practice of planting a special propagating bed each year, as the growing of runners on a plant seriously affects its fruiting capabilities, especially during the first year.

5. During the life of a strawberry plantation great care is taken that the soil is kept in good tilth to keep down weeds and to conserve moisture.—(Circular No. 58, Dept. Agri., B.C., 1922.)

Experimental work at Long Ashton.—The experimental work which is being conducted at the Long Ashton Experimental Station has been summarised in the Development Commission Report, No. 17, 1926, p. 45, as follows :—

> "Two 'strain' trials are in progress with the variety 'Royal Sovereign.' In the first of these, 'strains' of widely different vigour, obtained from several sources, are being grown on for several generations under similar soil and cultural conditions with a view to ascertaining whether original differences will be maintained. Such an experiment is of importance, as it is not clear whether the original differences are due to inherent qualities of the stocks or to differences resulting from cultural and other treatments. In the second, parent plants of similar vigour have been planted. Runners will be taken from selected groups of these in different ways to determine how far the original vigour of the parent plants will be retained or lost over a number of generations by different methods of runner selection. . . . In a few years these experiments should contribute valuable information on questions relating to the vigour of commercial stocks.
>
> "Nutritional problems are being attacked by laboratory methods and in field trials. . . . So far the results obtained indicate that better results are obtained from the use of farmyard manure than from any comparable system of artificial manuring."

In an address by Mr. L. N. Staniland of the Long Ashton Research Station at the Wisbech Institute, Jan. 11, 1927, there is much valuable information which might be briefly summarised at this point. The observations refer of course in particular to the Wisbech district, but the principles involved are of fundamental importance.

1. The questions of strain in runners and of good root formation are both of great importance.
2. To build up a good strain of runners, growers must select runners from healthy maiden plants, and not more than five from each plant. These five must be the first runner on each string. The second or third do not give the same result in the course of time. Growers should start with some of the best runners and work up a good sound stock from these by careful rogueing.
3. With regard to pests certain strains showed susceptibility to certain diseases, and although after careful selection the plants became less affected with a disease, nevertheless the tendency to that disease was never lost.

4. The most important thing about a strawberry plant is the root, and although a plant takes a great deal of killing it will never crop properly if the roots are not functioning properly.

5. It is essential that every year at the end of the fruiting season a little earth should be drawn up to the crowns for the young roots (which arise higher on the stock than the old ones) to work into.

6. If the roots do not have a chance the foliage suffers, and in the following spring the plants will show a poor top only.

7. Attention to strain and good rooting are the two main points that will lead to better cropping.—(From a report in the *Fruit, Flower and Vegetable Trades Journal*, Jan. 22nd, 1927.)

Further experimental observations.—It will be noted by readers that in the previous sections attention was called in particular to the importance of keeping the soil in a proper state of tilth, with special reference to proper moisture and ventilation conditions. A simple experiment will demonstrate the importance of this with special reference to Lanarkshire soils.

Soil from a badly diseased field (a heavy silty loam) was filled into some 3½ inch pots. Runners from a large healthy strawberry plant growing in an 8 inch pot were fixed on the pots and allowed to root. Some of the 3½ inch pots were allowed to stand on the soil surface, thus ensuring good ventilation and good drainage. Other pots were sunk to the rim in the soil, thereby reducing considerably both drainage and ventilation. The runners rooted in all the pots after some time. Late in autumn the pots were examined by turning out the contents *en masse* (plate 1, figs 1 and 2), and afterwards by washing the soil away from the roots (plate 2, figs. 1 and 2).

Plate 1, fig. 1, shows the contents of a pot which had stood on the soil surface. The root system is well and freely developed, healthy, and free from disease. Plate 1, fig. 2, in contrast, shows the contents of one of the plunged pots. Here the roots were more poorly developed, and they showed all the typical disease symptoms. The roots in the two pots were then washed free of soil and photographed. The results are shown in plate 2, figs. 1 and 2. Here the large, healthy, disease-free root of pot 1 stands in marked contrast to the poorly developed diseased root of pot 2. This experiment shows clearly the effects on the root system of good ventilation and drainage as against poor ventilation and drainage. During the course of the winter all the pots became diseased to a greater or less extent. The significance of these results and their application to field conditions need no further comment.

Conclusion. —The purpose of this article has been to place before those concerned some of the special problems with which the Lanarkshire strawberry industry is confronted, and to adduce some helpful information from other sources. It is to be regretted that similar observations with special reference to Lanarkshire conditions cannot yet be issued. It is hoped, however, that in the future direct information will be to hand regarding the various important questions which it has been the object of this article to raise. For this work there is ample scope both for the practical grower and for the scientific investigator. Clearly each has his special province, and only by careful and accurate observation and experiment, and by helpful collaboration, can the industry again be placed on a relatively secure footing.

The author's thanks are due to those who have helpfully contributed information contained in this article.

BLACK SPOT IN CHEESE.

Professor R. H. Leitch, M.A., B.Sc.,
West of Scotland College of Agriculture.

Within recent years a serious defect in cheese, known as "black spot" or "black discoloration," is reported to have occurred with increasing frequency. Affected cheeses when cut across exhibit numerous blackened areas varying in size from pin-heads to the dimensions of a shilling. These saturnine blotches are usually circular in shape; more rarely, however, a veined form of black discoloration has been observed. The black spots, which are irregularly distributed throughout the cheese mass, give the cheese a repulsive appearance and render it practically unsaleable.

Black discoloration occurs both in white and coloured cheeses. It has been noted in Scots and English Cheddars and in Dunlop and Cheshire cheeses in this country; it has been recorded in American and New Zealand Cheddars.

What makes the fault of serious consequence is that it is not easy to determine the presence of black spot in large commercial cheeses when the routine method of sampling is followed. A cheese merchant assesses the value of cheeses mainly by reference to cores or plugs taken from their ends. Now it frequently happens that a random core of a defective cheese of this type will pass between the blackened areas so that nothing unusual is noted on the sample. Because of this difficulty in locating the blemish in commercial cheeses, cheese factors have on occasion experienced considerable financial losses by the purchase of apparently sound cheeses which subsequently proved to be discoloured. An Ayrshire cheese buyer states that he lost £100 on one farmer's cheese alone, and £200 on a large consignment of factory cheese. A co-operative trading organisation also confesses to substantial monetary losses through the emergence of this fault in some farm cheeses purchased on their behalf.

Although black discoloration has, for many years past, been recognised by merchants as an occasional fault in cheese, nothing was known of the actual cause. Obviously it was due to some form of contamination, possibly a mechanical impurity. One experienced merchant was wont to declare that it was simply due to dirt; another thought, from the appearance of the affected cheese, that it might be caused by soot.

Professor S. Orla Jensen in his book "Dairy Bacteriology" (page 153) states that "a colour defect, characterised by the turning grey or blue of cheese curd, is due to the admixture of salts of iron or copper. The iron may come from water, rusty utensils, or from steam pipes and copper from the cheese vat."

Dr. Constantino Gorini, a well known Italian authority, in answer to an enquiry, asserts that black spot or discoloration in cheese is due to the activity of an organism which he names *Bacillus lactis niger*.

The available English literature on cheese-making contains no reference to this form of discoloration.

At the instigation of representatives of the cheese trade in south-west Scotland, the Dairy Research Department of the West of Scotland Agricultural College initiated an investigation of this fault four years ago, and the result of this investigation forms the basis of the present communication.

As the majority of faults in manufactured products are due to the action of specific organisms, it seemed reasonable to think that black discoloration in cheese might possibly be of bacterial origin. A complete bacteriological analysis was therefore made of cheeses from different sources which exhibited this fault, but no positive results were obtained. Microtome sections (3μ in thickness) of the black patches failed microscopically to reveal the presence of bacteria in any numbers, and such organisms as were isolated from the infected parts were shown to have no significance so far as the fault was concerned. The blackened portions when inoculated into sterile milk produced no characteristic fermentation or blackening of the milk, and an emulsion of the infected cheeses into normal cheese milk did not reproduce the fault in the resultant cheese. Nor could it be shown that any specific enzymes such as might possibly induce blackening of the curd were present in the discoloured cheeses.

There still remained the possibility of metallic contamination. Sulphur, introduced as flowers of sulphur into the raw curd during the process of manufacture, did not induce black discoloration in the cured cheese. But the effect of the addition of the sulphur did have a very distinctive effect on the quality of the ripe cheese. The cured product developed a most undesirable odour and flavour; to the trade, such a cheese would be known as a "stincker." The experiment suggested that the bad flavour in commercial cheeses of this type is induced by organisms which react on the sulphur fraction of the cheese protein (casein contains 0·8 per cent. sulphur).

Small scale cheese experiments with salts of zinc and copper

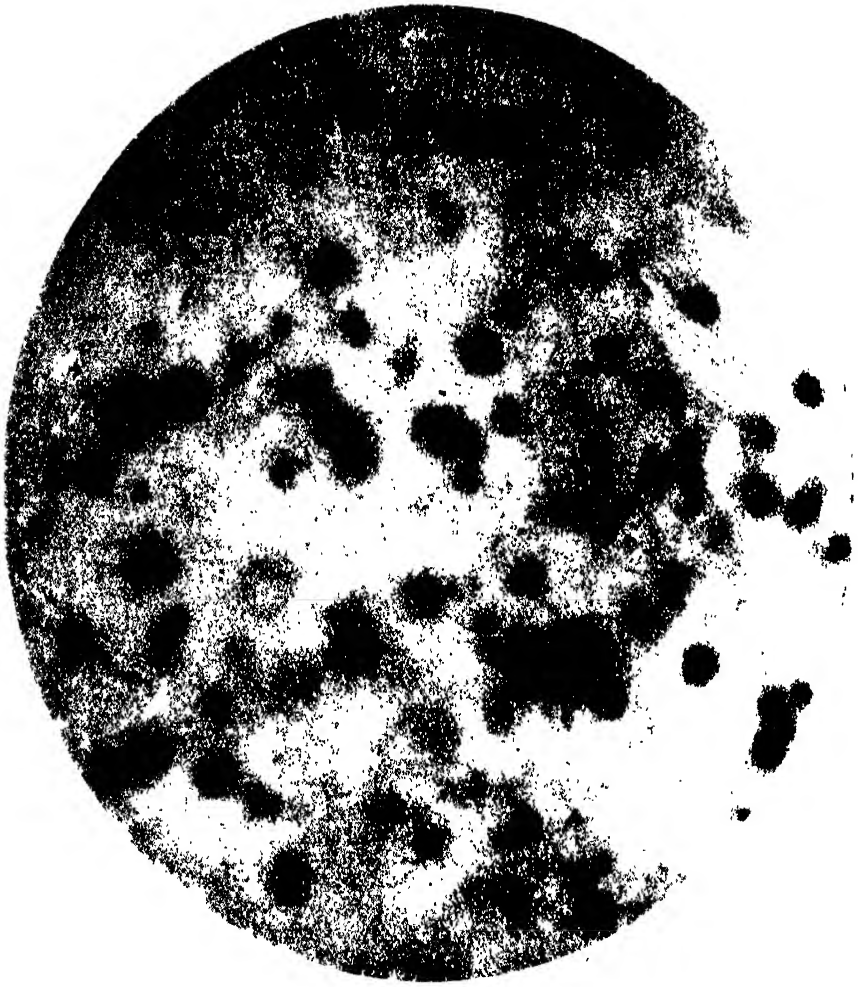


FIG. 1.

Extreme form of Black Spot occurring in a cheddar cheese: reduced by one half.

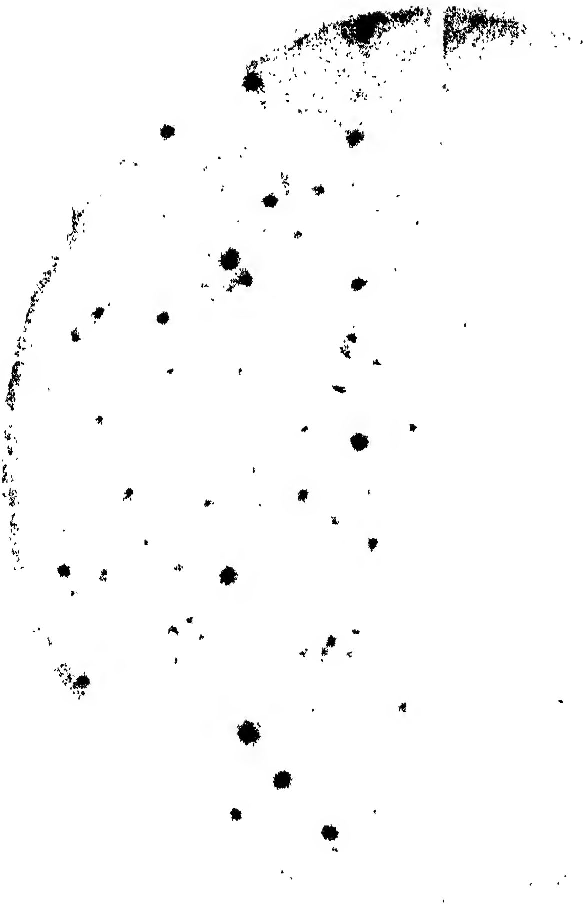


Fig. 2.

Black Spot in experimental cheese 47. Red lead added to curd on rack after the running of the whey. Discoloured cheese on left; normal cheese on right.

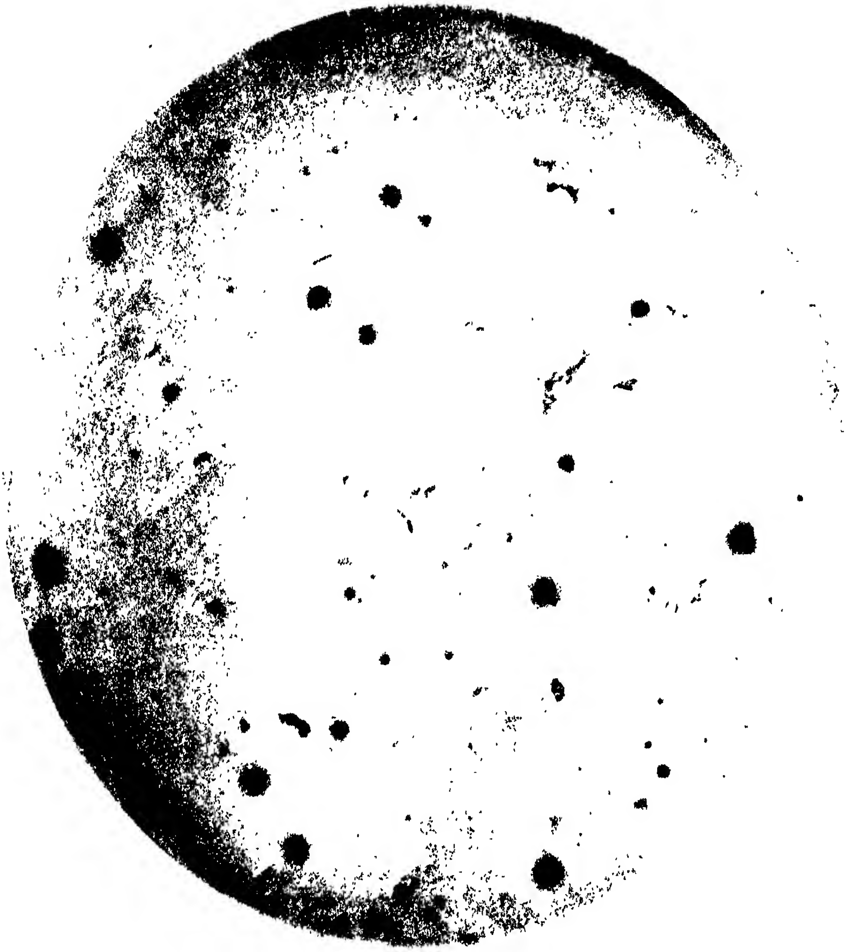


Fig. 3.

Black Spot in experimental cheese 40: deposit from interior of lead service pipe added to cheese-milk at renneting.

FIG. 4.

Lead crystals isolated, by Fairhall's method, from Black Spot cheese shown in fig. 1. Magnified 175 diameters.

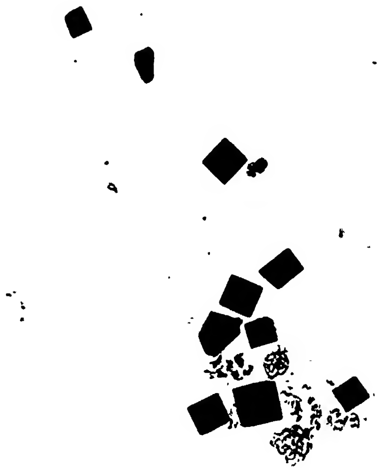


FIG. 5.

Lead crystals isolated from minute fragment of metal or alloy (probably solder) found in Black Spot cheese. Magnified 175 diameters.

gave negative results so far as black discoloration is concerned. Neither did the addition of iron compounds to the cheese-milk or to the curd at various stages in the process of manufacture induce black discoloration in the ripe cheeses. The iron was added as ferric hydroxide, rust, ferrous sulphate, ferrous sulphide, lactate of iron, iron filings, and also in the form of that flocculent ferruginous deposit which so commonly occurs in country water supplies, in ditches and field drains.

But when reference was made to lead, positive and striking results were secured. Small amounts of lead compounds added at different stages in the cheese-making process reproduced in the ripe cheese the characteristic black discoloration in all degrees of intensity. In our first experiments with lead compounds in 1925, the black discoloration was reproduced so exactly in the experimental cheeses that there seemed little doubt that lead contamination is the real factor which induces this blemish in commercial cheese. However, as the amount of lead compound required to induce the fault is very minute (one part in 500,000 to one part in a million), it is a difficult matter to establish by ordinary chemical analysis the presence of lead in blackened cheeses to which lead compounds had not knowingly been added. And yet the chain of evidence is not complete until it can be clearly shown that lead does exist in the blackened areas of faulty farm or factory cheeses.

Recently Fairhall (*J. Biol. Chem.*, **57**, 455) published a micro-chemical method for the detection of traces of lead in biological material. This method is based on the formation of a lead compound—potassium-copper-lead-hexanitrite ($K_2C\mu Pb(NO_2)^6$) —which microscopically appears as brilliant black crystals of definite crystalline form. When Fairhall's method with but slight modification was applied to the blackened portions of a farm cheese sent to our laboratory for examination and report, the characteristic minute lead crystals were obtained. A normal cheese examined at the same time failed to produce any black crystals. Fig. 4 is a micro-photograph of the lead crystals obtained by Fairhall's method from the blackened parts of the faulty farm cheese shown in the first illustration (fig. 1). Fig. 5 shows the lead crystals obtained from a minute piece of unaltered metal—suspected to be a lead alloy and probably solder—taken from a black discoloured cheese. (In the many black cheeses examined, this was the only case in which a fragment of any metal or alloy was observed.)

It would appear that practically any lead compound will produce black discoloration if incorporated in cheese. In our experiments we have employed flakes of red lead paint, chemically pure red lead, lead carbonate, lead acetate, white lead, and particles of white paint (which has a lead basis). All these forms gave positive results. We have also been able to produce a similar black discoloration with the deposit from the interior of water service pipes made of lead.

For experimental purposes the milk of the station herd was employed, and cheeses of 22 lbs. capacity were made. The daily milk supply was split into two portions, one portion being used to make the control cheese, and the other, to which the lead compound was added, to make the experimental cheese. It may be remarked here that in no case did the ripe control cheeses show any signs of black discoloration. The cheeses were examined for discoloration when they were four months old. (Commercial cheeses of home origin usually reach the consumer about this age.) In all cases the cheeses were cut right across and an inspection was made of the cut surfaces. As already indicated, coring the cheeses is not always a satisfactory method, as the core may altogether miss the discoloured parts.

The following brief notes give the necessary experimental data and the observed results.

Commercial red lead as the experimental factor.—Some tiny flakes of red lead paint, weighing 0·21 gram, which were taken from the inner surface of the water heater in the dairy, were pulverised and added to the cheese-milk before renneting. (Experimental cheese No. 32, 13/7/26.)

The ripe cheese showed the typical form of black discoloration observed in faulty commercial cheeses. The blackening took the form of (*a*) pin-head spots, intensely black; (*b*) larger circular areas with deep black centres and smoky marginal zones, ½ inch diam.; (*c*) an indefinite black veining, presumably between original curd particles. The black parts were fairly uniformly distributed throughout the cheese, and were easily detected on a core of the cheese.

The experiment was repeated with half the amount of red lead (0·1 gram), which was added as before to the milk at renneting. (Cheese No. 37, 19/7/26.)

Again the ripe cheese exhibited a well marked black discoloration. Both the pin-head form and larger spots with intensely black centres and well defined margins were developed. A few indefinite smoky areas were seen, but the veining form observed in the previous cheese was not typically developed.

In the case of another experimental cheese (No. 47, 24/7/26), the same amount of red lead, 0·1 gram, was employed, but the lead compound was sprinkled over the curd on the rack, just after the running of the whey and before the matting or fusion of the curd particles had begun. The result was similar, but the black spots were smaller, more numerous and more evenly distributed throughout the cheese. The fault was easily detected on a plug of the cheese (fig. 2).

Chemically pure red lead as the experimental factor.—Pure red lead (0·1 gram) was added to the freshly stirred curd on the rack after the running of the whey. (Cheese 38, 20/7/26.) The ripe cheese exhibited numerous small black specks and a faint mottling throughout the substance of the cheese. When a core of the cheese was examined the mottled appearance could be observed under good conditions of light, but only when a careful inspection of the plug was made.

The same amount of pure red lead added to the cheese-milk at renneting (cheese 43, 22/7/26) induced a well marked black discoloration. The characteristic form was the pin-head type, but larger areas ($\frac{1}{4}$ inch in diameter) with smoky margins occurred at scattered intervals. A core of the cheese showed the fault quite distinctly.

White lead as the experimental factor.—White lead, $PbCO_3$-$Pb(OH)_2$, when employed at the rate of 0·15 gram and incorporated with the freshly drained curd on the rack produced a very marked form of the discoloration, the appearance of the infected cheese being the most spectacular of the series. (Cheese 41, 27/7/26.) There could be observed isolated jet-black spots of regular size ($\frac{1}{3}$ inch diam.), large well defined oval areas, greyish black in appearance, and a profuse black veining, reminiscent of the veins of Stilton cheese. A core of the cheese was most obviously discoloured.

In the case of cheese 42, made on 23rd July 1926, a similar amount of white lead was added to the milk at renneting. The infected spots were intensely black, but not so numerous as in some of the other discoloured cheeses, and for this reason might have been missed in the core of the cheese. Some smoky areas were also observed.

White paint as the experimental factor.—A dozen small flakes of white paint (0·5 gram) from the dairy door were pulverised and introduced into the cheese-milk at renneting. Well defined black patches and scattered irregular smudges made the fault very obvious on the cut surface of the cured cheese. On account, however, of the irregularity of their distribution, a core of the cheese might have given negative results. (Cheese 48, 26/7/26.)

The same amount of white paint was applied to the curd on the rack in the case of cheese 49 (27/7/26). When the ripe cheese was examined the fault was less obvious than in the case of the previous cheese, and the black spots might easily have been missed in a core of the cheese. The cut surface revealed small black specks and smoky blotches.

Lead acetate as the experimental factor.—When this lead compound was admixed with the cheese-milk at the rate of 0·2 gram, a more uniform discoloration was developed in the cured cheese than in previously recorded cases. The whole cheese was lightly discoloured, and in addition small localised blotches with irregular margins were seen. The discoloration was quite obvious on a core of the cheese. (Cheese 44, 23/7/26.)

Applied to the curd on the rack, 0·2 gram lead acetate produced a more pronounced form of the discoloration. The isolated discoloured patches were of larger dimensions but the curd mass was less generally discoloured. The fault was clearly distinguished on the core. (Cheese 45, 23/7/26.)

Solder as the experimental factor.—A small bar of solder (50 per cent. tin and 50 per cent. lead) was placed inside the cheese vat before the cheese-milk was added and was allowed to remain there until the curd was removed to the cooler. Only a few black specks were observed in the whole cheese. The result was nearly negative, since there was no appearance of the black discoloration in a random plug. (Cheese 46, 24/7/26.)

But when the acid curd during matting was left in contact with the solder, the black discoloration was more marked, though the fault was only obvious when the cheese was cut up. (Cheese 9, 2/2/25.) This circumstance is worthy of attention, since, if the curd is drained in the vat and is brought into contact with soldered parts of a repaired vat, it will explain how slight black discoloration is sometimes developed.

Encrustation in interior of lead pipes as the experimental factor.—The solvent power of soft water for lead is well known to chemists. But the possibility of water from a service pipe carrying appreciable amounts of lead has been doubted by some, while as a factor in black discoloration lead-contaminated water has been considered an improbable circumstance by others.

A piece of lead pipe which had been in use for some years and had an encrustation in its interior was secured from a local plumber. The deposit, which appeared to be entirely organic in nature was easily removed from the interior of the pipe without scratching or piercing the metal underneath. The presence of lead in this deposit was proved by calcining it and applying the usual chemical tests.

A small amount of the deposit (0·1 gram) was added to the cheese-milk at renneting in one case (cheese 40, 21/7/26), and to the granular curd after the running of the whey in another (cheese 39, 20/7/26).

In both cases a well marked black discoloration developed in the cured cheese. The discoloured areas had intensely black centres with diffuse margins, and stood out in marked contrast to the surrounding unaffected curd. The black spots occurred at intervals in the cheese and might not have been seen in a plug of the cheese (fig. 3).

The conclusion one might draw from this experiment is that if the deposit of such a nature were carried into the water which is used for diluting the rennet or for washing the cheese vat, black discoloration might be caused by such a factor.

Sources of lead contamination in cheese-making.—The principal source of lead contamination in cheese-making is undoubtedly the cheese vat itself. The modern cheese vat is a double-jacketed rectangular vessel composed of (*a*) an inner casing made of sheet steel protected internally by a coating of tin; (*b*) an outer casing made of charcoal steel. The space between the two casings is the water or steam jacket. To protect the walls of the water jacket from the corroding action of water and steam, the metallic surfaces are painted with "red lead"—commercial red lead in a vehicle of boiled linseed oil. The red lead gradually becomes detached, and small dissociated particles are almost invariably found on the floor of the outer casing and in the residual water of the jacket. If the warm water from the jacket is used, as it sometimes is, for washing the vat after the curd has been removed to the cooler, small particles of red lead may be left behind in the vat after cleaning, and will thus be introduced into the next day's cheese-milk. A case of black discoloration in the cheese of a south country dairy which was investigated was undoubtedly induced in this way.

Again it not infrequently happens that small holes develop in the floor of the inner casing; this is usually caused by the tinning becoming locally defective and exposing the underlying steel plate to the corroding action of acid from the cheese curd and to the rusting effect of water. In this way the water of the jacket gets into the cheese-milk, especially during the scalding period, and carrying small particles of red lead in suspension will infect the cheese with the discoloration factor.

Water heaters in dairies which are coated internally with red lead must also be regarded with suspicion, and more especially if such water is used for washing the cheese cloths. We have found that when the rack cloths become impregnated with tiny flakes of red lead they will infect the curd and cause the fault.

Small particles of any paint which contains white lead, which through accident or negligence gain access to the cheese-milk or curd, will cause black discoloration.

Solder used in jointing the vat may be a possible source of lead contamination, especially if it is the soft type rich in lead. In one case under our observation it was noticed that the solder jointing, which was of a soft nature, was scored with the cheese knives, and that small pieces of the alloy could easily be scraped off with a blunt steel instrument.

Summary.—Black spot in commercial cheese is not of bacterial or enzymic origin, but is due to lead contamination. Pasteurisation is no remedy for this fault.

NOTE.—*This contribution was received from the author in December* 1926.

AGRICULTURAL RESEARCH IN THE BRITISH EMPIRE.[1]

IV.—AGRICULTURAL RESEARCH IN AUSTRALIA.

F. L. M'DOUGALL, C.M.G., and A. S. FITZPATRICK, M.Sc., F.I.C.,

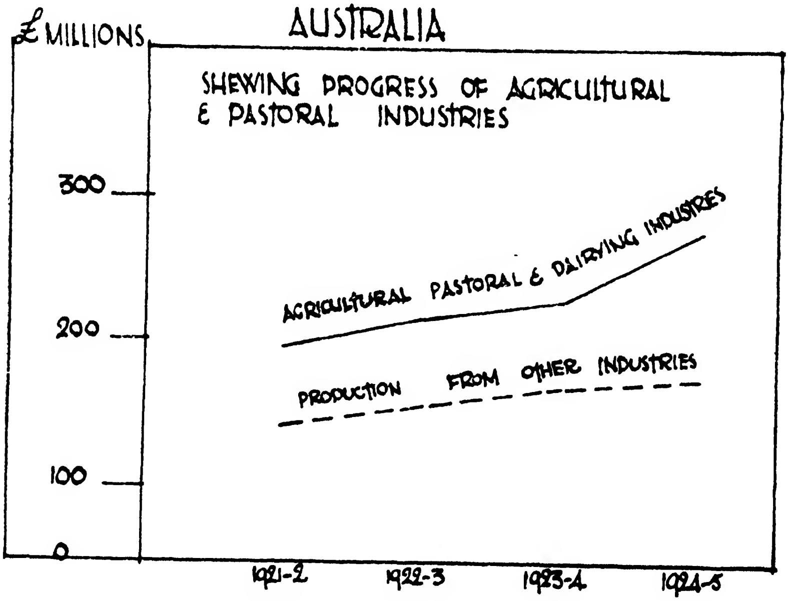
Commonwealth Council of Scientific and Industrial Research.

As the territory of the Commonwealth of Australia extends from Cape York, the most northerly point, which is only 7° south of the Equator, to South West Cape in Tasmania, the most southerly point, almost 44° south—in the "roaring forties" of the Southern Ocean—and as from east to west the greatest width of the Continent is 2,500 miles, it will readily be understood that Australian agriculture faces climatic

[1] This article is one of a series contributed in collaboration with the Director of the Rowett Research Institute.

problems of the very greatest diversity. Actually about one-third of Australia lies within the tropics, another third may be described as being semi-tropical, and the remainder falls definitely within the temperate zone. Thus in Queensland sugar cane, pineapples and bananas are cultivated on a large scale; in the Murray Valley a Mediterranean climate is found suitable for the cultivation of vines, peaches, apricots and the orange; in Southern Victoria and Tasmania oats and potatoes are staple crops. Although there is great dissimilarity of climate, some forms of agricultural production, such as, for instance, dairying, are carried on almost throughout the whole climatic range of Australia. Dairying is successfully practised within the tropics of Queensland, in the semi-tropical areas of the northern rivers of New South Wales and in the cool temperate districts of Southern Victoria. Australia, therefore, presents not only an immense variety of problems to the research worker, but also a field in which scientists can study agricultural problems under almost any climatic conditions.

The importance of agricultural and the pastoral industries to Australia will readily be realised if the following diagram is studied :—



The figures on which the above diagram is based are set out in the following table :—

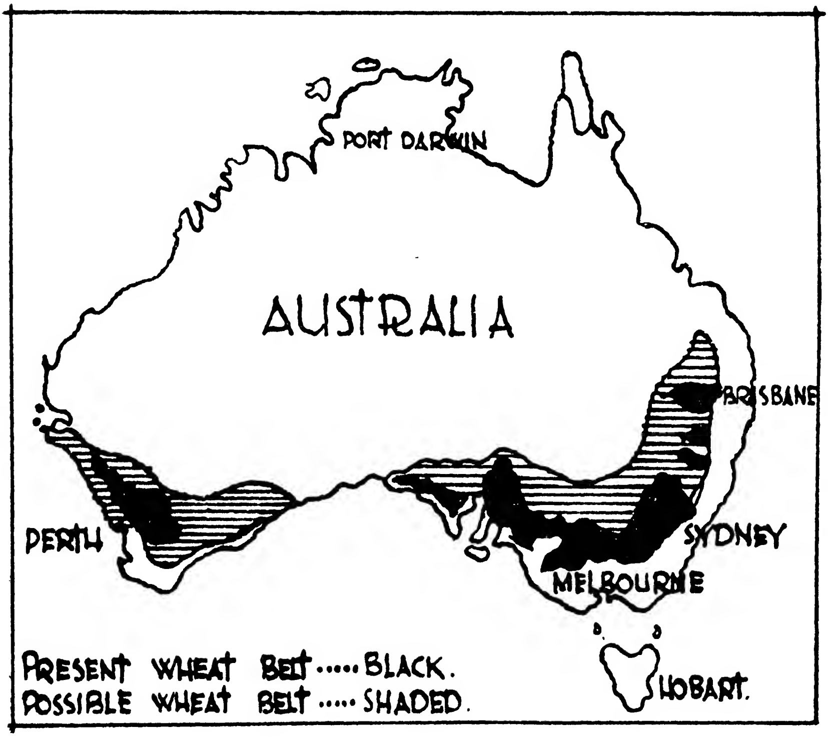
Value of Australian Production.

Year.		*Agricultural, Pastoral and Dairying.*	*Other industries.*
1921-22	...	£196,355,000	£143,013,000
1922-23	...	218,260,000	154,628,000
1923-24	...	226,121,000	166,830,000
1924-25	...	274,177,000	174,980,000

Although these figures represent large scale production, yet it should be realised that two factors indicate the immense scope for the further development of the agricultural and pastoral industries within the Commonwealth. These factors are as follows :—

(*a*) Up to the present time farming in Australia has been on an extensive rather than on an intensive scale. Immense areas of virgin land have been available for the farmer, and comparatively little attention has yet been paid to the examination of methods whereby lands can, upon an economic basis, be made to yield a maximum return.

(*b*) The percentage of land actually in cultivation in the districts in which it has been proved that satisfactory results can be obtained is small. The following sketch map shows the present wheat belt of Australia, and the probable inland limits in which climatic conditions would permit of economic production of wheat :—



An expert investigator has estimated that the present wheat belt covers some 124 million acres, but that, as a result of improved methods of dry farming and improvements in the breeding of wheats for dry areas, the possible wheat belt includes the immense total of 260 million acres. These figures may be regarded as an indication of the way in which most branches of the agricultural and pastoral industries can be increased within the confines of the Commonwealth.

Wool production is easily the most important primary industry in Australia, and wheat takes the second place. Dairying comes third, with the production of beef and mutton fourth in order of importance. Other established agricultural industries include sugar growing, viticulture, both for wine and dried fruit, fruit growing in all its forms, pig raising, the growing of potatoes, maize, oats, barley and hay.

Australia is but a young country with a small population, and naturally must look to other portions of the Empire, and particularly to Great Britain, for assistance in the solution of some of her agricultural problems. Nevertheless much useful work has been accomplished in the past; a number of workers are to-day engaged on problems of great economic importance, and there is every reason to expect that Australia will fully play her part in the Imperial development of agricultural research.

One most encouraging feature is the way in which the importance of research is appreciated by the people of Australia. This interest is reflected in the attitude of the press. Newspapers, and particularly those which circulate in the country districts, devote a large amount of space to descriptions of the results of research work.

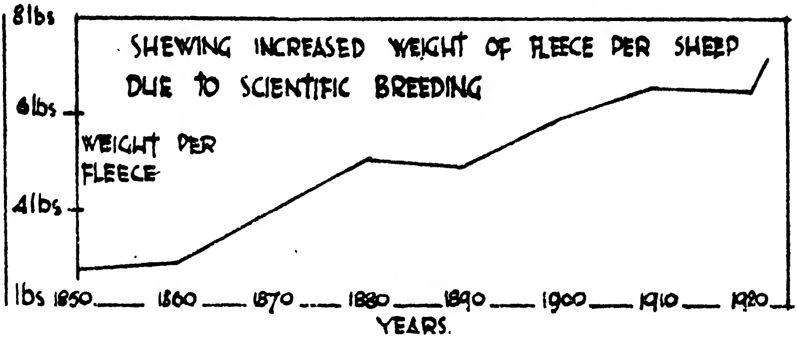
It is proposed in this article briefly to review some of the results of past research work, to indicate the programme which is now being carried on and the organisations through which this work is being extended.

Sheep Breeding.—The first merino sheep were imported into Australia in 1797, and the growth of the industry is vividly shown by the following figures :—

In 1807 245 lbs. of wool were shipped overseas, and in 1925-26, 7,689,000 centals of wool were exported.

Interesting comparison can be made in regard to the number of sheep and the total wool production. In 1891 the number of sheep was 106 million, the wool produced being approximately 543 million lbs. In 1919-20 the number of sheep was 77 million, and the wool produced amounted to approximately 683 million lbs.

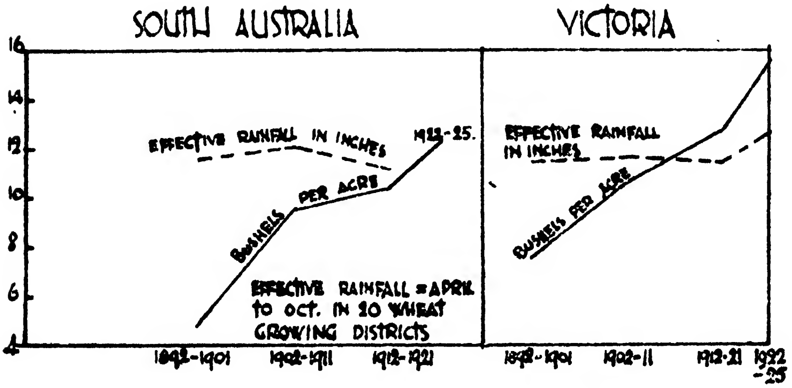
The predominating cause of this remarkable result is to be found in the early recognition by Australian sheep farmers of the importance of regulated breeding, which, after the rediscovery of the Mendelian principle, has been conducted on a scientific basis. This keen desire for improvement in the woollen industry has been fostered by the Pastoralist Association, the Royal Agricultural Societies, and by the Departments of Agriculture in the various States. The striking successes achieved by the Australian pastoralists in their efforts to improve the merino breed is shown in the following diagram.



In 1850 the average weight of fleece per sheep was less than 4 lbs., whereas in 1925 it averaged 7·69 lbs.

Wheat Breeding.—Australia is justly proud of the enterprise of her pastoralists, but the splendid results achieved by the scientists supported by the practical farmer in the improvement of Australia's wheat industry have not been adequately recognised.

The late William Farrar, a scientist trained at Cambridge University, devoted many years to the breeding of wheat at Lambreg, New South Wales, and finally produced, among other classes of wheat, a type called Federation, distinctive by reason of its short stalk and absence of flag (an important factor for dry farming) and high yielding qualities. The work begun by Farrar has been carried on at Werribee and Dookie (Victoria), Roseworthy (South Australia) and Cowra (New South Wales) Research Stations. Resistance to drought and to rust and other plant diseases has been sought. By the careful study of the factors in crop production—fallowing, manuring with superphosphate and the use of the most suitable seed—the wheat yield per acre has, relative to the rainfall, been raised in a striking fashion. This is best indicated by reference to the following graphs :—



In considering the above diagrams, it should be remembered that during the period indicated, wheat production in Victoria has been pushed into the dry Mallee districts, and that in South Australia wheat is now grown throughout what was known thirty years ago as the 90 mile desert.

Wheat Harvesting.—In dealing with the research on wheat production, it is desirable that reference should be made to a machine which, on the economic aspects of the wheat industry, has cut the cost of production down to a minimum. This machine—known as the combined harvester—gathers the grain, threshes and winnows it as it goes along, and delivers it into a bin ready for bagging. In a heavy crop the machine will bag nearly 100 bushels per hour, and, as is frequently admitted at farmers' meetings in Australia, this Australian invention has been one of the chief factors in her development as a wheat exporting country. The foregoing, while in no way exhausting what has been achieved, indicates prominent examples from the two leading industries.

The Commonwealth Council for Scientific and Industrial Research.—In 1925 the Commonwealth Parliament passed the necessary legislation to establish the Commonwealth Council for Scientific and Industrial Research. This body, which takes the place of the former Advisory Council of Science and Industry, consists of a central Council and State Committees, through which co-operation is effected with the various State Governments and Universities. The Commonwealth Council deals with the whole field of scientific research in Australia, but is naturally concerned with the special claims of the primary industries. The Commonwealth Government, recognising that machinery is useless unless supplied with funds, arranged for the Federal Parliament to allocate £250,000 for the scientific research work carried out under the auspices of the Commonwealth Council.

Simultaneously with the creation of the Commonwealth Council for Scientific and Industrial Research, the Commonwealth Government established the Development and Migration Commission, one of the activities of which is to make a careful investigation of economic conditions in Australia. Thus there are now two central organisations, one surveying the scientific and the other the economic aspects of Australian industries, and the two bodies work in the closest correlation.

State Government Organisations.—Each of the six State Governments maintains a Department of Agriculture. These Departments, according to their staff and equipment, are able to devote a certain amount of attention to research, but naturally the greater proportion of their activities are devoted to education, demonstration and extension work among farmers, and to the administration of various Acts of Parliament which affect agriculture. It is impossible to describe in detail the many phases of the work of these Departments, even on the research side, but their valuable contributions on cereal breeding, dairying, viticulture and horticulture, veterinary science and agronomy, have done much to raise the standards of agricultural production throughout the Commonwealth.

The Universities.—Each Australian capital city has a university, and most of the universities have a Faculty of Agriculture, which generally works in close co-operation with the State Departments of Agriculture. The agricultural researches carried out at the universities are to some extent influenced by the nature of the primary industries pursued in their respective States. Thus, in Sydney University, plant pathology and plant genetics are prominent lines of investigation; in Melbourne, at the Veterinary Research Institute and the School of Agriculture, veterinary pathology and factors in crop production are of importance. At Adelaide University the activities of the Waite Agricultural Research Institute are mainly concentrated on agronomy, agricultural chemistry, plant breeding and plant pathology. A comprehensive research, under Professor Brailsford Robertson, into the mineral deficiencies of pasture lands is now being undertaken, with the assistance of the Empire Marketing Board and the Commonwealth Council for Scientific and Industrial Research. At Queensland University, where there is as yet no Faculty of Agriculture, excellent work has been done under Professor Goddard at the Department of Biology on the investigation of diseases in bananas. Professor Goddard is also collaborating in the work of the Commonwealth Prickly Pear Board.

Some Present Research Problems.—*Fruit Growing.*—The special problems of the fruit growers in the Murray Valley and elsewhere have recently received considerable attention from the Commonwealth Council of Scientific and Industrial Research, and as a result the Council is now stimulating a co-operative effort through the media of the Waite Research Institute, the Griffith Citricultural Research Station and the Merbein Viticultural Research Station. One of the major problems is the suitability of various soils for irrigation and the study of the effect of green manuring on soil fertility.

An interesting example of Empire co-operation is to be seen in the present investigation of the dried fruit grub pest. Owing to the co-operation between the Commonwealth Council of Scientific and Industrial Research and the Empire Marketing Board, a highly qualified entomologist, lent by the Imperial Bureau of Entomology, has recently gone to Australia to investigate this problem.

Cold Storage and Preservation of Foodstuffs.—The Council is concentrating initially on the problems of fruit and meat, and in pursuance of this policy has sent graduates to England to be trained under the Food Investigation Board (of the Department of Scientific and Industrial Research). Dr. Kidd (of the Cambridge Low Temperature Research Station) is at present visiting Australia for the purpose of advising on the best scheme of investigations to be carried out in Australia on cold storage and preservation.

It is considered in Australia that only by close co-operation between the Food Investigation Board in Great Britain (the principal market for these foodstuffs) and the Commonwealth Council of Scientific and Industrial Research can the problems of the Australian share of the Empire's food supply be solved.

Meat Export.—The scientific problems in the establishment of a beef export trade have been for some time the concern of a special meat freezing Committee. As a result of the assistance granted by the Commonwealth Council of Scientific and Industrial Research, researches to determine the effect of age, breed and environments of the beast on the refrigeration properties of its flesh are now being carried out. The Commonwealth Council of Scientific and Industrial Research is co-operating very closely with the Empire Marketing Board and the British Department of Scientific and Industrial Research in the investigations of cold storage problems.

Tropical Agriculture.—Bananas.—Mention has already been made of the excellent work of the Department of Biology, Queensland University, in the solution of the bunchy top infection of bananas along the area between Brisbane and Sydney.

Prickly Pear. — This plant had, in 1919, spread over 23,000,000 acres of land in Queensland and New South Wales, and was estimated to be spreading at the rate of 1,000,000 acres per annum. The Commonwealth Government, in co-operation with the State Governments of New South Wales and Queensland, has for some time been carrying out investigations for the eradication of this devastating growth.

The latest reports indicate that, by a scheme of biological control now being applied, various insects are firmly established and are causing substantial destruction of this noxious weed.

Animal Problems.—Nutrition.—Under the Commonwealth Council of Scientific and Industrial Research a Nutrition Committee has been set up, the Chairman being Professor J. B. Robertson (Adelaide). A report from this Committee has been submitted to the Council recommending investigations on the following problems :—

(*a*) Mineral content of pastures and water supplied to stocks.

(*b*) Adequacy of proteins in pastures and fodder supplied to stock, especially during droughts.

(*c*) The determination of indigestible residues and astringent material in edible plants at different seasons and in different localities.

(*d*) The vitamin content of pastures and animal products, and especially those of products that are exported.

(*e*) The study of pasture regeneration of depleted areas.

The mineral contents investigations are now being carried out at the Waite Research Institute (Adelaide) with the assistance of the Empire Marketing Board, this being taken as part of the Empire scheme of investigations on pasture lands which has its centre at the Rowett Research Institute, Aberdeen.

In the past a considerable amount of research work directed towards an explanation of nutritional diseases has taken place in the various States of Australia. Though up to the present no definite correlation has been attempted, a careful examination of the published records indicates a common cause of the numerous diseases recorded, namely, mineral deficiency of the pastures. In Tasmania, New South Wales, Queensland and Victoria, diseases variously known as Dry Bible, Impaction Paralysis, Midland Disease, Osteomalacia, Worm Infestation in sheep, have been shown to find an indirect cause in the fact that much of the surface soil of Australia is deficient in lime and phosphorus or in phosphorus alone. Professor A. E. V. Richardson, at the Waite Research Institute, Adelaide, is conducting a line of study on the relation between soil and the health of animals which, in due course, will doubtless harmonise with and help to explain other investigations taking place in other States.

Diseases and Pests.—After careful consideration had been given to important pests and diseases by a conference of the leading veterinary pathologists of Australia, the Commonwealth Council of Scientific and Industrial Research has decided to continue or to initiate investigations into certain diseases and pests affecting cattle, sheep and pigs in Australia. These include such problems as foot rot, fly pests, abortion in cattle, and paralysis in pigs.

Dairying.—A Committee on Dairy Research has been established (under Professor Woodruff) by the Commonwealth Council of Scientific and Industrial Research to consider the necessary investigations on dairy problems which should be pursued under the direction of the Council. Very extensive dairying investigations are being carried out by the State Departments of Agriculture, notably in Victoria and in New South Wales, and the relation of the Commonwealth activities to this work requires very careful consideration.

Tasmania.—It has been realised that there is much scope for improvement in the whole economic position of Tasmania. For this reason the Commonwealth Council of Scientific and Industrial Research, in co-operation with the Development and Migration Commission and the Tasmanian Government, has proceeded with enquiries into animal and plant industries in that State.

Dr. G. F. Finlay has been engaged on making a survey of the animal industries, and will tender his report together with recommendations to the Council. Mr. G. F. Hill and Dr. Ethel M'Lennan are engaged on investigations on entomological and fungoid diseases in the plant industries of Tasmania. These investigations on agricultural matters will form the ground work for the economic stabilisation of Tasmania, which is now being undertaken by the Development and Migration Commission, with the assistance of the Commonwealth Council of Scientific and Industrial Research.

Training of Research Workers.—A fund of £100,000 has been invested as a trust fund by the Commonwealth Government for the purpose of training research workers as recruits for scientific investigations in Australia. Under this scheme research students have been selected and have gone to such institutions as the Low Temperature Research Station, Cambridge (meat, cold storage), and Cornell University, U.S.A. (entomology). From the State Departments of Agriculture research workers are, from time to time, granted leave of absence on full or half pay for the purpose of visiting various research stations in Great Britain and in other parts of the Empire.

Co-operation within the Empire.—It is hardly to be wondered at that, in a country so predominantly British as Australia, the results of agricultural research in Great Britain are closely followed. By frequent visits of the research workers and the directors of research from Australia to New Zealand and *via* South Africa or Canada to Great Britain, perhaps to spend a short time in research institutes in this country, closer contact is maintained with the agricultural developments throughout the Empire.

It is the definite policy of the Australian authorities to encourage the visits of British scientific experts to Australia to advise on various phases, not only of agricultural but of other branches of national industry. The immense importance of the researches carried out at such institutes as those at Rothamsted, Cambridge, East Malling, Edinburgh and Aberdeen is fully realised by agricultural experts in Australia, and if Australia is to advance as she should in the primary industries, the co-operation of Australia with British scientists is as essential as it will be welcome.

SOME EFFECTS OF CALCIUM COMPOUNDS ON THE SOIL AND ON PLANT GROWTH.

W. T. H. Williamson, B.Sc., Ph.D.,

Edinburgh and East of Scotland College of Agriculture.

Several compounds of calcium are used in agricultural practice and the effects produced by these substances on the soil and on plant growth have been the subject of much study on the part of scientific investigators. In addition to the various forms of "lime" utilised as soil improvers, many of the fertilisers in common use are compounds of calcium. These include most of the phosphatic fertilisers and such nitrogenous manures as "nitrate of lime" or calcium nitrate and "nitrolim" or calcium cyanamide. In a previous communication (1) the importance of maintaining the supply of calcium in the soil was emphasised, and the chief effects of lime as a soil improver were pointed out. It may therefore be of interest to discuss the effects of other compounds of calcium, as these are perhaps less generally known.

Many Scottish soils contain no reserve of calcium as "carbonate of lime," and attention has been recently turned to the calcium present in soils in what is known as the exchangeable form (2), as in such soils this is the form most likely to affect the physical and chemical condition of the soil as regards plant growth and most likely to be affected by manurial treatment. For instance, as mentioned in the articles referred to above, a "sour" soil generally has a low content of exchangeable calcium, and a soil which has been subjected to flooding by sea water has much of its exchangeable calcium replaced by sodium, with the result that the soil becomes badly puddled. The continued use of artificial fertilisers (other than those containing calcium) tends to reduce the amount of exchangeable calcium in a soil, the calcium being replaced by the other bases present in the manure. On the other hand, the use of substances containing calcium would be expected to maintain the supply of this element in the soil or even to increase it. The latter effect, however, would depend on the amount of exchangeable calcium already in the soil. If this were high the addition of a calcium compound would have little or no effect on it.

The effect of individual compounds of calcium may now be considered. If a soil is acid, the addition to it of some form of lime, such as calcium oxide (quicklime) or calcium carbonate (ground limestone), results in a reduction in the degree of acidity. If sufficient lime is added the soil is rendered neutral, and if an excess is applied the soil acquires an alkaline reaction. The amount of lime required to bring about a certain reduction in the degree of acidity of a soil in the field is found to be much greater than is necessary to produce the same effect in a laboratory experiment with the same soil. The quantity required in the field is generally found to be about three times that indicated by the laboratory method. This is partly due to the fact that, in the calculation from the analysis, the weight of soil is taken to a depth of 9 inches only, whereas, as shown by E. M. Crowther (3), the acidity and the effect of the lime are distributed over a much greater depth. Whether or not the addition of lime to a soil will have any effect on the yield of the crop depends on a variety of circumstances, and a soil which shows a "lime requirement" in the laboratory will not necessarily respond to liming.

When a substance like calcium nitrate is added to a soil, then, unless the soil is fully supplied with calcium, some of this element will be absorbed by the soil replacing other bases or hydrogen present in the soil complex. The replaced hydrogen will cause the production of soluble acid in the soil solution. Thus treatment of a soil with a solution of a neutral salt like calcium nitrate gives an extract which is much more acid than that obtained by extraction of the soil with the same amount of water. Even a neutral soil may give an acid extract with calcium nitrate. This does not mean, however, that the soil itself will be rendered permanently more acid. It is really the soil solution which has increased in acidity, and in the field where the soil is subjected to frequent leaching by rain water the soluble acid produced by the addition of calcium nitrate would soon be washed out from a well-drained soil and disappear in the drainage water, while the soil itself would be found to be no more acid than it was originally. Indeed the condition of the soil might more likely be found to be improved owing to a gain in exchangeable calcium. In the case of calcium cyanamide, the residue left in the soil is calcium carbonate, so that this fertiliser, like the last, in addition to supplying nitrogen, helps to keep up the calcium content of the soil. In fact, the addition of calcium cyanamide to the soil is equivalent to a dressing of carbonate of lime. The results of field experiments in America (4) show that the continued use of calcium nitrate does not increase the acidity of the soil and may actually reduce the lime requirement, while calcium cyanamide reduces both the acidity and the lime requirement.

The fact that superphosphate is considered an acid manure has led to a very prevalent idea that its use will increase the acidity of a soil. This fertiliser consists mainly of a mixture of an acid calcium phosphate and calcium sulphate or gypsum, and a solution of it gives an acid reaction. Its application to the soil will therefore produce an immediate increase in acidity, but this effect is merely temporary, and no permanent increase in the acidity of the soil will be found to take place. The grass plots at Rothamsted which have been continuously manured with superphosphate at the rate of 3½ cwts. per acre since 1856 have been shown to be no more acid than the unmanured plots, while the degree of acidity exhibited by the barley plots at Woburn, continuously manured with superphosphate for 46 years, is no greater than that of the unmanured plots (3). The Rothamsted experiments further show that the superphosphate has increased the amount of exchangeable calcium in the soil (5). Mineral phosphates and basic slags, containing excess of calcium, tend to decrease acidity and add to the calcium supplies in the soil. M'Arthur (6) has shown that the calcium silicate contained in basic slag has the same effect as an equivalent dressing of carbonate of lime.

Two years ago experiments were started at Boghall Experimental Farm with a view to studying the effect of dressings of calcium compounds on a piece of very sour land. This investigation is being carried out with the aid of a grant from the Board of Agriculture and the Development Commission, and most of the analytical work in connection with it is being undertaken by Mr. Andrew Comrie, to whom I am indebted for the results, details of which will be published elsewhere. The piece of land in question was sown with barley in the spring of 1924, and the result was practically a complete failure, only small patches of barley surviving after the first few weeks. There was a prolific growth of weeds, mainly spurry and sheep's sorrel, with some hemp-nettle and redshank. The soil from the field was very extensively sampled and examined to discover whether there were any significant differences between those parts of the field where

the barley plants survived and the adjacent parts where the crop failed. The most striking differences observed were in the content of exchangeable calcium. This was found to be invariably higher in the soil where the barley grew to maturity than it was in the surrounding soil where the crop failed. In the spring of 1925 a part of the field on which the barley crop had entirely failed the previous year was laid out in plots of 1/250 acre, and different amounts of various calcium compounds were applied, each treatment being in triplicate. The substances used were carbonate of lime, superphosphate, mineral phosphate, and calcium chloride. In addition, each plot, including the controls, of which there are four, has received annually a general manurial dressing at the rate per acre of 2 cwt. nitrate of soda, 1 cwt. muriate of potash, and 2 cwt. superphosphate.

The quantities of each calcium compound applied were calculated on the basis of various theoretical considerations. In the case of the carbonate of lime the amounts varied from $2\frac{1}{2}$ tons to 12 tons per acre. Each treatment with carbonate of lime has resulted in a reduction of the acidity of the soil and in an increase of the exchangeable calcium content. The mineral phosphate, which was applied at the rate of $5\frac{1}{2}$ to 8 tons per acre, has also reduced the acidity, although not to the same extent as the carbonate of lime. Superphosphate was applied at the rate of $8\frac{3}{4}$ tons to $12\frac{1}{2}$ tons per acre. The results of the work on the phosphate plots are not yet complete, but as was expected, the immediate result of adding superphosphate in such large quantities was an increase in the acidity. When sampled in December 1925 these plots were still more acid than the original soil or the corresponding control plot alongside. As the land is not well drained and the dressings of superphosphate were so heavy it would be expected that these plots would take longer than usual to return to a normal condition. This is well illustrated in the case of the calcium chloride plots, the work on which has been carried further. Calcium chloride is a by-product in the manufacture of bicarbonate of soda and is extremely soluble in water (in distinction from calcium sulphate or gypsum, which is still used in some places as a soil improver and is relatively insoluble). It was, therefore, considered a suitable substance for experiments on the effect of heavy dressings of a neutral salt of calcium on a soil. As explained in the discussion of the action of calcium nitrate, it would be expected that, when a neutral salt like calcium chloride is added to the soil, some calcium would be absorbed and a soluble acid would appear in the soil solution. This acid would later be washed out and the soil should ultimately show no greater degree of acidity than it had originally, while the content of exchangeable calcium should be increased. The calcium chloride was applied to the plots in the beginning of May 1925 at the rate of $12\frac{1}{2}$ tons per acre, a dressing equivalent to the heaviest one of carbonate of lime. In June of that year the plots so treated were found to be much more acid than the original soil or the control plots alongside; in October and

December the degree of acidity was much reduced but was still greater than that of the control. By June of 1926, however, these plots were found to be no more acid than the control, and when sampled again in September 1926 they had also the same degree of acidity as the original untreated soil, while the amount of exchangeable calcium was considerably increased.

These experiments have not been carried out over a sufficient number of years to justify drawing any conclusions regarding the effect of the various treatments on the yield of barley, but it may be said that, while the barley failed completely on all the controls each year, varying quantities grew to full maturity on the treated plots. With regard to the effect on the weeds, the carbonate of lime has in every case reduced the amount of spurry in relation to that of sheep's sorrel, so that, while in the rest of the field the former weed is more abundant than the latter, on the limed plots the reverse is the case. The effect of the heavy dressing of such a soluble salt as calcium chloride was, at first, to destroy every form of vegetation with the exception of a very few plants of sorrel, but by October a fresh growth of spurry had appeared, and last year all the calcium chloride plots supported a crop of barley which was, in some cases, as good as that obtained on the most heavily limed plots. The weeds in the same season on these plots were mostly spurry, except in the case of one plot on which redshank was the most abundant weed.

References.

1 W. T. H. Williamson, *Scottish Journal of Agriculture*, vol. ix, No. 1, p. 29.
2 W. G. Ogg, *Scottish Journal of Agriculture*, vol. ix, No. 1, pp. 25-29.
3. E. M. Crowther, *Journal of Agricultural Science*, vol. xv, Part 2, p. 222.
4 Joffe and M'Lean, *Soil Science*, vol. xxiii, No. 2, p. 127.
5 Page and Williams, Transactions of the Faraday Society, vol. xx, p. 573.
6 D. N. M'Arthur, *Journal of the Society of Chemical Industry*, vol. xlii, p. 213T.

CRANE FLY GRUB AND THE OAT CROP.

John Rennie, D.Sc.,
North of Scotland College of Agriculture.

Crane flies, better known in this country as "Daddy-long-legs," are amongst the commonest of farm insects, and detailed description is scarcely needed for purposes of general identification. They are slender bodied, long legged, narrow winged and mostly large insects. The possession of only one pair of wings behind which can be readily seen, like a pair of slender pins, the characteristic "balancers," marks them rather easily as members of the order Diptera or true flies. They belong to a family *Tipulidæ*, several species of which are common on farm land in the grub or larval stage. The most frequent, judging by the occurrence in cultivated soil in the north of Scotland, I have found to be *Tipula paludosa*, *T. oleracea*, and *Pachyrhina historio*. Other forms less numerous are fairly common in woods, moorland and waste ground.

It is now generally known amongst agriculturalists that these flies, which may be seen in great abundance in late summer and in the autumn, are the parents of the highly destructive larva or grub known variously under the common terms of " leather jacket," " tory worm," or simply " the grub."

During recent years these insects have been the subject of close study both in field and laboratory at Aberdeen. The species found to be commonest in the northern area of Scotland is *Tipula paludosa*, but there are no essential differences in habit so far as these affect corn and pasture between this species and *T. oleracea*, which appears to be the commoner form in England.

Adult flies of both species begin to appear about the month of June. Other species may be seen earlier, e.g. a spotted winged form (*T. varipennis*) has been obtained in large numbers in the Island of Lewis in the first week of May, and a large handsome crane fly, with beautifully marked wings, *Pedicia rivosa*, has been found in Aberdeenshire in the beginning of June. As the season advances, the numbers of the common species steadily increase, until in late August and September the fly may be extraordinarily abundant. About the beginning of October the numbers have decreased very significantly, and in a short time none at all are to be found.

The Life History of the Crane Fly.—The newly emerged female flies are strikingly full in the body—big with eggs. The fly is rarely seen in this condition, and in experiments it has been found that mating takes place almost immediately after their emergence from the pupal cases in the soil, and that egg-laying commences within a few hours afterwards. Polygamy is notoriously rife, and repeated indiscriminate matings of both sexes were found to be the usual occurrence in captivity. The bulk of the eggs present in the body are soon laid. The female, inserting her ovipositor in the ground, releases a few in one place, and moving onward repeats the process until eventually she becomes appreciably more slender in the body. There is evidence that later there is a further development of eggs, and a subsequent period or periods of egg-laying ensues. The marked change of form undergone by the female at this time enables one readily to tell whether oviposition has taken place. The eggs thus laid are small, oval bodies, about one millimetre in length, black in colour and having a tough skin, highly polished when freshly laid. Each female lays not fewer than 400 eggs, and probably a good many more.

About a fortnight after the eggs are laid the first stage larva or grub emerges. It is of a pale reddish colour, less than one-eighth inch in length, and in general not very like the familiar, older " leather jacket." In particular it possesses at the hinder end of the body two sets of long bristles which project lateral wise in a fan-like manner from the tail region. By the time the larvæ are 14 days old, they are now about one-fifth of an inch in length, and resemble in general appearance the larger and more familiar "leather jacket." They feed from the very commencement of their existence, and continuous observations have shown that they spend not less than nine months—i.e. broadly from September to June—in this condition, and approximately the whole year is occupied in the complete development of this insect. It is generally believed in England that two generations are passed through in the course of a year, but we have found in the north of Scotland at all events that this is not the case.

In experimental rearing it was found that in the early stages the larva or grub was markedly susceptible to changes in the physical condition, and particularly to dryness. When prevented from reaching the moist regions of the soil they died off rapidly, and the evidence obtained suggested strongly that a damp condition of the soil in late summer and autumn favoured the survival of larger numbers of grubs to harass the farmer in the following year than was the case when the autumn was a drier one. We know less regarding their powers of endurance in winter, but it was found that frost at any rate had not the killing powers which are popularly imagined.

While nine months may be taken as about the normal period of larval existence, experimentally larvæ which were kept on limited food supplies remained alive in this stage for 15 months, and it would appear that the duration of this period depends to some extent on the facilities for feeding. Grub were not found to feed when the temperature was low, and consequently prolonged severe winter weather tends to lengthen the life history period.

Fully grown larvæ reach a size of about 35 millimetres, when they pupate. In contrast to the long grub period, there is a very short pupal stage during which the larva undergoes the transformation into the winged creature. On the pupa externally there can be recognised the head, legs, wing rudiments and even sex differences. The pupa is passive so long as it remains undisturbed in the earth or until the time of emergence of the adult approaches. This takes place in from nine days to about a fortnight. The abdominal region carries a number of spiny or thorn-like projections, and by muscular jerks of this part of the body the pupa is levered in the ground with the help of the spines until the anterior region projects above. From the pupal case in this position the adult fly breaks free, emerging by a cleft which appears in the middle of the back.

The adult life is short, lasting not more than a few weeks at the most, the main business being, as already described, that of propagation of a fresh generation. Little food is taken, and their activities appear to be directed chiefly to the exercise of this function.

The adult insect has a number of active natural enemies amongst the birds, which, on account of this, are sometimes reckoned amongst the farmer's friends. While no doubt they are helpful to some extent, their services are probably more apparent than real, for in many instances the bulk of the egg-laying has been completed within a few hours of hatching and before the female flies have taken to the wing. Nature, in this instance, is on the side of the crane fly.

The degree of crop losses arising from the attacks of insects is one in which numbers of factors are in operation, besides the mere presence of the insect itself, a fact well illustrated in the case of the crane fly. One or other of the two species of grub occurring in agricultural land is generally distributed throughout the country, and every year these insects are to be found on the majority of arable farms. But there are many years in which significant crop losses are not generally sustained, and many farms on which in the obvious presence of the insects evidence of their attacks is not apparent.

With a view to clearing up the problem of crop losses in relation to " grub " attack, the co-operation of farmers in supplying data regarding their experiences and preventive or remedial practice was sought some time ago in conjunction with experiments then in progress in the north of Scotland. One hundred and eighty-nine replies were obtained in answer to a series of questions submitted. The value of these collectively is very great, and in the present communication I propose to review them in the light of the life history and habits of the insect as ascertained by observation and experiment at the same time within the same area.

The first question addressed to the farmer was whether crop losses due to the activities of " grub " occurred on his farm, and, if so, to what extent,—whether regularly, periodically, slightly, moderately or excessively. One hundred and fifty-eight farmers reported the occurrence of attacks of the insect in varying degrees of intensity from time to time, and in the remaining 31 the reply stated that " grub " attacks were not known upon the farm in question. These replies came from farms situated in the counties of Banff, Moray, Inverness and Ross, in all of which the crane fly is known to be quite common. It is further highly improbable that the larvæ of these insects are ever absent in any year from the soil of these farms. The estimates of farmers as to the prevalence of this or any other soil insect pest are as a rule based upon recognised damage to crops in the first instance rather than upon their recognition of the insects themselves in the field. If there is no visible failure of the crop, it is in general assumed that the pest is absent or represented only in limited numbers. My experience of this insect suggests that it is common and more or less abundant every year. By actual search over a succession of years I have found, in cases where the farmer reported that " grub " never gave him any trouble, that the insects were quite abundant upon his fields. It is clear that even considerable numbers, except where a certain limit is exceeded, may be counteracted by other factors.

In spring it is not difficult to arrive at an approximate estimate of the numbers in an acre of ground. By the simple method of plotting out, upon representative portions of a field prepared for sowing or recently sown with oats, areas one-fortieth of an acre in extent, and selecting a mild morning, the earlier the better, for the test, an approximate count of the grubs present on the plot may be made by first lifting all loose pieces of turf ("foggage"), teasing these thoroughly and removing the grubs, including those found beneath the turves. Next, any large loose stones are turned and sheltering grubs found below are removed, as also any seen moving on the surface, and included in the count. Less than an hour's time is required by two workers for this operation. If representative samples of the field—e.g. low lying, sheltered, damp or high ground—are treated in this way, a useful approximation to the total numbers present in the ground is arrived at. The following are actual results obtained by this method of sampling fields.

				Per acre.
1.	31 grubs per plot	1/40 acre,	crop well brairded :	1,240
2.	82 grubs per plot	do.,	do.,	3,280
3.	210 grubs per plot	do.,	crop 2-3 inches long :	8,400
4.	268 grubs per plot	do.,	crop newly sown :	10,720
5.	72 grubs per square yard (average of 10 samples),		crop badly damaged :	348,480

Experience has shown that any other method, such as digging up grass before it is ploughed or after, and tearing the turf for examination, is not only more tedious and laborious, but invariably gives a lower count. All the grubs are not found by either method, but the foggage collecting method on prepared harrowed land is the more expeditious and has been proved to give more accurate results. Information obtained in this way has enabled us to arrive at a knowledge of the range of numbers which may be present from year to year in a field, as well as some knowledge of the effect of numbers on the crop on the ground.

Cases occur in which grubs to the extent of 12,000 per acre, as determined by the "foggage" collecting method, may be present, in which subsequently no appreciable reduction in crop yield occurs. It is not suggested that the grubs do not attack the crop, and that the yield might not be better if they were fewer. But there are no markedly thin patches and the yield does not fall below the general average.

It has also been found that if the average number per acre is between 45,000 and 50,000, reasonable manuring and efficient farming practice, such as is discussed later, will prevent appreciable loss and provide a satisfactory yield. Much larger numbers of grubs may not infrequently be found in the fields amongst oats, as is shown by the figures already quoted, but experience gained by estimating numbers in the soil shows that only when these are well over 50,000 per acre, assuming capable farm practice otherwise, do numbers become the dominant factor in determining losses from the presence of this insect. Taking a practical issue at this point, if a farmer finds there are grubs up to 50,000 per acre on a field prepared for sowing, it will be good farming on his part to sow later rather than early. The reason for this conclusion follows.

The next question to which an answer was invited was: "Following what kind of weather do you find 'grub' more plentiful or scarce? (e.g. whether after severe frosts, stormy weather, mild open weather, &c.)."

The replies to this question revealed a widespread impression that after a mild open winter the larvæ are most likely to be plentiful, and that attacks on the oats are to be looked for in such a case. It was recognised by some that frost does not kill grub but is helpful to the crop, in that it gives a better tilth. Some expressed the opinion that the type of winter makes little or no difference.

The main factors affecting the "grub" problem in winter may be briefly outlined thus:—

(1) The numbers of eggs laid in the previous summer or autumn. This determines the numbers of insects starting winter life.

(2) The type of weather as far as it may act as an eliminating agent. I am of opinion that weather affects grub not at all as a killing factor. Exposure to frost over night does not kill grubs. In mild winter weather they probably feed to some extent and will be fuller grown in spring, and perhaps less ravenous in their attack on young germinating corn.

(3) Opportunities for reduction by natural enemies. Mild weather may be expected to permit attacks by moles and various birds, but reduction in numbers by such means is not likely to be significant at this season.

It is probable that the basis for the view that "grub" is more plentiful after a mild winter is to be found in the larger proportion of fuller grown larvæ which are to be seen after such a season. Smaller grubs are less easily observed. The view expressed by a good many of the farmers that the type of winter weather makes little difference is probably very near the truth. We thus arrive at the conclusion that the chief determining factor of the numbers surviving in spring is the number of eggs laid in the previous autumn. In this connection it may be recalled that in my breeding experiments newly hatched larvæ were found to be extremely susceptible to drought, and that one possible cause of variation in the numbers of winter-surviving larvæ may be dry autumn weather, when the majority of the larvæ are hatching from the egg.

It is probable that amongst natural factors the key to the cause of most cases of failure of the oat crop is to be found in the kind of weather prevailing in spring. Farmers were asked to state after what kind of spring weather, early or late, grub attacks were bad or slight.

There is practical unanimity that a cold wet spring favours the ravages of grub on the oat crop. Typical replies are :—

"Worst after a cold late spring."
"Cold and wet at the time of second growth."
"Early seed time with bad cold weather following."
"When wet and cold three weeks after sowing."
"Cold weather after early sowing."
"A late cold spring with slow growth."
"An early spring and wet weather after sowing."

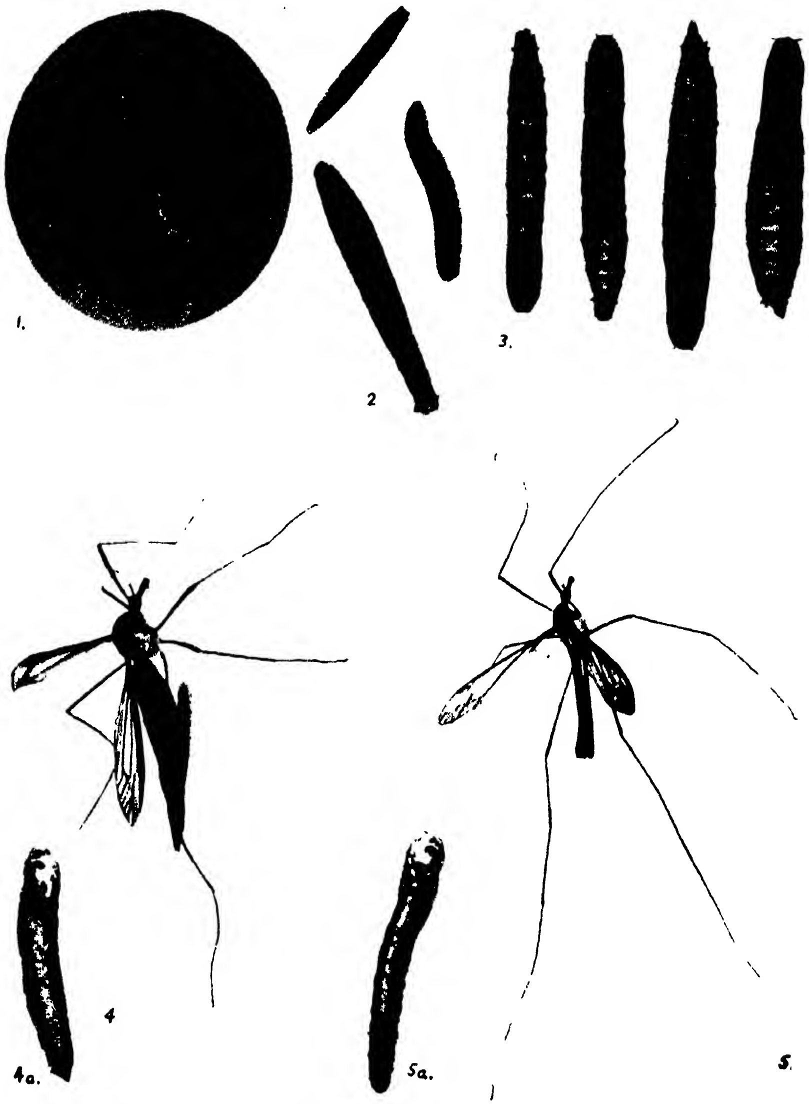
These impressions accord well with scientific fact. What actually happens is that under conditions of cold intervening during the period of germination, growth is retarded, and plants attacked before the period of secondary growth at which the adventitious root system becomes established are liable to be killed. It is not directly due to the grub being more ravenous in cold weather than in warm, but because this stage of growth is critical, and the longer it lasts a larger proportion of plants are actually killed from the attack. The grub is active at a later stage, but then, although it damages, it does not kill the plants. Growth continues and the capacity to tiller is not destroyed. Bare patches are not apparent in the latter case, and the damage eventually is not apparent, nor is it of ultimate importance, since it does not prevent tillering.

"Any cause therefore tending to extend the period of germination or immediately subsequent growth increases the liability of the crop to loss from *Tipula* attack. In this north-eastern area the period between sowing and brairding for oats in an average season is from 10 to 14 days. In a series of seven cases which came under observation in one season in which failure of parts of the oat crop, attributed to *Tipula* attack, took place, this period ranged from 16 to 21 days. There was one case in which, owing to severe drought, it lasted six weeks. The actual proportions of crop failure were stated thus :—

Period between sowing and germination.		*Proportion of crop lost.*
16 days	...	One-fourth of whole crop.
6 weeks	...	One-third of whole crop.
17 days	...	One-tenth of whole crop.
3 weeks	...	Loss incurred; proportion not estimated.
16-18 days	...	Almost one acre destroyed.
3 weeks	...	One-third of crop.
3 weeks	...	One-third of crop; it recovered later.

"On this account early sowing, especially in the north-eastern climate, is attended with a certain amount of risk. The same risk would apply to all late districts in seasons when fine weather in spring tempts the farmer to sow early." [1]

[1] *Annals Applied Biology*, 1917, p. 135-6.



Life History of *Tipula paludosa*, Meigen.

1. Eggs.
2. Grubs or Leather Jackets.
3. Pupæ; on left, two males; on right, two females.
4. Newly hatched female fly. 4*a*. Its empty pupal case.
5. Newly hatched male. 5*a*. Its empty pupal case.

A query regarding experience of attacks on land showing any special features as regards want of drainage, exposure and the like elicited positive opinions from the majority, although a fair number held the view that the kind of land made no difference. Land receiving such descriptions as " damp," " mossy," " cold subsoil," " with much foggage ploughed in," " undrained," " red sour soil," " wet clay," " wettest part of a field," were reputed by a considerable number as most frequently liable to be badly " grubbed." On the other hand many express the opinion that the type of land makes little or no difference, and some regard the driest and lightest land as most liable.

Here again on the whole there is agreement that heavy, undrained, low lying or mossy land with much foggage to plough down is most liable to be grub infested. Such conditions are again those which are likely to give retarded growth at the time of brairding. Rough ground, it should be noted, is favoured by the adult insects for oviposition, and such ground is thereby liable to have in spring a high percentage of grubs per acre in any case.

Another question on which the experiences of farmers was obtained was : Have you observed any differences in the extent of the attack upon different varieties of oats? If so, state particulars.

Replies here showed that there appears to be a fairly prevalent opinion that the grub has some selective taste and prefers some varieties to others, or that certain varieties have less power of recovery from attack. This is illustrated in the following comments :—

> " Banner oats by far the worst."
>
> " Banner oats are more liable to be attacked than Potato."
>
> " Never had much grub with Sandy oats; have seen Potato oats pretty bad."
>
> " Yielder and Bountiful 'grub proof'; Banner, Thousand Dollar and White Horse succumb very easily."
>
> " They like Potato oats better than Sandy."
>
> " Waverley suffers more from attack than Potato or Sandy."
>
> " Banner oats suffer more than Potato."

The majority of replies, however, were to the effect that no difference in the extent of attack upon varieties, adjudged by losses, had been observed, and the trend of farming experience in the north goes to show that results with different varieties or the same variety are not uniform. Farmers did not always discriminate between liking for a particular oat on the part of the grub, and the better capacity for recovery which might be characteristic of certain varieties. The following answers are more discriminating :—

> " Of the 'Waverley' and 'Hamilton,' oats which were

sown side by side, the 'Waverley' had to be re-sown; 'Hamilton' oats were only slightly thinned."

"The 'Red' oats resisted poorly, 'Providence' and 'Potato' did better."

Taken collectively, the views of farmers who have had experience of grub attack is contradictory with regard to the relative advantages of particular varieties. While this is so, a number emphasised what is the really important feature in this connection, viz. that good tillering varieties of oats are most satisfactory. There is general agreement that the newer varieties have less power of recovery because they do not tiller well.

Another experience which has been found of service in overcoming grub is to effect a "change of seed." Seed grown on the coast and sown in an inland locality, and seed grown in, e.g., the Lothians and sown in Aberdeenshire, have in both instances given better results, where larvæ were at work, than native grown oats.

Further, the sowing in a late district of seed from an early one, also seed in a heavy soil from a light one, in both instances have been claimed as satisfactory measures against losses from grub attack. Probably this is a point which should not be stressed too confidently; quality more than source of seed might well be emphasised. And here again, other factors operating in conjunction, such as type of soil, individual practice, manuring, and so on, as well as other factors already indicated, all have their effect on the ultimate result.

The final question of general interest addressed to the farmer in this enquiry was: What methods have you adopted against the grub? To what extent have any of them been successful?

The replies obtained proved of such variety and interest that I propose to give these in fuller form than the others. The list given includes practically all the suggestions which were submitted on this subject, and I have arranged the recommendations, some of which were repeated in several replies, in accordance with seasonal operations. I do not propose to discuss these in full detail; the value from the cultural point of view of a good number of the suggested operations is likely to be obvious, but certain recommendations may be briefly emphasised because of their obviously direct bearing upon the control of the fly or upon the stimulation of the crop.

Autumn and Winter.

Grass to be well eaten and trodden by sheep.

Use link harrow before ploughing.

Chain harrowing before ploughing, also rolling before ploughing.

Deep ploughing, and breaking in harrow to cut furrows; smooth with chain harrow.

Plough with skim coulter; turn down the surfaces.

Draining and liming; ground lime used freely.

Spring.

Sowing.

Strong good seed.

An extra bushel per acre is a great help.

Change of seed, e.g. from coast to inland, north to south, &c.

Avoid too early sowing.

Use good tillering varieties.

Culture.

Roll immediately after sowing.

Do. when ground is slightly damp.

Double rolling, or roll with a pair-of-horse roller immediately after harrowing.

Harrow with disc harrow.

Harrow in oats by the line of furrows, never across. Roll heavily.

Roll the braird *before sunrise.*

Manure to assist rapid growth ; use salt and nitrate.

Sow potash with seed ; seldom fails.

Special.

Chickens on grass fields in moveable houses.

Turn on ducks where attack is heavy.

In view of the habit of the grub in coming to the surface of the ground by night, the repeated recommendation to roll early in the morning (before sunrise is suggested in some instances) is significant. Such procedure in spring, particularly when the oats are brairding, is likely to crush the grubs on the surface or near it, and considerable numbers may be destroyed in this way. By consolidating the soil, rolling also impedes their movements in the upper layer. I have observed that when the soil in experimental boxes was packed tightly the grubs remained for days in the same position. Delay of this kind is of some importance in spring in giving the young plants time for growth at the most critical time in relation to grub attack. Further, since the changes of temperature of the soil between night and day have the effect of loosening the soil around the plants, this tends to give freer access to the roots for the larva. Close packing of the soil around the young plants in the morning is therefore of special value when grubs are abundant in the soil.

The risks attendant upon too early sowing have already been commented on. It is well known that the leather jacket grub shelters in considerable numbers in the " foggage," and in so far as harrowing assists in turning and breaking up these turfs and causing them to wither it will serve to expose the grubs, while if this is followed by rolling, apart from the cultural value of these operations, they have a detrimental effect upon grub life. Draining the land is helpful, since on the whole *Tipula* favours undrained land for egg-laying. Where practicable also the pasturing of sheep upon the grass prior to ploughing can be recommended on commonsense grounds. The presence of the sheep, apart from their manurial and mechanical effect upon the soil, acts directly in disturbing flies at the time of egg-laying. Owing to the sluggishness which characterises the flies at this time, I believe many are trampled down by sheep. Also, owing to the close cropping by the sheep, "foggage" is less abundant, and less shelter is available for the grubs after harrowing.

A notable feature of these recommendations is the entire absence of any reference to the use of insecticides. Undoubtedly reliance upon cultural methods, which by taking advantage of a knowledge of the life history and habits of the insect pest follows the line of prevention rather than "cure," represents the highest type of farming. Such methods, independently of the presence of grub, favour increased production, and are also less costly in the long run.

In a series of experiments and observations carried out by the author, the results of which were published some ten years ago (1), two important facts regarding the feeding habits of the crane fly grub were specially noted which bear upon the question of the extent of crop loss which may result from their presence. These grubs were found to depend for their food in the absence of a growing crop upon the decaying organic matter in the soil, and in spring when the oat crop is germinating they come to the surface and attack the young growing parts above the ground. It was this latter habit that led Packard and Thompson (2) of the United States Department of Agriculture to test the efficiency of bran bait poisoned with Paris green upon crane fly grub. In their account of their experiments they write:—"It was observed by the junior writer that the crane fly maggots usually come out upon the surface of the ground during the night. This fact, together with the indication that this species feeds upon aerial or above-ground portions of the plants much more than is commonly supposed, suggested the possibility that they would be attracted by the poisoned bait commonly used for grasshoppers. During the winter of 1920-21 experiments were conducted in heavily infested areas to determine the efficiency of poisoned bran baits as remedies for the insects. As a result from 50 to 90 per cent. of the maggots were killed on experimental plots, where several different poisoned bran formulæ were tried."

Of the various formulæ tried, Packard and Thomson recommended the following as the cheapest and easiest to mix: Bran, 25 lbs.; Paris green, 1 lb.; Water, about 3 gallons, to make a flaky mash. The Paris green is mixed into the dry bran, and water added gradually until an even crumbly mash is obtained. It is applied in the proportion of 10 to 20 lbs. per acre broadcast by hand, or with a broadcast grain seeder. This quantity is the smallest amount which gave a uniformly high percentage of kill over the entire plot. The authors point out the necessity for avoiding dropping the bran in lumps and for keeping it beyond the reach of children and animals. Packard and Thompson's results with Paris green were fully confirmed by the staff of the Plantenziektenkundige Dienst, at Wageningen, Holland (3), where also very careful experiments were conducted with regard to the possible harm to animals and to vegetation with the use of Paris green. Similar satisfactory results have been obtained by the staff of the West of Scotland College of Agriculture, by the county organisers of the other colleges and by numerous farmers throughout Scotland. The use of poisoned bait where the presence of the grub in destructive numbers has been discovered too late has proved of distinct value in preventing further ravages, and thus enabling the surviving plants to fill up the ground by tillering. Another important point is its value in reducing the numbers of noxious insects in the soil in the succeeding year. It is here suggested that its use on newly sown land would operate beneficially, and especially so in a protracted cold spring.

More recently some interesting work on the control of crane-fly larvæ has been carried out in Germany with other substances. Gasow (4) has found that watering the soil with a solution of ammonium carbonate or with a 2-4 per cent. solution of liquid ammonia brings the grubs to the surface, where they eventually die. This method of treatment is of special value in that it can be used to test the degree of infestation of the fields early in the season, so that some forecast of the numbers of grub likely to be operating on the crop can be obtained. Gasow has found also that, as substitutes for Paris green, baits made up of sodium fluoride—1 part to 25-40 of bran, or one of sodium fluosilicate, 1 part to 50 bran—gave excellent results and were cheaper. Experiments designed to test these conclusions are in progress at the North of Scotland College of Agriculture.

References cited.

1. Rennie, J.—1917. Annals of Applied Biology, vol. III.
2. Packard and Thompson.—1921. Circular 172, U.S. Department of Agriculture.
3. De Jong, W. H.—1925. Een Studie over Emelten en hare bestrijding (pp. 89-105). Plantenziektenkundige Dienst, Wageningen.
4. Gasow, H.—1926. Mitteil. Dtsch. Landw.—Ges. XLI, p. 140. (Abstract in Centralb. Bakt. Paras. Infekt. IIte Abt., p. 118.)

THE BIOLOGIST ON THE FARM.—No. XXV.

Professor J. Arthur Thomson, M.A., LL.D.,
University of Aberdeen.

Is there a Vitamine of Reproduction?—On general grounds one would think that great caution should be exercised in naming new vitamines, which have not been isolated or chemically determined. For a vitamine is little more than a name for a hypothetical accessory substance whose absence from the food is followed by certain deteriorative results. But we have been hearing lately, from Evans and Burr, of a new fat-soluble vitamine E, a substance necessary in the food supply of the mother if the embryo is to complete its development. It has been called the vitamine of reproduction.

The new vitamine is abundant in the ether extract of wheat embryos and in dried leaves of lettuce. It occurs unhurt in the carefully dessicated leaves of alfalfa and pea, in seeds like cotton and Indian corn, in some fruits like bananas, in egg-yolk and many animal tissues. If 25 milligrams of wheat germ oil be mixed daily with the food of a rat that is with young, the development of the embryos is very successful and normal birth results, but this will not be the case if the hypothetical substance is not present in the diet. Even five times as large a quantity of some other oil, such as peanut and flax-seed oil, with little vitamine E will not compensate for the absence of the so-called vatamine of reproduction. We read that a single dose of 550 milligrams of wheat germ oil on the day of mating will insure the birth of normal young rats without further feeding with the vitamine!

Prairie-dogs and Pasture.—Darwin laid emphasis on the selective influence of animals on the plants of a given area. The continued presence of a particular kind of animal, such as rodent or goat, may involve the elimination of particular plants; and, conversely, the eradication of a particular food-plant may involve the disappearance of certain animals, such as the butterflies whose caterpillars fed on the leaves in question. Thus the selective influence works in interesting circles,—animal and plant, plant and animal.

This is well borne out by recent studies of the effect of prairie-dogs on the vegetation of the Arizona ranges, where vigorous efforts are being made to check the ravages of the rodents. Certain grasses flourish well inside the total protection area, but are practically eliminated in the prairie-dog tract, and also in the cattle and rodent grazed area outside. The fruiting heads of the principal forage grasses are continuously cropped by prairie-dogs and other rodents, and this naturally effects a change in the vegetation. Some weeds and herbs, such as *Senecio aureus*, *Pentstemon strictus*, and a species of *Delphinium* are quickly consumed by prairie-dogs and cattle. On the other hand there are some, like the Evening Primrose called *Oenothera coronópifolium*, which do not seem to be liked by the prairie-dogs, for they are common among the plots. There is nothing new in this except that the very extensive experiments in Arizona are being carefully scrutinised by ecologists, who thoroughly appreciate the reciprocal influences of animals and plants, plants and animals.

Human values of Biology.—To the biologist, no doubt, this is a very familiar idea, but it seems to linger on the threshold of everyman's everyday consciousness. Although we live in an age of applied science, and although the art of medicine has advanced by leaps and bounds, there are many who are but hesitating in their appeal to the scientific expert for advice in regard to every practical problem. Yet the material benefits alone are overwhelmingly great, and are increasing every day in both variety and number.

We would quote from a recent admirable address by Professor C. A. Kofoid. "Most striking illustrations of the benefits derived by mankind from biology are to be found in the applications to medicine and surgery. Witness the germ theory of disease, aseptic and plastic surgery, serum and vaccine therapy, calories and vitamines, and the applications of endocrinology. Medical progress is reputed to have added not less than twenty years to the average life of man in the last century, and these are twenty years of the highest efficiency—from 35 to 55 years." But we know of critics who would dispute the accuracy of this encouraging conclusion.

Let us continue however. "So also in the field of preventive medicine. Plague will never again set back civilisation for centuries by a pestilence of 'Black Death.' Man's knowledge of rats, fleas and *Bacillus pestis* makes it feasible for him to-day to face plague with equanimity instead of fear. He knows he can throttle it, wherever and whenever it breaks out, and proceed with trade and commerce with little interruption. With like assurance man invades the fever-stricken tropics and builds the Panama Canal, and everybody has his bananas because of man's biological understanding of the life-history, habits, breeding and parasites of mosquitoes, and of the relations which these persistent pests bear to yellow fever and malaria. New food resources of untold importance in the tropics are thus opened for human needs, and new armies of commerce and industry spring into being not only because of steel and electricity, but also because of hungry or dead mosquitoes.

"The physical deterioration and intellectual backwardness of the victims of hookworm—and there are millions of them in the tropics of both hemispheres—may be prevented by adequate sanitary measures and relieved by simple therapy. Rabies, childbed fever, scarlet fever, diphtheria and typhoid fever have been robbed of their terrors or all but banished."

Professor Kofoid goes on to speak of the augmentation of our food supply by the applications of biology to agriculture, the improvement of fruits and crops, the conquest of many pests, the utilisation of the nitrogen of the air, and so through a creditable list which should make it easy to believe in science, and should make it almost instinctive to ask the aid of science at every turn. Yet there are many who seem to shrink from a resolute facing of the facts—which is what science stands for. They prefer, both as regards farm and hygiene, to continue muddling through.

Clouds in the Sky.—We have given a sample of Professor Kofoid's optimism, but it would be misleading to suggest that he is unaware of the clouds that remain in the sky. There is the rapidly increasing absolute volume of human population on the globe, shadowed by the doubt whether life is worth living for immense numbers whose struggle for existence is painfully keen. Even in civilised countries it is often true that we should be happier if there were fewer of us. It seems very doubtful whether the increase in the harvests of land and sea is keeping pace with the absolute increase in the world's population, which now stands at over 1,700,000,000 souls. In spite of the triumphs of medicine, disease continues rife, and the health-rate in vast sections of the community is disgracefully low, yet accepted with acquiescence. It is doubtful whether the disharmonies of sex were ever more marked than they are to-day.

We speak much of the balance of nature, and often recognise it, yet we are discreditably careless with our birds, some of which constitute our main defence against an increase of insect pests which would bring the world to an end—as far as man is concerned—in a few years. "Our fight with Arthropods for the control of nature is all too often a losing battle. The boll worm marches majestically on across America in spite of imported parasites and airplanes dusting poisons. The codling moth, the gypsy moth, the alfalfa beetle, the chestnut blight have the scientifically trained entomologists of the country buffaloed—to use a peculiarly appropriate term. . . . Verily we should be humble rather than boastful of the progress of science." Obviously we have here referred only to a few of the clouds in the sky, but these are enough to suggest the need for keeping our loins girt and our scientific lamp burning.

Eleven thousand generations of Paramecium.—If we gather a handful of hay from the meadow, or even from the roadside, and steep it in water at a comfortable room temperature it soon becomes turbid with life. Out of the crevices of the hay there come various micro-organisms which multiply rapidly; and of course there may have been some others to start with in the water itself. The whole sequence of life in a hay-infusion is often intricate, and it varies according to the place and season, but if we examine a drop at the end of a week we usually find numerous Slipper animalcules, various species of the cosmopolitan genus *Paramecium*. They are about a hundredth of an inch in length, and rush about in the drop at a great pace, propelled by numerous living lashes or cilia, which are arranged in rows on the surface of the miniature slipper, and beat the water in harmonious bendings and straightenings. If all the thousands of Slipper animalcules in the tumbler of water are descended from one by successive divisions, the population is called a "pure line"; and in such a lineage there is no "conjugation" or temporary union of two individuals, such as occurs at frequent intervals in ordinary natural conditions where many lineages are mixed up together.

On May 1st, 1907, Professor Lorande Loss Woodruff of Yale University started a culture of *Paramecium aurelia* with a single "wild" individual, and this was maintained as a "pure line" till April 1926. We suppose it is going strong still. There have

been 11,700 generations in the nineteen years. There have been periodic accelerations and depressions in the division-rate, but 634 generations is the average for eight years. No foreign strains have been allowed entrance, and no conjugation or mutual fertilisation has occurred. It is not denied that fertilisation may have a stimulating function in a lineage, but as it has not occurred (examinations were made *every* day for eight years), the conclusion is safe that fertilisation plays no indispensable rôle in the life-history of Infusorians living in entirely favourable conditions. It was discovered, however, by Professor Woodruff and Miss Erdmann that a remarkable process of nuclear disintegration and reorganisation takes place regularly, often once a month, in the life of the pure-line Slipper animalcules. The process is called " endomixis," and in some species it may occur in natural conditions. It looks like a prelude to fertilisation, but it is not followed by fertilisation. It looks like a means of securing rejuvenescence, but whether it is essential to the continuance of a pure-line race is still uncertain.

Woodruff's study—a fine instance of scientific patience and persistence—affords an interesting example of the power organisms have of multiplying. All the generations have started from a single animal isolated in 1907. This progenitor of the cultures demonstrably possessed " the potentiality to produce similar cells to the number represented by 2 raised to the 5071st power, or a volume of protoplasm greatly exceeding one thousand times the volume of the earth."

Fertility of a female Mule.—In the third part of volume V of the *Annals of the Natal Museum* (1926), Dr Ernest Warren gives details as to the fertility of a female mule. It was the result of a cross between a jack donkey and a dark chestnut mare, and came in foal to a hackney stallion. It was eight years' old when it first foaled, and it is believed to be in foal again. The characters of the foal show a remarkable combination of horse and ass characters, varying from nearly complete dominance of either to perfect blending of both. The belief that mules are always sterile dies hard, but here we have a well-documented case of female mule fertility. It is admitted, of course, that for ordinary mules (offspring of male ass and mare) sterility is usual in both sexes. It is perhaps universal in males, but it is certainly not invariable in females, as Dr. Warren's case plainly shows. Many plant hybrids are more fertile than their parents, as happens with different species of tobacco plant, but reduced fertility or even total sterility is a commoner result. Sterility in the males and partial or complete fertility in the females may be illustrated by hybrids between different species of guinea-pigs or between wild and domestic cattle. What constitutes the sterility of hybrids remains obscure, but it probably depends on some incompatibility in the chromosomes of the germ-cells of the two parents. It is generally allowed that hybrid sterility should be sharply distinguished from the sterility that may arise in the course of close inbreeding.

Yeasts and Flowers.—In the soil of vineyards there is always to be found a very minute fungus, the yeast-plant. At its simplest it is a single oval cell, about 1/3000th of an inch in length. It gives off buds which sometimes bud again, so that little temporary chains are formed. In unfavourable conditions it forms four spores within its cell, and when these are liberated they are readily carried about by insects or by the wind, and can remain for a time in a state of dormancy or latent life. When they light on grapes that have been bitten they become active in the exuding sweet juice and set up fermentation. From the wine-press the yeast plants pass to the vats and cause the fermentation which changes the sweet must into the alcoholic wine. The sugar of the must is split up into CO_2 and ethyl alcohol, besides bye-products like glycerine and succinic acid. As the alcohol accumulates in the liquid the fermenting action is slowed, and when there is 14 per cent. it stops. The fermentation is not dependent on the life of the yeast plant, for it can be produced by grinding the yeast with sand and filtering the juice under high pressure through porcelain. The active ferment is known as zymase, and as everyone knows it may operate not only in producing wine and beer, koumiss and pulque, but in the formation of commercial ethyl alcohol from potatoes and the like, and in the lightening of bread by the production of gases that raise the dough. For special purposes man has reared many varieties of yeast, which are distinguished by their results, though they seem very much the same under the microscope.

Apart from these cultivated yeasts there are many that live in wild conditions, and we wish to say a little about those that are found associated with the nectar of flowers. A dozen or so European forms are known that occur in the nectar of many different kind of flowers, or on the surface of the stigma and other parts. They vary considerably in colour, for white, red, yellow, brown and violet forms are known. They are distributed mainly by insects, the wind playing a lesser part. Cold climate and rainy weather hinder distribution. The spore-forming stage has never been observed, but peculiar "cruciform" colonies are often found in the nectar, perhaps in association with the high concentration of the sugar.

The same wild yeasts may occur on different plants, and the same plant may show different yeasts at different times. T. Jimbo examined 23 species of plants in Japan and found 22 different yeasts, but he corroborates the conclusion that the infection is not specific. That is to say, the same yeast may occur on different species of flowers. An interesting pink form is able to produce considerable quantities of oil both inside and outside the cell.

It may be recalled that a great many yeasts are now known to occur in the food-canals of insects, especially among the cockroaches and related members of the order Orthoptera. In a considerable number of cases the evidence points to the conclusion that these yeasts are partners, which ferment the food in the alimentary tract and make it more available for the insect. Somewhat similar is the rôle that bacteria play in the food-canal of herbivorous animals and in man's intestine in breaking down the cellulose of the food. Organic nature is wonderfully interlinked.

VARIATION IN THE PROPORTION OF SOLIDS-NOT-FAT IN MILK.

J. F. Tocher, D.Sc., F.I.C.

Introductory.—In my recent contribution to this Journal on the subject of milk I showed that the proportion of water in genuine milk could vary continuously from 83 to 90 per cent., and that the proportion of butter fat in genuine milk could vary continuously from 1·6 to 7·4 per cent.[1]

I propose now to discuss the extent of the variations in solids-not-fat which occur in genuine milk when we consider (1) samples of milk from individual cows; (2) samples of the bulked milk from herds of various sizes, and (3) daily samples of bulked milk from the same herd. The Regulation of the Board of Agriculture with regard to solids-not-fat may be summarised as follows:—It is presumed for the purposes of the Sale of Food and Drugs Acts, until the contrary is proved, that if a sample of milk contains less than 8·5 per cent. solids-not-fat it is not genuine by reason of the addition thereto of water.

The extent of the variations in solids-not-fat in milk was not fully realised until the results of the investigation ordered by the Inter-departmental Committee in Milk (Scotland) were known. The results are embodied in a monograph published by the Stationery Office in 1925.[2] In this monograph it is shown that, so far as samples of milk from individual cows are concerned, the proportions of solids-not-fat in milk vary from 6·9 per cent. to 10·6 per cent.—a range of nearly 4 per cent. The average percentage was found to be 8·8 per cent. or 0·3 per cent. higher than the prescribed presumptive limit of 8·5 per cent.

How the Percentage of Solids-not-Fat varies in the Milk from Individual Cows.—The evidence as to the extent of the variations which occur in the percentages of solids-not-fat in milk has hitherto been obtained mainly from the *bulked* milk of herds irrespective of whether the herds belonged to the same breed or to different breeds and irrespective of the size of the herds themselves. It is now known that the breed of the cow, the number in the herd, the age of the cow and the stage in the lactation period are factors affecting the percentages of solids-not-fat in milk just as they are factors affecting the percentage of butter fat in milk. We must therefore endeavour to find out

[1] *Scottish Journal of Agriculture*, Vol. IX, No. 4, pages 351 to 356; Vol. X, No. 1, pages 17 to 27.

[2] Variations in the Composition of Milk. H.M. Stationery Office, 120 George Street, Edinburgh. 1925. £1 : 1s.

the exact extent to which solids-not-fat percentage is affected by these and other factors. That can be done provided data are available showing the percentage of solids-not-fat for each breed, each age, each stage of lactation period and for herds of various sizes. The data collected under the direction of the Inter-departmental Committee on Milk (Scotland) were of such a character as to enable a statistician to measure the extent of the influence of each factor. The 676 samples of milk obtained from 676 individual cows throughout Scotland were analysed for all the constituents of milk, including the percentage of solids-not-fat. We can thus present a bird's eye view of how the individual cows in a herd of 676 cows varied with respect to solids-not-fat. The 676 cows were not specially selected, but were taken from all breeds, for all ages, and for various numbers of weeks in milk. Looking at the 676 cows as constituting a large random herd, it was found that the percentage of solids-not-fat of the bulked milk of the herd was 8·8 per cent. When the breed of the cow was considered it was found that the average percentage of solids-not-fat for Ayrshire cows was 8·75 per cent. The corresponding figure for the Friesians was 8·62 per cent., and the corresponding figure for the remaining cows of other breeds was 8·86 per cent. The question may be now asked :—How far do the percentages of solids-not-fat of milks of individual cows vary round the average of 8·8 per cent.? The following table (Table I) shows the nature of the variation in the percentage of solids-not-fat of 676 cows. The results are shown graphically in Diagram I.

DIAGRAM I.
Distribution of Solids-not-Fat.

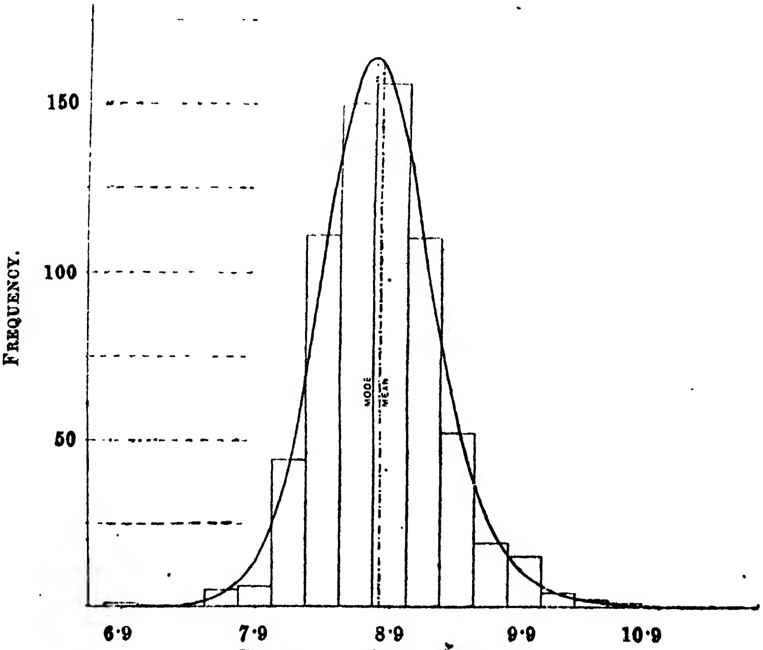


TABLE I.

A distribution of Solids-not-fat Percentages. (All the cows were completely milked in each case.)

Solids-not-Fat Percentage. From	to	*Frequency Distribution.*
	7·50	1
7·50	7·75	5
7·75	8·00	6
8·00	8·25	44
8·25	8·50	111
8·50	8·75	150
8·75	9·00	156
9·00	9·25	110
9·25	9·50	52
9·50	9·75	19
9·75	10·00	15
10·00	10·25	4
10·25	10·50	2
10·50	10·75	1
		676

It will be seen from this Table that 167 samples, out of a total of 676 samples of milk, contained solids-not-fat less than 8·5 per cent., the presumptive limit. Thus 24·7 per cent., or roughly one quarter of the total number of samples of milk from individual cows, contained less than 8·5 per cent., a rather striking result. If these 167 cows were taken and divided into herds, there would be herds which would frequently bring the dairyman into trouble on account of the fact that the cows give milk poor in solids-not-fat. Whether all these 167 cows would always be giving milk containing less than 8·5 per cent. solids-not-fat during the lactation period is an entirely different matter. It will be seen later in this article that cows do not give *uniformly* either low percentages of solids-not-fat or high percentages of solids-not-fat.

How the Percentage of Solids-not-Fat varies in the Bulked Milk of Herds of Various Sizes.—The size of the herds as influencing the percentages of solids-not-fat in the bulked milk of the herd has not hitherto been adequately considered. What we want to know is the percentage of solids-not-fat found in the bulked milk of a herd of say 10 cows every day for a fairly long period. We want similar information for herds of definite sizes less than 10 and for herds of definite sizes larger than 10. If we had this information we would be able to know the number of days on which the solids-not-fat percentage in the bulked milk fell below the prescribed presumptive limit of 8·5 per cent. At the present time we do not have information of this kind from commercial herds throughout the country. We can, however, form a basis of comparison by taking, for a herd, groups of 10 cows not specially selected out of the 676 cows. We would then find what the bulked milk of these 67 herds of 10 cows would give with respect to percentage of solids-not-fat. We could do the same for a herd of any size, say for groups of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, &c. cows. This work has actually been carried out and we are able to give the results in the form of a table. We already know that if we had 100 cows, 24 or 25 of them would give milk containing less than 8·5 per cent. solids-not-fat. That is to say, of 100 herds of one cow, 24 herds of one cow would give less than 8·5 per cent. solids-not-fat. The question we have now to answer is :—If we had 100 herds of 2 cows, or of 3 cows, or of any other number of cows, what number of herds out of the 100 herds would give less than 8·5 per cent. of solids-not-fat? The following table (Table II) shows the numbers.

TABLE II.

Number of Cows in Herd.	*Number of Herds giving less than* 8·5 *per cent. Solids-not-fat out of* 1000 *Herds*	*Number of Cows in Herd.*	*Number of Herds giving less than* 8·5 *per cent. Solids not-fat out of* 1000 *Herds.*
1	247	11	11
2	165	12	8
3	116	13	7
4	84	14	5
5	62	15	4
6	46	16	3
7	34	17	2
8	26	18	2
9	19	19	1
10	15	20	1

It will be seen from this table that in 1000 herds of 5 cows 62 herds would give less than 8·5 per cent. solids-not-fat. In 1000 herds of 10 cows 15 would give less than 8·5 per cent. solids-not-fat. This is a very important result from the point of view of the milk producer, of the physiologist, of the Local Authority and of the State. It raises the question :—Are we right in selecting arbitrarily the figure 8·5 per cent. as a presumptive limit operating against the dairyman, or can we institute a better means of protecting the public against adulteration of milk by means of adding water to milk? The analyst cannot declare from the results of his analysis what quantity of water has been added in any case where it is presumed water is added, and therefore the proof that water has been or has not been added must be revealed by cross examination of the persons handling the milk prior to its sale.

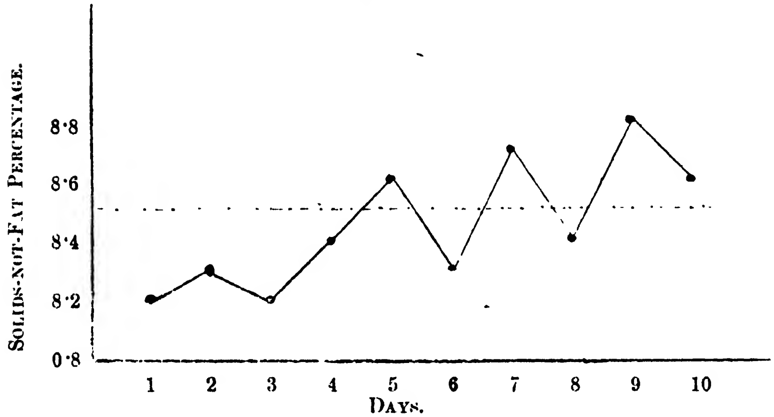
How the Percentage of Solids-not-Fat varies in the same Cow or in the same Herd from day to day.—The following percentages of solids-not-fat were found for ten days in an Ayrshire cow calving in February.

Day	1	2	3	4	5	6	7	8	9	10
Percentage Solids-not-fat	8·2	8·3	8·2	8·4	8·6	8·3	8·7	8·4	8·8	8·6

The accompanying diagram (Diagram II) shows the extent of these variations for one cow. The only other data I have at present available is that of a herd of 24 cows, the percentages of solids-not-fat in the bulked milk of which were determined for 39 days. It will be seen from Diagram III that as great a variation as 10 per cent. of the mean value of solids-not-fat can take place in one day. On one particular day (see Diagram III) out of the 39 days the bulked milk of the herd of 24 cows gave less than 8·5 per cent. solids-not fat. On one other day the percentage of solids-not-fat was exactly 8·5 per cent. The average percentage of solids-not-fat for the whole herd for the 39 days was 9·02 per cent. The record for 39 days is therefore very illuminating, and shows the actual fact of a herd of 24 cows giving on one particular day less than the prescribed presumptive limit of 8·5 per cent. More important than this fact is the fact of the irregularity in the percentages of solids-not-fat from day

DIAGRAM II.

Daily Variations in the Percentage of Solids-not-Fat in one Cow.

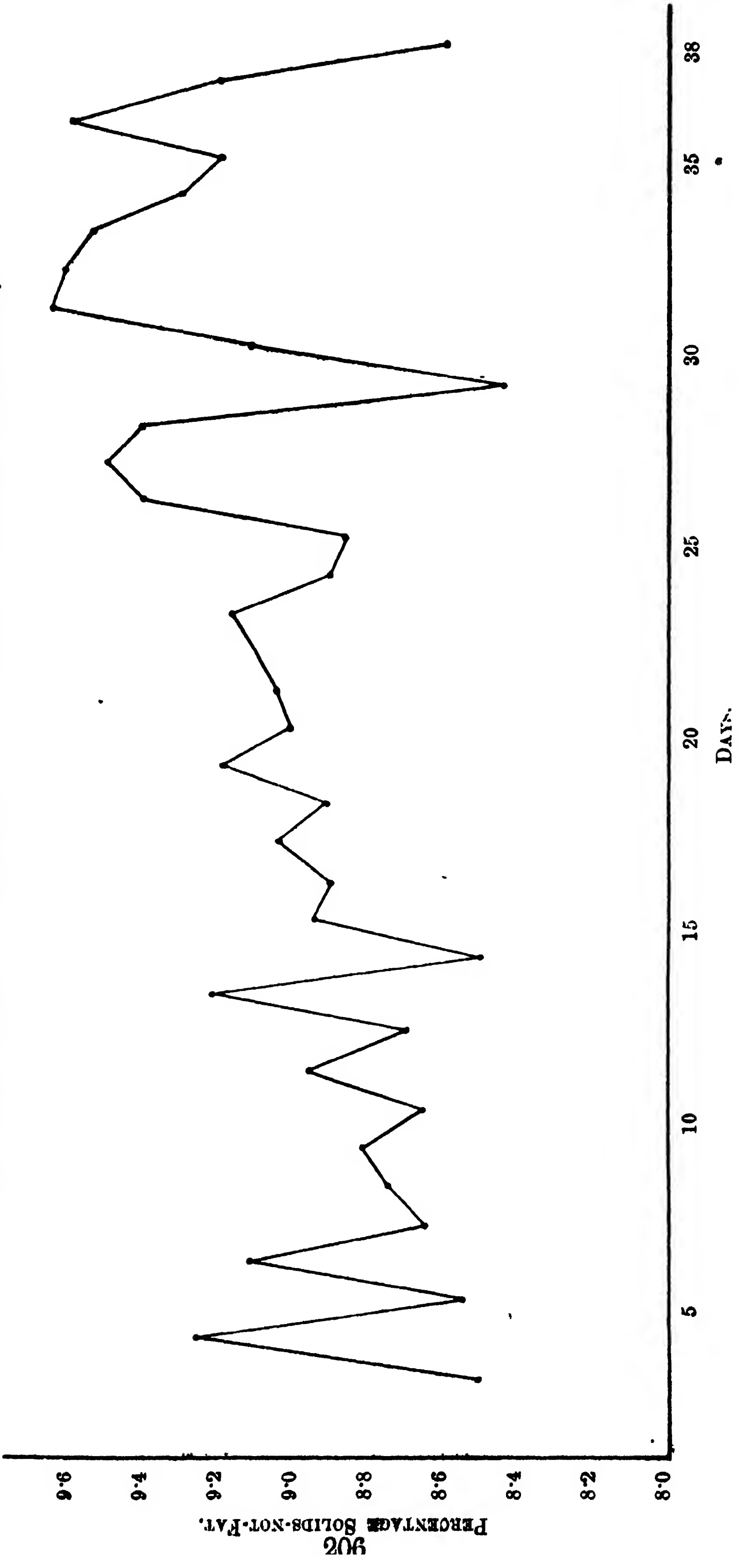


to day. As already pointed out, it is the custom of certain local authorities to take byre samples, after an official sample has been found to be below the prescribed limit, so that we again raise the question, do byre samples really help in detecting adulteration? In the article published in January I expressed the view that such byre samples do not help the Court very much, because there is no constancy in the proportions of butter fat found in bulked milk from the same cows day after day. It appears from these results that the same remarks hold true with regard to solids-not-fat in the bulked milk of the same cows day after day. We cannot argue, because a byre sample is found to contain a higher proportion of solids-not-fat than the official sample, that the official sample was adulterated. The evidence must be obtained from those handling the milk.

The Relationship of Percentage of Solids-not-Fat to other Constituents of Milk.—I have shown, in the Monograph already referred to, that cows that are high yielders give a lower proportion of solids-not-fat on an average than cows that give

DIAGRAM III.

Actual Daily Variations in the Percentage of Solids-not-Fat in a Herd of 24 Cows for 39 Days.



low yields of milk. The accompanying (Diagram IV) shows the nature of the relationship between solids-not-fat and yield. The influence of age of cow in determining the percentage of solids-not-fat in milk can be seen in the accompanying diagram (Diagram V), while the influence of stage of lactation on solids-not-fat can be seen from the accompanying diagram (Diagram

DIAGRAM IV.

Solids-not-Fat and Yield.

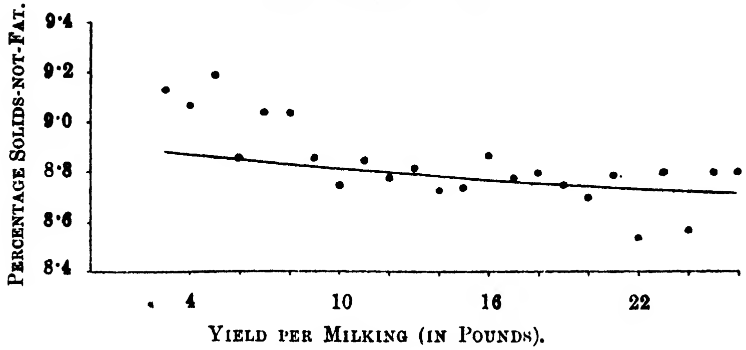


DIAGRAM V.

Solids-not-Fat and Age.

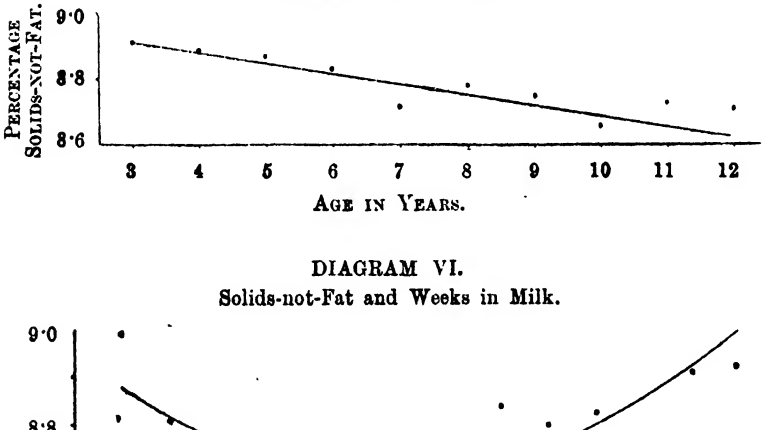
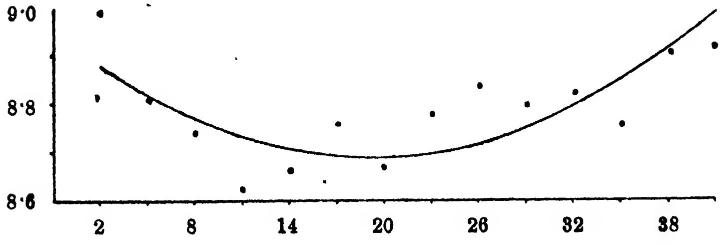


DIAGRAM VI.

Solids-not-Fat and Weeks in Milk.

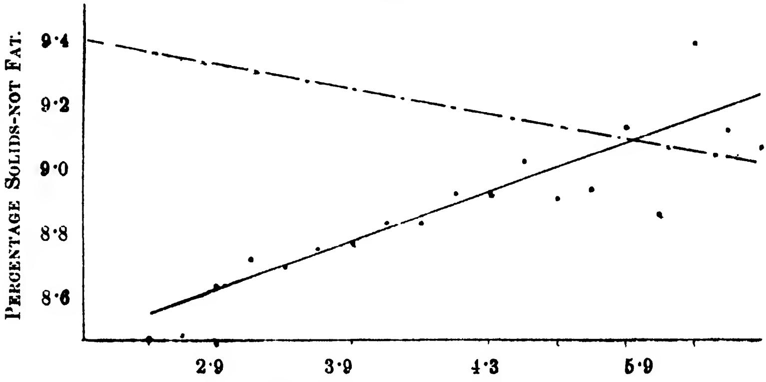


VI) which shows the percentages of solids-not-fat given by cows which have been milked various numbers of weeks from the date of calving. The relationships existing between butter fat and solids-not-fat require to be very carefully stated and studied. If samples of milk are drawn on the same day from different cows or from different herds of cows and analysed for butter fat and solids-not-fat percentages and the results collated, it is found that on an average a high percentage of butter fat is associated with a high percentage of solids-not-fat and *vice versa.* This result was first given by me in the *Scottish Journal of Agriculture*[1] and was confirmed from the Inter-departmental data.[2]

What does this correlation or relationship really mean? It means that, in general, a cow which is a good butter fat producer is also, in general, a good solids-not-fat producer, and a cow which is a poor butter fat producer is also, in general, a poor solids-not-fat producer. The accompanying diagram (Diagram VII, continuous line) shows the nature of the relationship. But

DIAGRAM VII.

Solids-not-Fat and Butter Fat.



now consider a different problem. If we take the *daily bulked milk of the same herd* of cows and analyse the milk day after day for butter fat and solids-not-fat and table the results what do we find? It is found that the relationship between butter fat and solids-not-fat is of an entirely different character from the previous example and is as follows :—The greater the percentage of butter fat on any particular day the smaller is the percentage of solids-not-fat. In other words, a high percentage of butter fat is associated in general with a lower percentage of solids-not-fat than the average in the daily samples of the bulked milk of the same herd (Diagram VII, broken line). Now the reason for this has also been discovered. In a paper published in *The Analyst*[3] it is shown that the total amount of "butter fat + solids-not-fat" in the bulked milk of a herd shows little variation from day to day. If the proportion of total solids in the milk of a herd was absolutely constant, say 12 per cent., then an increase of 1 per cent. in butter fat would mean a decrease of 1 per cent. in solids-not-fat. This ideal state is not, of course, realised in practice. The proportion of total solids is not absolutely constant in a herd, *but it tends to be so,* and is much less variable than the percentage of butter fat and the percentage of solids-not-fat.

1 *Scottish Journal of Agriculture,* Vol. II, No. 3, 1919.
2 Variations in the Composition of Milk. H.M. Stationery Office. 1925.
3 *The Analyst,* December 1926, pages 606 to 613.

This explains the peculiarity that has been brought out frequently in Court. A herd on one particular day gives butter fat and solids-not-fat both above the prescribed presumptive limits. On the next day, however, the butter fat is higher than on the previous day and the percentage of solids-not-fat has fallen below the prescribed presumptive limits. This is a statement of actual fact. The explanation of the fact must be given by the physiologist.

Need for Investigation into the Causes of Variation in Solids-not-Fat in Milk and into Causes of Variation in the Composition of Milk generally.—The results summarised in this article show that the percentage of solids-not-fat is affected by the following factors, but it is not suggested that these are the only factors which cause variation in the percentage of solids-not-fat in milk. Factor No. 1 is the number of cows whose milk is bulked. As many as 24 per cent. of all individual cows give less than 8·5 per cent solids-not-fat. As many as 6 herds out of 100 herds of 5 cows give less than 8·5 per cent solids-not-fat. The number in the herd is an important factor in determining the percentage of solids-not-fat. Factor No. 2 is the yield given by the cow. A cow which gives a high yield has a less percentage of solids-not-fat in its milk than a cow which gives a low yield. Age of cow is factor No. 3. The younger the cow the higher on an average is the proportion of solids-not-fat in her milk. The solids-not-fat fall steadily with increasing age. Factor No. 4 is the number of weeks the cow has been in milk since her last calf was born. Soon after calving the proportion of solids-not-fat is high, but falls steadily until about the twentieth week, when the proportion is lowest. Owing to the fall in yield, the percentage of solids-not-fat rises steadily to the end of the lactation period.

These results show the great need for further investigation into the extent to which solids-not-fat may vary in cows' milk. We want to know, for instance, how solids-not-fat vary during the entire lactation period in cows calving in the months of January, of February, and in every other month of the year. The determinations of the percentages of solids-not-fat alone would not, however, be sufficient. We should have also stated and recorded (1) breed of the cow; (2) age in years and months; (3) number of calves borne by the cow; (4) number of weeks in milk; (5) yield per milking; (6) percentage of butter fat; (7) date of calving; (8) dates of œstrum; (9) health conditions; (10) pathological conditions; (11) nature of feeding; (12) weather conditions, especially sudden changes; (13) changes in milkers; (14) month of sampling for season effects; (15) record of abnormal milking conditions, if any, and possibly other conditions which may be subject to change. A sufficiently large number of cows of different breeds, different ages, different dates of commencing lactation period, &c. should be selected for the purpose of such an investigation. The total yield of milk for each day and the percentages of butter fat and solids-not-fat for each day should be determined. An analysis by modern statistical methods would reveal the extent of the variations, and would quite probably point to causes which should be thoroughly investigated by the physiologist and nutritional expert. Daily samples of the bulked milk of a certain number of commercial herds would also prove a suitable subject for investigation. The whole of the collated data would prove very valuable, especially to the milk producer and to the administrator.

FARM PESTS—BIRDS.[1]

JAMES RITCHIE, M.A., D.Sc., F.R.S.E.,
Natural History Department, Royal Scottish Museum.

BIRDS AND THE WOODS.

Game Birds.—In addition to the short series of true woodland birds, the crossbill, the capercaillie and the woodpeckers, the activities of which are almost confined to the woods, there are two species said to be responsible for a certain amount of damage, which, although they do not spend their whole time there, are invariably associated with woodland. These covert birds, as they may be called, the black grouse and the pheasant, wherever they may wander in the course of the day, prefer as a retreat the outskirts of a wood, and it is there in the shelter of the thick undergrowth that the nests are made and the broods hatched. Both birds subsist upon a mixed diet, becoming predominantly vegetarian or insectivorous as season and opportunity offer. On this account it may well be, as has been alleged, that in hard weather the pheasant may do some harm by attacking the buds of young trees, but I have found no evidence of consistent or serious damage such as would condemn the bird on this ground.

With the black grouse or black game (*Lyrurus tetrix*) the case is different. It is a more confirmed vegetarian than the pheasant, the staple part of its food consisting of the shoots of moorland plants such as heather, blaeberry and crowberry, and of the berries and fruits of these in season. It also feeds upon the buds and leaves of trees, and this accounts for the antipathy of the forester. During several decades black grouse have been diminishing in numbers in Scotland; at the same time silviculture has been making progress. The two movements may well be connected, for in the new woods the presence of black game is discouraged on account of the firm belief of the forester that they are hurtful to young growing trees.

The greater part of the damage is generally thought to be caused by the birds during hard weather, when other food is

[1] **Articles in this series, dealing with Mammal Pests, commenced in the JOURNAL in July 1922. The first article on Bird Pests appeared in January 1924.**

scarce; and particularly during snowstorms, when buds of trees are the only food available, and when the presence of snowdrifts brings the growing tops of young trees within reach. That this is not always the case, however, is shown by an experience recorded by Mr. H. S. Gladstone, who found that serious damage occurred repeatedly even during mild weather, when presumably other food could have been obtained.[1] The incident indicates how great damage may be done by even a small number of black game, and illustrates another general truth, that coniferous trees are the greatest sufferers.

BLACK GROUSE OR BLACK GAME.[2]

In January and February, 1919, Mr. Gladstone planted nine acres at Capenoch, Dumfriesshire, with two-year-old native larch. Black game attacked the plantation with such thoroughness that scarcely a tree escaped damage, so that while many died out, the majority survived as " scroggy bushes." In 1923 it was decided to replant the area, and on the 5th February the work of setting some 5000 two-year-old Japanese larch was commenced. Within ten days the black game also were at work again, and on the 17th

[1] *Scottish Naturalist*, 1923, p. 45.

[2] Illustrations from Saunders' *Manual of British Birds*, by courtesy of Messrs. Gurney & Jackson.

February Mr. Gladstone records that already "fully 2500 have had the side shoots nipped off all round, and about 2000 have had their leading shoot destroyed." This damage was done by a small pack of about eight or twelve grey hens. It was a remarkable feature of the attack that the birds confined their attention to the newly planted trees and that the survivors of the 1919 planting, growing alongside, suffered no damage.

In the case of such winter depredations by black game the Game Laws place the forester at a serious disadvantage in protecting his property. The open season lasts from 20th August to 10th December, so that during the period when they cause most destruction to woods black game may not legally be shot, and they are not susceptible to the ordinary methods of scaring by noise or flapping tags of cloth. So serious was this disability considered to be that the Committee appointed to report on Game and Heather-burning in Scotland recommended in 1921 that "in the interests of forestry the Board of Agriculture for Scotland be empowered, where they are satisfied that black game are damaging plantations of young conifers, to grant authority to the owner of such young trees to kill black game in such plantations at any time."[1] So far this recommendation has not been carried out. Mr. Gladstone confesses, however, that more than one of the marauding grey hens in his plantation were shot, and that even after cooking the flesh was so impregnated with the taste of larch as to be almost inedible.

On behalf of black game it is only fair to add that they are not always so destructive to woodland, and that, as I have been told by one of the largest landowners in the country, even where his ground carries a heavy stock of black game, planting of coniferous trees is continually being carried out without ill-effect.

The Lesser Woodland Pests.—There is a number of common birds whose activities in the woods may not be altogether ignored, though the harm they do is seldom of practical significance. This may be due to the fact that the damage is sometimes casual, occurring only once in a while on account of special circumstances, or, when it is habitual, to its slight incidence, either because it is limited to a short period of the year and even then contributes only to a small extent to the food-supply, or because it affects a food material of which there is abundance and to spare.

One type of casual damage to which plantations are liable has already been referred to in connection with the starling and garden shrubberies (JOURNAL, 1926, p. 391). During the winter months starlings, most of them temporary immigrants from the continent, congregate in selected roosting places in hordes which may number thousands and tens of thousands. Young plantations are frequently resorted to for the roost, to which the starlings return day after day at dusk. The weight of so great numbers, packed together as closely as they can sit, not only destroys the smaller branches, but large branches also frequently

[1] Report of the Game and Heather-burning (Scotland) Committee, 1921, p. 12.

give way under the burden. The trees, thus permanently disfigured, suffer also from the layers of filth deposited upon them, and where the roost is in proximity to human dwellings the stench has been known to make continued habitation almost unbearable.

Rooks are responsible for a second type of casual damage to woodland. In summer rookeries, where the number of trees available for nesting is limited, the piling of nest after nest in a single tree top may prevent natural growth, and the spreading out of the upper branches, where growth should have been vertical, may result in a stunted and misshapen tree. On this account coniferous trees, which depend for their shape upon the uninterrupted growth of a predominant leading shoot, suffer from the presence of rooks' nests when wide-spreading hard-wood trees escape injury. An example of such damage has been described by Mr. Walter Stewart in the rookery at Garnkirk, Cadder, in Lanarkshire. "The coniferous section of this rookery has been in existence many years, but fortunately now shows some decrease. It is built on low misshapen Scots firs, which very probably owe their deformity to the huge piles of nests which they have had to carry."[1] This type of damage is of importance from the foresters' point of view, for it is certain that young fir trees, subjected not only to the muffling effect of the dense and expansive platforms of twigs erected by the rooks but to the pressures of the nests and of the rooks which inhabit them, cannot develop into the straight trees necessary for first-class pitwood. It is essential, therefore, that at its first appearance any attempt of rooks to nest in young coniferous trees should be frustrated by the destruction of the nests.

Habitual feeders on the produce of the woods against which damage has been alleged, consist almost wholly of the finches, the beaks of which are adapted for a specialised vegetarian diet of seeds. The crossbill has already been discussed as a true woodland bird; the other finches are less tied to the woods, although at one or another period of the year the majority find there their staple food-supply.

Thus the siskin, which nests more commonly in Scotland than in any other part of the kingdom, frequents coniferous woods during the summer, feeding upon buds and the insects about them; but in the autumn and winter, when its numbers are increased by immigrants, it feeds largely upon the seeds of larches, birches and alders. Greenfinches and bramblings, the latter all winter visitors, for only on rare occasions has the brambling been known to nest in Scotland and never south of the Border, congregate in the autumn and winter and in constant companionship feed upon beech trees. So great is the fondness of the brambling for beech-mast that its distribution in this country may be said to be determined to a great extent by the abundance and ripeness of the mast. Before its departure in spring, when the beech food has come to an end, it turns to the

[1] *Scottish Naturalist*, 1923, p. 144.

buds of oaks and larches, which it plucks to pieces; although the presence of greenfly without and insect larvæ within the buds may be a factor contributing to this destruction. The hawfinch and bullfinch also destroy large numbers of buds in springtime, without the excuse of seeking the noxious insect.

None of this destruction by finches can be said to be of serious economic importance. There are sufficient seeds of most forest trees to supply the needs of the seed-eaters, and even in the case of beech-mast, where ripe seeds are more valuable since the mast seldom ripens in some districts, the finches are not the worst offenders. It is only in the case of very young forest trees that the destruction of buds is likely to have any ill-effect. It is a different matter, however, when the finches turn to the forest seed-bed. Both greenfinch and chaffinch have been convicted of this misdemeanour, and the large numbers which flock together before the opening of the breeding season would "soon clear a new planting of its seed and cause endless harm."

Last of the lesser woodland pests is the woodpigeon, the enormous immigrant flocks of which subsist to a great extent upon beech-mast; so that, as with the brambling, the progress of continental woodpigeons in winter is largely regulated by the abundance and fertility of beech trees. Probably the harm done is not great, but it must be remembered that beech trees ripen their mast in many Scottish districts only after an exceptionally fine summer, so that the chance of natural recuperation in a beech-wood are less than with other trees. Woodpigeons further reduce the chances. During 1926 beech-mast ripened abundantly in parts of Scotland where it had hardly "filled" for a decade, and immigrant woodpigeons traversed the country in flocks much greater than usual. As this note was being written there was brought to me from Tweedside the crop of a woodpigeon, containing thoroughly ripe beech-mast, 99 fruits weighing 2 ozs., most of them well sprouted. This was but a single meal, rudely interrupted; multiply it by 5 or 6 for a day's allowance; consider that a single flock of immigrating woodpigeons, which was seen to arrive across the Moray Firth on 20th December 1924, was estimated to be about 50 yards broad and at either end extended beyond the limits of vision; let us estimate the number conservatively at 10,000. Then the food of a single flock of migrant woodpigeons for a single day would be approximately 5,000,000 beech fruits, weighing over 11 cwts. Such numbers might well convert a seemingly innocent food-habit into a matter of some moment.

Final considerations regarding Birds and the Farmer.—The long catalogue of birds which, in whole or in part, gain their livelihood at the expense of the British farmer is completed—the destroyers of live stock, the pilferers of grain crops, of green and root crops, of gardens and of woods. They comprise the birds which directly attack farm stock and produce, and as such are open and acknowledged pests, though other activities less patent and often unacknowledged may, as I have tried to show, temper their misdeeds and convert the apparent pest into a benefactor.

Such are the direct pests, but the catalogue would be incomplete if we failed to remind the reader that the farmer and his produce enter the charmed circle of the web of life, and are subject there to complex influences not apparent at a first glance. Thus there are bird pests which never yet attacked a crop, and which are never mentioned in the complaints of the sorely tried farmer. Amongst these are the birds which destroy beneficial insects. Red clover depends for its fertilisation and seed-setting upon the visits of certain species of humble-bees. In New Zealand the clover crop, grown from British seed by British

LONG-EARED OWL.

settlers, blossomed but never seeded itself until, after many unsuccessful attempts, humble-bees of the proper kind had been imported from the home country and, multiplying, made the barren clover fields fruitful. And the tits and other birds which destroy myriads of humble-bees are indirectly affecting the fertility of British clover fields.

So again, the birds which destroy ichneumon flies, hover flies and other insects, which in their turn parasitise harmful caterpillars and grubs or devour greenfly and the like, are indirectly encouraging the caterpillars, grubs and greenflies at the expense of the farmer's crops.

A second group of the indirect pests comprises the birds which feed upon birds more useful than themselves. The shrikes or butcher birds—the Great Grey Shrike, a winter visitor, and the

Red-backed Shrike, which nests in southern England—destroy many small insectivorous birds, which they impale upon a natural thorn or even upon the barbs of a wire fence. The Sparrow Hawk, though no exception could be taken to its capture of pests like woodpigeons, more frequently destroys small passerine birds, which indeed form its staple food. The Merlin feeds largely upon meadow pipits, wheatears and larks, all useful birds from the agriculturist's point of view. Of our native owls, the Long-eared Owl shows a more pronounced tendency than any other to kill small birds, but it has not earned the ill-repute which has attached to the imported Little Owl, now a common English bird, on account of its constant warfare against the small birds of the countryside.

It seems hardly fair to class the gamekeeper as an agricultural pest, but the web of life has strange ramifications, and the man who kills stoats and weasels, which in turn would have slain mice, voles, rats and rabbits, or shoots owls and kestrels which depend largely upon the small destructive mammals, has something to answer for to the farmer.

It has been our duty in these pages to pillory the birds which do harm, more or less, to the farmer's interests. Few of these birds can be looked upon as wholly bad, and in the case of many the evidences of good accomplished more than counteract the traces of evil. Yet, of necessity, all reference has been omitted to the wholly useful birds, the lapwing and the plovers, the waders, the swift, swallow and martins, the cuckoo, the wren, the wagtails, and many other insectivorous birds. To counter the pessimism which too great a concentration on bird pests may engender, it is well that the other side also should be borne in mind, and we conclude with the considered opinion of one of America's foremost living ornithologists, Mr. Frank M. Chapman: "If we were deprived of the services of birds [in the destruction of insects], the earth would soon become uninhabitable. Nevertheless, the feathered protectors of our farms and gardens, plains and forests, require so little encouragement from us—indeed, ask only tolerance—that we accept their services much as we do the air we breathe. We may be in debt to them past reckoning, and still be unaware of their existence" (*Bird-Life*, 1899).

Pasture on Woodland Clearance.

THIS description of an interesting and successful experiment has been contributed by Mr. R. Laird, B.Sc.

On a south Ayrshire farm during the years 1921-1923 some 40 acres of woodland were cut down, leaving a scene of desolation, similar to many others to which we have been accustomed during recent years. The farmer, annoyed at such an appearance of waste and having considered how he might effect a profitable improvement, decided that he would sow down part of it with grass and clover seeds in the nature of an experiment.

Such a procedure was viewed with misgivings by his friends and by the seed expert. Doubt as to the success of this scheme was natural as the land in question was a long narrow strip, very steep, almost an escarpment in places, covered by immense boulders, which in many places formed a continuous chain of stepping stones, so that any form of cultivation was impracticable. The aspect was mostly to the north-east, the soil fairly sharp and dry and full of stones, except that a few rushes were growing at one point owing to an open channel being choked.

The farmer assured the seed merchant that he was determined to carry out the experiment, and they ultimately decided to try the following seed mixture :—

11 lb. Perennial ryegrass.
10 lb. Italian ryegrass.
2 lb. Timothy.
8 lb. Cocksfoot.
4 lb. Meadow fescue.
½ lb. Crested dogstail.
¼ lb. Smooth stalked meadow grass.
¼ lb. Hard fescue.
1 lb. Tall oat grass.
2 lb. Broad red clover.
2 lb. Late flowering red clover.
2½ lb. Alsike, and white (from cleanings).
1 lb. Wild white, and
½ lb. Birdsfoot trefoil,—all per acre.

Towards the end of June 1923 about 20 acres of the most promising of the woodland was seeded with this mixture. The only tillage treatment given was that some branches were dragged over the seeded area to try to secure the rubbing of the surface and the covering of a proportion of the seeds; any other cultivation—harrowing or rolling—was impossible owing to the boulder-strewn surface.

Since the wood had been cut down the cattle and sheep grazing in the adjoining fields had been allowed to roam over the woodland at will, and these at the time of seeding were still grazing in the wood whenever they chose and were never removed subsequently. Also the weather at the time and immediately afterwards was very dry—conditions which had every chance of adversely affecting the experiment.

At this sowing there was only a slight growth of stargrass (or tufted hairgrass), bent grass and Yorkshire fog, and the seed mixture sown proved effective in checking their further development and in ultimately crushing them out completely.

Encouraged by this first success, the farmer decided to seed a further portion the following spring, and in April 1924 an additional 10 acres were seeded with a mixture similar to the first. The land in this instance received no tillage treatment whatsoever, not even branch harrowing, and the seeds were merely trampled in by the cattle and sheep grazing continuously over the area. By this time the weed grasses were more strongly established, but the sown grasses and clovers have been successful in overcoming their competition.

The remaining 10 or 12 acres, which have not been seeded, were very rough with whins and some bracken, and it is very doubtful if it would be worth the expense of seeding. Probably it would be in most parts, as at one point the seed mixture sown in 1924 was continued in a strip about 15 feet wide into this rough part on which the stargrass, bent grass and holcus were well established, and these have been very effectively checked. This stretch is now occupied by the valuable grasses and clovers, its green appearance forming a very strong contrast to the surrounding roughness. This strip has not at any time received any kind of manurial treatment.

A feature which is very noteworthy and should be borne in mind is that all this improvement in the first instance was due to seeding alone; it was only in January 1926 (one year ago) that a manurial dressing of fully 3 cwts. per acre of potassic superphosphate was given to the whole area seeded, except the narrow strip previously mentioned. Further, that no cultivation (harrowing, rolling, &c.) was given even at the time of seeding, and that the cattle and sheep were never removed to permit of the establishment of the young grass and clover plants. Grass weeds were checked by the seeding, but more broad-leaved weeds (thistles, ragweeds and docks) sprang up.

The wild white clover is very conspicuous, and the red clover is still prominent. Cocksfoot and Perennial ryegrass are the most prevalent of the grasses, Timothy is less common than a year ago, and the other grasses are represented in a smaller degree. At every point where the seeded area adjoins the untreated portion the contrasts of colour and growth characteristics are very strongly marked. Wherever the seeds have been sown they have grown, and even in competition with other plants they have flourished.

During last summer the profusion of white clover in conjunction with top and bottom grasses in this pasture was a sight to be viewed with admiration and wonder, the more so on account of the method whereby the result had been attained. Farmers, seedsmen and others who had the opportunity of visiting this experiment were unanimous in placing the grazing value in the first rank. The cattle and sheep which had free access to it were continuously on it, and derived a good deal of very palatable nutriment therefrom. The manuring in the early spring may probably have made the pasturage more acceptable, but right from the beginning, before the manurial treatment, the stock always took to it and kept it well grazed.

It would be very difficult to assess accurately the present grazing value of this land and the monetary value of the improvement effected, because a definite number of stock has not been confined to it for a whole season or even for a shorter grazing period. The stock grazing this improved woodland pasture have had free access to it in addition to the adjoining fields of pasture, so that no direct valuation is possible. Nevertheless, when the constancy with which the cattle and sheep grazed this pasture is taken into account, and the fact that expert judges were thoroughly agreed that more than one-half of the area treated was superior to ordinary good grazing land, and that the remainder—part of which was impaired by a choked open trench and the presence of some rushes—was superior to average pasture, the conclusion is that the improvement must be expressed in pounds sterling per acre annually from now onwards for an indefinite number of years.

On the other hand, the total cost of this venture, including cost of seeds and manures and their application, amounted to over £3 per acre, but results have more than justified this outlay, in spite of the excusable apprehensions of many that the risk of securing an economic return was far too great to be undertaken. The confidence of such an enterprising farmer is worthy of the highest commendation, and is due the success which has been its outcome.

Such an outstanding result is surely worthy of the deepest consideration by farmers who have in their hands at the present time stretches of bare rough ground which was formerly woodland. These in their natural state have, as a rule, very little grazing value, but when properly seeded may, except under some particularly adverse circumstances, acquire a high grazing value. The chances of establishing a first-class sward will be greater if the natural weed-grasses have not had time to become too strongly developed, although in the case cited the sown grasses and clovers were successful in competition with these weeds. In one case brought to the writer's notice the mere manuring of the woodland without any seeding was effective in producing a very marked improvement, the wild white clover in particular becoming very prominent. The chances of success are greater, however, if some strong grasses and some bottom grasses are sown in conjunction with clovers to secure the most productive and most perfect sward, and the young plants encouraged by the application of phosphatic and potassic manures.

NOTE.—*Anyone desirous of visiting the experiment outlined above should oommunicate with the West of Scotland Agricultural College, 6 Blythswood Square, Glasgow.*

THE following article on the value of the chemical test as an aid in identifying Wild White Clover has been contributed by Messrs. Wm. M. Findlay and George Dower of the North of Scotland College of Agriculture.

Several years ago Dr. Pethybridge of Dublin issued a report describing tests he had carried out as to the possibility of distinguishing seeds of Wild White Clover from that of Ordinary White Clover by chemical means during a germination test.

Chemical Test for Wild White Clover.

Briefly, the method is to germinate seed until the green seed leaves appear. About 50 seedlings are crushed and placed in the bottom of a test tube 3 inches to 4 inches long, a drop of toluene being added as an antiseptic. A strip about 1 inch long of filter paper, which has previously been steeped in a solution of anhydrous sodium carbonate and picric acid, and is yellow coloured, is put inside and fixed by the cork, which should be sealed by wax to prevent evaporation. The tube is then kept at a temperature of about 32° C. for a number of hours. If hydrocyanic acid (HCN) is liberated from the crushed seedlings, its presence will be indicated by the yellow picric paper turning reddish or brown.

The first tests indicated that Wild White Clover gave a positive reaction and Ordinary White Clover a negative reaction. Subsequent tests, however, showed that many samples of American White Clover also gave a positive reaction.

Dr. Pethybridge's conclusion was :—" It is clear, therefore, that the HCN reaction of the seedlings cannot be employed unreservedly as a satisfactory and reliable test to distinguish the seeds of Wild White Clover from those of Ordinary White Clover. The most that can be said is that if batches of the seedlings do not produce HCN the sample of seed is not one of Wild White Clover. If HCN is produced, however, this is not a clear proof that the sample is necessarily one of Wild White Clover Seed."

Tests made later by Miss Sampson at the English Seed Testing Station, and described in a Bulletin of the Welsh Plant Breeding Station, agreed closely with those obtained by Dr. Pethybridge. The following deductions were drawn :—

1. " A sample purporting to be genuine Wild White but failing to respond to the test should at least be regarded with a considerable amount of suspicion."
2. " The fact of a particular sample of White Clover seed giving a positive result to the cyanophoric test is not necessarily a proof that the sample is Wild White."

During the past few years tests have been made at Aberdeen, and they agree with the conclusions arrived at by Dr. Pethybridge and Miss Sampson.

At first, when recording the results, such terms as Faint, Moderate and Strong were used, but this was found not to be sufficiently accurate for future comparisons. A scale is now used of different shades from Negative (0) to Very Strong (7), No. 7 having a distinct bluish tinge.

The test tubes are generally examined at regular intervals of a few hours. Some samples show the reaction much earlier than others, and these usually turn out to be strongest.

In 1924, a number of samples that had been previously tested were sown in short rows. Among the samples were 7 said to be Wild White, 5 Ordinary White, and 15 Cultivated White, and the following table shows how they reacted.

	Strong.	*Moderate.*	*Negative.*
Wild White	3	3	1
Ordinary White	—	—	5
Cultivated Wild White ...	6	2	7

The five Ordinary samples produced plants with generally big leaves and thick fleshy stems, and they flowered early, and now a large proportion of the plants are dead. The six Wild White samples and the eight Cultivated that gave the positive reactions were good, and many of the plants had small leaves, thinner wiry stems close to the ground, and were generally later in flowering. It was noted, however, that some plants in most of the samples were thicker stemmed and flowered earlier than other plants from the same sample. The sample said to be Wild White that had given a negative reaction, and also the other five Cultivated samples, behaved exactly like Ordinary White, and are now very poor, a great many of the plants being dead.

Chemical tests were also made with plants from several of the rows. The following table gives a few typical results :—

Reaction of Seed.	No. of Plants Tested.	Reactions—			
		Strong.	Moderate.	Faint.	Negative.
S.	20	7	2	3	8
S.	20	6	5	0	9
S.	20	9	3	2	6
M.	20	0	6	4	10
M.	20	2	2	6	10
M.	20	0	4	2	14
N.	20	0	0	0	20
N.	20	0	0	1	19
N.	20	0	0	0	20

These show that even in the samples giving the strongest reactions there was usually considerable variation among the individual plants, and that only about half gave a strong reaction. In many cases the appearance of the stem and leaves was noted, and negative plants produced from the samples that had given a positive reaction often had the appearance of Ordinary White Clover, and the result in a future trial substantiated this observation.

One-half pound per acre of two samples each of True Wild White, of the Cultivated that gave a moderate reaction (M.R.), and of the Cultivated that gave a negative reaction (N.R.), were also sown in a field as part of a seed mixture. In 1926, when in second year's grass, the plots were very marked. The True Wild White plots were thick with Wild White Clover, the M.R. plots were fairly thick, while in the N.R. plots the White Clover was practically absent.

In 1925, twelve samples of Cultivated White were sown in rows. Only one gave a negative reaction, and already most of the plants are dead, while in the other eleven rows the plants are healthy and vigorous.

In several cases where samples had given strong reactions, the larger flatter and the smaller rounder seeds were picked out separately and tested. In every trial the reaction was about the same with both sizes and shapes of seeds. The same kinds of seeds were also picked out of samples of Ordinary White, and in all cases negative results were obtained.

It is generally recognised that the seeds of Ordinary White are larger than those of Wild White. In order to ascertain if this fact would be of help in identifying Wild White, a number of samples were sifted through a 1 m.m. sieve and the proportion of Large (L) and Small (S) seeds noted.

The following table gives the results of a few samples of Ordinary White, all of which had given negative reactions, and of Wild White that had given reactions of 7 or 6.

Ordinary White.		*Wild White.*	
Large. Per cent.	*Small.* Per cent.	*Large.* Per cent.	*Small.* Per cent.
95	5	35	65
92	8	21	79
90	10	19	81
83	17	14	86
78	22	10	90
74	26	7	93

These figures give the extremes and a few intermediate of the samples sifted, and it will be seen that there is a considerable proportion of large seeds in the Ordinary White and only a small proportion in the Wild White. These figures should not be taken, however, as conclusive, as only about 100 samples, mostly of one season's growth, were sifted. It is quite possible that samples of different seasons' growth may vary in size. The samples were sown in the spring of 1926 in rows, and the appearance of the plants agree with the chemical test. The sifted seeds (L. and S.) were also tested separately, and, as in the case of the selected seeds mentioned above, there was little difference in the reactions.

In 1925, seed was saved from a number of the rows of the Wild and the Cultivated Wild White previously referred to that had been sown in 1924. This would all be Cultivated Wild White. Rows of each were sown in the spring of 1926. The following table shows the proportion of the sifted seed and the result of the chemical test of a few of the samples.

Previous Reactions.	Size of Seed.		Reaction of Seed.	L.	S.
	L.	S.			
A. Strong	85	15	N.	N.	N.
	77	23	5	3	5
	88	12	N.	N.	N.
	75	25	4	1	5
B. Moderate	78	22	N.	N.	N.
	78	22	1	N.	2
	77	23	3	2	4
	97	3	N.	N.	N.
C. Negative	89	11	3	N.	5
	93	7	N.	N.	N.
	92	8	1	N.	1
	85	15	N.	N.	N.

In practically all cases where the original sample gave a strong reaction the cultivated seed they produced gave a weaker reaction, obviously showing that there is a proportion of short-lived plants in samples of Wild White, and that, as these flower both earlier and more freely, there is necessarily a larger proportion in the cultivated seed than in the original sample. On the other hand, some negative samples produced seed giving moderate reactions. This would indicate either that there had been a few seeds from HCN plants in the original sample, but not sufficient to give a reaction, or that crossing had taken place.

There is some evidence that HCN plants will produce both positive and negative seeds. Seed was saved from a number of individual plants in 1926. In some cases the seed gave a stronger reaction than the plant, and in others the plant gave a stronger reaction than the seed. The seeds will be sown this spring (1927).

In the spring of 1926 samples said to be Wild White were obtained from different sources. These were sifted into Large and Small and the chemical test was made with both. The results of a number of the samples were as follows :—

Sample.	Large.	Small.	Chemical Test.		
			Sample.	Large.	Small.
	Per cent.	Per cent.			
No. 1.	69	31	N.	N.	1
2.	19	81	7	7	7
3.	78	22	4	1	4
4.	69	31	3	2	5
5.	35	65	7	6	7
6.	29	71	7	7	7
7.	22	78	6	6	6

A consideration of three points, viz. :—

1. The large proportion of large seeds;
2. The comparatively weak chemical reactions;

3. The fact that the large seeds gave a distinctly weaker chemical reaction than the small seeds,

indicate that samples Nos. 1, 3 and 4 contain a considerable proportion, probably at least one-half, of seeds from short-lived plants, and are, therefore, samples of Cultivated Wild White. Rows were also sown in the spring, and the appearance of the plants agrees with this conclusion.

Summary.—1. If the large and small seeds of a sample of English Wild White both give strong positive reactions it indicates that the sample is True Wild White.

2. (*a*) If the large seeds of a sample give a weaker reaction than the small seeds it indicates that the sample is either Cultivated Wild White containing a proportion of Ordinary White or a mixture of Ordinary and Wild White. (*b*) This indication will be strengthened if there is also a large proportion of large seeds in the sample.

3. Regarding the plants themselves, when sown in rows alone or in a field as part of a seed mixture the following results were observed :—

(*a*) Samples of English seed that gave a strong reaction did well.

(*b*) Samples of seed that gave a negative reaction were failures.

(*c*) Samples of Cultivated Wild White that gave a moderate reaction gave a moderate result.

THE following article has been contributed by Dr. W. G. Ogg of the Edinburgh and East of Scotland College of Agriculture.

Soil Acidity and the Growing of Sugar Beet.

It is now generally recognised that most agricultural crops grow best when the soil reaction is neutral or only slightly acid. Certain plants, such as potatoes and oats, have a much greater tolerance for soil acidity than others, such as barley, sugar beet, clover and lucerne. It is not suggested that the latter group will not grow on acid soils, but it has been shown by numerous experiments that a better yield is obtained when the conditions approach neutrality, and cases of entire failure have frequently been observed under conditions of high acidity.

The growing of sugar beet in Scotland has made this question of soil acidity one of particular importance to farmers. In other countries where sugar beet is grown, great care is exercised in selecting suitable ground for the beet crop and advice is frequently sought with regard to lime requirement. In Sweden, for example, 250,000 soil reaction tests were carried out in two years by the sugar factories.

Some countries where beet is grown very extensively have large areas of soils which contain ample natural reserves of lime, but in Scotland, owing to our climate and the materials from which our soils are derived, only small areas of naturally lime-rich soils occur, and these are mainly in Fifeshire and the Lothians. The majority of Scottish soils, therefore, require liming if the best results are to be obtained in the growing of sugar beet.

Of the arable soils examined in the south-east of Scotland 10 per cent. were found to be neutral or alkaline, and taking the country as a whole the percentage of such soils is almost certainly much lower. A further 10 per cent. of the soils examined were slightly acid, but probably not acid enough to interfere seriously with the growth of beet. There are also fairly acid soils in some districts which have reserves of lime in a form which enables most agricultural crops to grow well in spite of the soil acidity, but it seems likely that in the growing of sugar beet these soils would respond to liming.

The writer has made a detailed examination of 50 Scottish soils on which sugar beet was grown and, through the courtesy of the farmers concerned and the Anglo-Scottish Sugar Beet Corporation, has been enabled to compare the reaction of these soils with the crop of beet obtained. The best results were obtained where there was little or no acidity, and most of the cases of failure were found to be on strongly acid soils. The experiments carried out by the county staff of the Edinburgh and East of Scotland College of Agriculture also bear out the same point. The plots to which lime was added showed an improvement in yield compared with the no-lime plots.

Since sugar beet penetrates to a considerable depth into the ground, it is advisable to test the reaction of the sub-surface layers as well as of the surface soil. The sub-surface layers in the majority of the soils in the south-east of Scotland examined by the writer were less acid than the surface layers, but in a number of places the reverse was the case, and these would afford a possible explanation of checks which sometimes occur in the normal healthy growth after beet has made a good start.

A point to be noted is that the lime ought to be applied some time before the crop is sown—several months if possible—in order that the lime may have an opportunity to become thoroughly incorporated with the soil, and also that it may dissolve a little and penetrate to some depth. Lime applied at sowing time often fails to have the desired effect.

It should be understood that, although in this note only soil acidity has been dealt with, other soil conditions, such as texture, depth, &c., must also be taken into account.

Farmers intending to grow beet who are in any doubt as to the suitability of their land are advised to get into touch with the Agricultural College of their area through the district county organiser.

THE following article has been contributed by Messrs. A. C. M'Candlish, Ph.D., and R. R. Kay, B.Sc.

Swedes *versus* Swedes and Silage for Milk Production.

The silage and roots problem is still under discussion, and quite conflicting claims are at times made for the two feeds as the basis of the ration for the milk-producing cow. No single trial can settle this problem as there are many conditions to be taken into consideration. This question is being investigated at Holmes Farm, and the present report covers the second of a series of trials.

Resumé of previous work.—In an earlier paper by M'Candlish and M'Vicar (4) a direct comparison of silage and swedes was given, and it was found that an allowance of 40 lbs. of swedes induced a 7 per cent. greater milk yield and a 3 per cent. greater fat yield than a ration containing on the average 22 lbs. of silage, and in feeding value 1 ton of swedes was equivalent to 11½ cwts. of silage. At the same time a review of the literature on the subject was given, and it will only be necessary to mention here a few reports that have become available since that time.

It has been found by Baird (2) that cows averaging 19·19 lbs. of milk per head daily when receiving turnips, gave 17·04 lbs. when fed maize silage, and 17·81 lbs. when fed sunflower silage. In a comparison of maize silage and roots Ste. Marie (9) obtained a production of 15·8 lbs. of milk per day when the cows were fed maize silage and 16·4 lbs. when they were on roots. It was stated by Bailey (1) that turnips are satisfactory for keeping up the milk flow, but are inferior to maize silage and sunflower silage for keeping up the live weight of the cows. In comparing a ration containing 60 lbs. of maize silage with one containing 30 lbs. of silage and 30 lbs. of mangolds, Munro (5) obtained 24·91 lbs. of milk per cow daily on the silage ration and 25·21 lbs. on the silage and mangold ration. A ration containing 22 lbs. maize silage and 37 lbs. mangolds was compared by Rothwell (8) with allowances of 32 lbs. of silage and 85 lbs. of mangolds. The mixed ration gave 7 per cent. more milk and 6·5 per cent. more fat than the silage ration, while the mangold ration gave 5·4 per cent. more milk and 1·6 per cent. less fat than the mixed ration.

The trials just reviewed were all conducted in Canada, while the next group were carried out in the British Isles. It was concluded by Drew (3) that 6 lbs. of oat, pea, bean and vetch silage was equivalent to 10 lbs. of mangolds plus 3 lbs. of hay, while Oldershaw (6) found a slight advantage for mangolds over oat, vetch and bean silage. In comparing a ration containing 50 lbs. of silage with one including 42 lbs. of mangolds, 14 lbs. swedes and 24 lbs. silage, Rae and Gardner (7) found 1 lb. of silage to be equal to 2 lbs. of roots. They also noticed that when the cows were changed from good to less palatable silage the milk yield suffered.

Experimental outline.—In the trial at Holmes Farm swedes that had been pitted were used, and the silage fed was composed of oats, peas, beans and vetches. There were ten cows in the test, and information concerning them is given in Table I, and where necessary this is calculated to the first day of the experiment, 18th December 1925. The two cows Nos. 52 and 54 were pure bred British Friesians, while the remainder were pure bred Ayrshires. All were free of the bull when the trial started.

The trial extended over three periods of 30 days each, but the first ten days of each period was looked on as a transition, and the records from that portion of the trial are not given here.

TABLE I.

Animals Used.

Cow—No.	6	8	26	29	52	54	59	60	61	63
Age—Years ...	5	6	4	4	3	3	3	3	2½	3
Fresh—Days ...	57	9	48	39	55	124	71	70	65	43
Previous Lactations	2	3	2	1	1	1	0	0	0	0

The dry roughage ration throughout consisted of 8 lbs. mixed hay and 10 lbs. oat straw per cow per day. In the first and third periods each cow received an allowance of 12 lbs. silage and 20 lbs. swedes daily, while in the second period the succulent portion of the ration consisted of 40 lbs. of swedes. The grain ration was fed according to the production of the animals. It was composed of 3 parts bean meal, 2 parts rice meal, 1½ parts decorticated cotton cake, 1½ parts decorticated earthnut cake, 1 part crushed oats, 2 parts wheat bran, and 1 part distillers' dried grains by weight. Throughout the trial the only case of difficulty in the feeding was with cow No. 52 in the first period; she was slightly off feed for a short time, and for four days received only half her silage ration.

The amounts of hay and straw fed were controlled by occasional weighings, while the concentrates, silage and roots were weighed for each feed. The cows had access to water and salt at all times. The milk was weighed and sampled at each milking, and composite samples for each cow were tested for butter fat at the end of each ten-day period. Samples of the roots and silage were also taken for analysis.

Results—When the average yield of milk and butter fat produced during the periods when roots and silage were fed is compared with the yield obtained when roots were the sole succulence, it is found that the variations in yield are very small. When roots and silage were fed together 3 per cent. more milk and 2 per cent. more butter fat were produced than was the case with swedes alone. These variations are practically negligible. If the cows be considered individually it will be found that seven gave increases and three decreases in milk yield, while eight gave increases and two decreases in fat yield when on the roots and silage ration. It is quite apparent that there was no great difference in the values of the two rations under the conditions of the trial.

The average consumption of hay, straw and concentrates during the silage and roots periods was the same as the amounts consumed when roots formed the sole succulence, so variations in the feed, other than the succulence, could have had no influence on production.

The silage contained 27·17 per cent. dry matter as compared with 22·22 per cent. in the previous trial, while the roots had 9·74 per cent. as compared with 9·83 per cent. in the earlier test. The silage was of better quality and more palatable than that used in the previous year.

TABLE II.

Summary of Production.

Period No.	Succulent Roughage.	Milk Yield.	Fat Content.	Fat Yield.
		Lbs.	Per cent.	Lbs.
I.	Silage and roots	6,868	3·67	251·84
III.	Silage and roots	5,286	3·74	197·70
Average	Silage and roots	6,077	3·70	224·77
II.	Roots	5,888	3·75	220·58
Increase over roots—Per cent.		3	−1	2

TABLE III.

Summary of Feed Consumption.

Period No.	Succulent Roughage.	Hay.	Straw.	Concentrates.	Silage.	Roots.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
I.	Silage and roots	1,600	2,000	2,670	2,376	4,000
III.	Silage and roots	1,600	2,000	1,969	2,400	4,000
Average	Silage and roots	1,600	2,000	2,320	2,388	4,000
II.	Roots	1,600	2,000	2,320	—	8,000

TABLE IV.

Composition of Silage and Roots.

(Analyses furnished by the Chemistry Department.)

	Silage.	Swedes.
	Per cent.	Per cent.
Moisture	72·83	90·26
Dry matter	27·17	9·74
Crude protein	3·92	0·80
Soluble carbohydrates	12·59	7·33
Crude fibre	7·80	0·97
Crude fat	1·02	0·14
Ash	1·84	0·50

TABLE V.

Equivalent Values of Swedes and Silage.

	Swedes.	Silage.
Milk per 100 lbs. dry matter in ration	99 lbs.	98 lbs.
Fat per 100 lbs. dry matter in ration ...	3·73 lbs.	3·64 lbs.
Milk per 100 lbs. succulent feed ...	74 lbs.	123 lbs.
Equivalent weights	1 ton.	12 cwts.
	1 ton 13 cwts.	1 ton.
Equivalent yields per acre	20 tons.	12 tons.
	25 tons.	15 tons.
	30 tons.	18 tons.
Equivalent prices per ton	15/-	25/-
	20/-	33/-
	25/-	42/-

When it comes to a consideration of the equivalent values of the two rations it is found that for each 100 lbs. of dry matter in the total ration when roots were the sole succulence there was produced 99 lbs. of milk and 3·73 lbs. of butter fat, while for the ration containing both silage and roots the returns were 98 lbs. of milk and 3·64 lbs. of butter fat for each 100 lbs. of dry matter consumed. This shows that the rations were about equal value for the purposes of milk production.

When roots alone were fed, 74 lbs. of milk were produced for each 100 lbs. of roots consumed, and if this value be attributed to the roots in the roots and silage ration, then 123 lbs. of milk were produced for each 100 lbs. of silage consumed.

On working out equivalent weights it is found that 12 cwts. of silage are equal in feeding value to 1 ton of swedes; in the previous trial 11½ cwts. was the equivalent found. Consequently if roots be taken at £1 per ton then silage is worth 33*s.*; and if a crop of 20 tons of swedes per acre can be obtained, then 12 tons of silage per acre must be fed out of the silo to get the same milk production per acre of crop.

Summary.—An allowance of 20 lbs. of swedes and 12 lbs. of silage is about equivalent to an allowance of 40 lbs. of swedes. The choice between the two rations will depend on the relative amounts of the two succulent roughages that can be produced and the cost of producing them.

BIBLIOGRAPHY.

1. C. F. Bailey.—Feeding Experiments with Dairy Cattle at Fredericton, N.B. Canada Expt. Farms, Fredericton (N.B.). Sta. Rpt. Supt., p. 10. 1923.
2. W. W. Baird.—Turnips, Corn Ensilage and Sunflower Ensilage for Dairy Cattle. Canada Expt. Farms, Nappan (N.S.). Sta. Rpt. Supt., p. 9. 1923.
3. J. P. Drew.—Growing of Crops for Silage, and some Experimental Results. *Jour. Dept. of Lands and Agr. for Ireland,* vol. 24, No. 3, p. 228. 1924.
4. A. C. M'Candlish and A. M'Vicar.—Silage *versus* Swedes for Milk Production. *The Scottish Journal of Agriculture,* vol. 9, No. 2, p. 194. 1926.
5. W. A. Munro.—Corn Silage *versus* half Roots and half Corn Silage for

Milk Production. Canada Expt. Farms, Rosthern (Sask.). Sta. Rpt. Supt., p. 11. 1924.

6. A. W. Oldershaw.—Silage Feeding Experiments. *Jour. Roy. Agr. Soc. of England*, vol. 86, p. 112. 1925.

7. R. Rae and H. W. Gardner.—An Experiment on Feeding Silage to Dairy Cows. *Jour. Min. of Agr.* (England), vol. 32, No. 7, p. 635. 1925.

8. G. B. Rothwell.—Feeding Experiments with Dairy Cattle at the Central Experimental Farm. Canada Expt. Farms. Anim. Husb. Div. Rpt., p. 11. 1924.

9. J. A. Ste. Marie.—Silage *versus* Oat Hay, *versus* Roots. Canada Expt. Farms, Ste. Anne de la Pocatiere (Que.). Sta. Rpt. Supt., p. 8. 1923.

THIS article on dual-purpose cattle and their function in British agriculture has been contributed by A. D. Buchanan Smith, Animal Breeding Research Department, University of Edinburgh.

Dual-purpose Cattle.

In Great Britain there is a continual controversy concerning the dual-purpose cow. It recurs in both the agricultural and the lay press. Not infrequently the dual-purpose cow seems to get the worst of the argument. That does not affect her much. She continues to chew her cud in spite of the raging of experts.

The public is being educated to demand better beef, and this appears to be best obtained in comparatively small herds. This demand implies young beef, the production of which requires individual attention, more concentrated feeding, and, in a sense, smaller scale production. Simultaneously, the consumption of milk is growing. It is to conform to economic demand that the farmer must modify his business. The British farmer has learnt by experience that agriculture of a single type is a dangerous thing to adopt. He has learnt that continued mass production of a single article may end in a bankruptcy court. That is one reason why by far the most common type is diversified farming.

Milk and beef are two agricultural commodities in which the British farmer is subjected to less severe competition from overseas than in other kinds of farm produce. Accordingly, they should best repay the cost of production, and the farmer who does not wish to put all his eggs in one basket, tries to produce both, and here we come to the *fons et origo* of the whole discussion. Whether or not has the British farmer succeeded in producing both milk and the best quality beef from one and the same herd of cattle?

Great Britain is the home of the majority of the improved breeds of cattle. The pioneer of all the breeds is the Shorthorn, and this breed is by far the widest spread of any in the United Kingdom. There are few unpedigreed cattle that do not possess some of its blood. Without doubt the purely milk and the purely beef breeds have achieved great things, but the fact remains that the average farmer of Britain, with the exception of certain districts, prefers to keep cattle of a dual-purpose nature.

Britain may rightly claim to be the home of the dual-purpose cow. Besides the dual-purpose Shorthorn, which is really more widely spread than the beef Shorthorn, there exist the following breeds which claim essentially to breed for the two types,—the Red Poll, the Lincoln Red Shorthorn, the Blue Albion, Welsh Cattle, the Dun and the Belted Galloway and the Devons, North and South. Also certain strains of the Aberdeen-Angus, Hereford, Ayrshire and Guernsey lay claim to a double vocation. Neither is the Holstein Friesian bullock to be despised by the butcher. Indeed, the type of the British Friesian approximates very closely to that of the Shorthorn, as American judges have frequently remarked.

In reply to the question of whether the two qualities can be successfully combined in a single herd, it may be stated there are two ways of doing it. The one is to establish a herd chiefly for milk and to use a bull of a distinctively beef breed. This implies the selling of all the calves. If the right kind of dairy cow is used—one of not too pronounced a dairy type, but yet yielding a good quantity of milk—then undoubtedly good quality meat can be produced, especially if the sire is an Aberdeen-Angus. This arrangement is adopted in quite a fair number of herds, but it cannot be considered to be very common as yet.

The other way is to keep a herd of dual-purpose cattle. The success of this method depends largely upon whether an individual animal can be bred both for beef and milk. That this would appear to be possible may be adduced from, amongst other evidence, a paper written by H. C. M'Phee and Sewall Wright of the United States Department of Agriculture, which shows that the milking Shorthorns of Great Britain have blood lines which are not very different from the beef Shorthorns. In fact, the pedigree dairy Shorthorns appear to be as closely related to the founder of the "Scotch" type of Shorthorn, "Champion of England," as the beef Shorthorns are. In the case of the dairy Shorthorn, however, there has been selection in the direction of increased milk yield, while the beef type has been by no means dispensed with.

Though it is possible that steers produced in such a herd are not of champion quality, nevertheless they can be graded very high. It must be remembered that Amos Cruickshank, the founder of the Scottish Shorthorn, believed in a good milker, and that there are still in many of the best of the pure bred beef Shorthorn herds in Scotland cows which are exceptionally deep milkers. The reason why so much more emphasis has been laid upon the beef type rests largely with the exporters, particularly the South American ones, who have almost ignored milking qualities. As these exporters in a measure dominate the pedigree market, it is only natural that there should have been a tendency to breed the beef type which suited their purposes irrespective of whether it was that most suited to the United Kingdom.

Since there has been of late a certain slackening of their foreign trade, the pedigree beef Shorthorn men are wisely paying more attention to the milking qualities of their animals, and at least one of the most prominent breeders has joined the Dairy Shorthorn Association. By doing this, these breeders consciously or subconsciously realise that there is a very definite place for dual-purpose cattle in the economy of British agriculture.

It is a commonplace conception in biology that while a plant or animal is most busily engaged in growth, it has little or no energy left for reproduction. It is this argument which is used in many forms against the possibility of combining in one animal the functions both of beef and milk, for beef represents energy used for growth, and milk energy used for reproduction. There is a certain justification for such an argument. Physiologically the synchronous production of beef and milk is incompatible. But the fact that the two take place (or ought to take place under modern systems of agriculture) at different periods in the life of the animal, appears to have been ignored.

Modern standards of quality beef demand an animal killed before it is two years old, preferably at around 14 months of age. Statistics of various experiments show that this can be done quite economically. Under these circumstances the reproductive system is not called into action until the growth period is almost at an end, and procreation does not attempt to take place simultaneously with growth. An animal may be mature from a beef point of view at 14 months, but it need not attain sexual maturity till it is two and a half or three years old. Therefore this argument which is used against dual-purpose cattle is really one of the strongest in their favour. Undoubtedly, cattle can be obtained which attain beef and sexual maturity at the same time; but in the proper type of dual-purpose cattle, there is an appreciable difference between the two. It is this difference that breeders of dual-purpose cattle are taking advantage of, or ought to do so.

This confusion of thought has probably been caused by selection for one quality only, regardless of the other. That Dairy Shorthorn cattle, which still retain many of the good beef qualities of their ancestors, have proved themselves the best milkers in the world is a point not realised by many critics. A deep milker, after all, requires some of the constitution of the beef animal to enable it to express its potentialities.

An additional point in favour of the dual-purpose cow lies in the fact that, after her period of usefulness as a milk producer has come to an end, she can be more easily fattened. Even though the meat thereby produced is not of a very high quality, the fattening is well worth the remuneration obtained. Many dairy farmers near the towns in Great Britain buy cows carrying their third or fourth calf, keep them for one lactation period and then fatten them off for the butcher. The type of cow required for this system of dairy-farming is obviously the dual-purpose.

The dual-purpose cow of Great Britain is therefore no chance production. It has been evolved by careful selection extending over more than half a century. It occupies an important position in British agriculture, if not the key position. That its beef qualities do not entirely negative its milk capabilities may be estimated from the fact that 65 per cent. of the cows entered in Volume 9 of the Register of Dairy Cattle, prepared and published by the Ministry of Agriculture, are of this dual-purpose type.

Agricultural Progress: The Journal of the Agricultural Education Association—Vol. IV., 1927.

Reviews. The fourth issue of this Journal maintains the high standard of content and quality set by its predecessors, and gives ample proof of the usefulness of the Association in its record of work accomplished and in progress.

In a foreword summarising the main activities of 1926, attention is called specially to the investigations into the problems of grassland management; and the opinion is offered that lately knowledge has accumulated more rapidly in this than in any other branch of agricultural science. The German method of utilising grass by heavy manurial dressing and sectional grazing is noted, the theoretical explanation of its value being given by the series of analysis of pasture plants at different stages of growth carried out at Aberystwyth and the Cambridge determinations of digestibility of grasses cut weekly from April to October. Results indicate the economic value of close grazing. In the same connection, the work of the Rowett Institute has emphasised the differences that may exist between different pastures in respect of mineral content, and has indicated the connection between mineral deficiencies in pasture and malnutrition of sheep grazed thereon. A third series of investigations is that carried out by the Plant Breeding stations at Aberystwyth and Edinburgh in which the qualities of certain strains of indigenous grasses has been demonstrated. The importance of careful scientific management of pasture is all the greater the more British farming is forced to rely on animal products.

Sir Thomas Middleton completes in a second article his review of the early activities of the Agricultural Education Association, noting the useful results achieved in co-operative experimental work done by the members in different parts of the country, their attempts to secure uniformity in analytical methods and to establish a system of abstracting technical reports, and their endeavours to get the National Diploma examinations put on more satisfactory lines.

An exposition of the chromosome theory of inheritance is contributed by Dr. F. A. E. Crew, showing how it comes about that the characters exhibited by an individual plant or animal are transmitted from one generation to the next through corresponding factors in the germ-plasm. The exposition is highly technical, and according to Dr. Crew, the conclusions arrived at are not yet applicable to the practice of stock-breeding, although even now genetical theory provides the breeder with means of eradicating hereditary defects from his stock and enables him to secure disease resistance and immunity.

"A Rothamsted Catalogue," by Sir Daniel Hall, describes the building up of a collection of early books and publications on agriculture which Sir John Russell has initiated at Rothamsted, and of which a catalogue with notes on authors has now been prepared and issued by Miss Mary S. Aslin. The catalogue deals with books printed between 1471 and 1840, and in Sir Daniel Hall's opinion it shows the library to be probably more complete than any similar collection.

Notices are included of various conferences of agricultural interest. The Oxford meeting of the British Association—Agriculture Section is described by Mr. A. B. Bruce, who reviews Sir A. D. Hall's Presidential Address on the World's Wheat Supply and the consequent discussion: the discussion on Agricultural Education, in which a contribution by Mr. Joseph Duncan is specially mentioned as distinguished by great originality of thought; that on Cultivations by Professor J. A. S. Watson; and others dealing with Overseas Training, Soil Classification, Silage, Feeding of Dairy Cows, and Mineral Deficiency.

A recent development of Rothamsted activity is the holding of conferences on specific subjects, and Mr. H. W. Garner gives a brief account of these, the subjects dealt with being (1) Liming, (2) Green Manuring, (3) The Manuring of Potatoes, (4) The Growing of Lucerne, and (5) The Cultivation and Manuring of Fodder Crops. The conferences are intended to bring together those engaged in the development of agricultural science and those whose daily work is agricultural practice.

One of the latest specialisations of agricultural science is the branch known as Soil Science which has hitherto been further developed on the Continent and in America than in Britain, but which is now receiving attention from a small corps of advisory officers both in England and in Scotland. Three conferences of soil investigators were held during the year and brief notices are given of their proceedings. The first, at Grongingen in Holland in April, dealt with problems of soil acidity; the second, held in Hungary in August, settled a basis of soil types for the construction of the soil map of Europe; and the third at Rothamsted in October discussed methods of mechanical analysis, especially with reference to dispersion and to the scale of diameters of fractions, with a view to arriving at uniformity of practice.

The Reports of the Imperial Economic Committee are noticed, and attention is called to the establishment of the Empire Marketing Board with its allocation of £1,000,000 per annum for five years to encourage the consumption of Empire produce: to the allocation of £150,000 of that amount yearly to research;

and to the consequent setting up of a Research Sub-Committee to deal with applications for grants.

Papers or summaries of papers read at the meetings of the Agricultural Education Association are given. The Summer meeting was held at Seale Hayne College, Devon, and several interesting accounts of aspects of Devon and Cornwall farming were read, while more general topics dealt with included " Farm Profits and Losses," " Labour Requirements of Arable and Grasslands," " Seed Mixtures," " Ropiness in Milk," and " Young Farmers' Clubs." At the Winter meeting in London papers were read on " Dairy By-Products," " Sugar Beet Experiments," " Silage," " Pig Production Records," and on other subjects.

Reviews of agricultural books, an excellent summary of bulletins issued during the year, and a section of notes and personalia complete an exceedingly interesting volume, highly creditable alike to the Association and to the honorary editors, Messrs. Dymond and Bruce.

Plant and Animal Improvement. Roberts and Davenport, 1925. Ginn and Company.—This book is primarily designed for the use of agricultural students, and, as such, it is a useful introduction to the study of inheritance in plants and animals. The material is presented with an explicitness thoroughly stimulative of interest, and there is close adherence to the agricultural aspects of the subject throughout. The greater part of the book is devoted to animal improvement. Too little attention has been given to plant improvement, and the material on this side of the question is rather fragmentary, and somewhat incoherent. The book is suited only to those who wish a popular introduction to the agricultural aspects of heredity.

A successful Norfolk Poultry Farm,[1] 1922-26.—The writer of this booklet, Mr. R. M'I. Carslaw, M.A., Dip. Agric. Cambridge University, describes it as an attempt to show the development, difficulties and successes of a poultry farm, the satisfactory financial results of which cannot be questioned. The occupier of the farm until demobilised from the Army was in no way connected with the soil, and to use his own expression "Did not know a pullet from a cockerel," which makes this account of his successful undertaking all the more arresting. It is not written as in any sense an advertisement for the poultry farm in question for its owner wishes to remain anonymous; it is written for the sake of those who are interested in the financial possibilities of poultry keeping. The farm is situated in Norfolk and its soil is light, and for the first five years consisted of 18 acres. Part of the land was reserved for rearing and the rest was laid out in acre plots, each acre being divided into two halves with a converted army hut placed centrally with a capacity of approximately 300 birds. The farm was from the first intended for commercial

[1] Report No. 5, Farm Economics Branch, School of Agric., Cambridge University. Price 1s., post free.

egg production, white leghorns being chosen for the main stock. As is almost universally the case, the poultry results are not shown as entirely apart from the other interests on the farm, but the results indicated that on a farm of this size commercial egg production could yield a balance to cover interest on capital, unpaid labour and profit, of 7*s*. 6*d*. per bird. The labour allowed may be considered generous, being over the generally accepted figure of one man to 900-1000 birds, but in the owner's opinion the increased labour is more than justified. The capital at £1 per bird on a farm with modern equipment, including electric plant, seems to be too low an estimate, and one which would not hold under Scottish conditions, where housing must be of a substantial nature. Interesting details are given regarding foods, methods of feeding and costs, buildings and appliances, including lighting plant, diseases, egg production, returns, &c. The weight of food consumed is equivalent to 128 lbs. per bird at 11*s*. 1½*d*. It must be borne in mind, however, that these figures include the total food consumed by all the poultry stock, including stock reared for replacements, and therefore cannot be taken as the actual food cost and consumption of a hen in production. The average number of eggs laid per bird was 147. The poultry farm was not without its outbreaks of disease, having had two severe outbreaks of roup and one of scouring caused by bran heated in store. Other details, tables and charts, make an interesting account of the pitfalls and possibilities of success in running a poultry farm over a series of years.

Labour on Scottish Farms.

IT is regretted that in the article on this subject in the issue of this JOURNAL for January (page 91) figures were given differing from those finally obtained. The final figures are as follows :—

	Regular Workers.	*Casual Workers.*
Males, 21 years old and over ...	60,803	8,534
Do. under 21 years old ...	22,483	4,434
	83,286	12,968
Women and girls	19,692	10,149
Total ...	102,978	23,117
Grand total	126,095	

The grand total is about 4,000 above that recorded in 1925, and is the largest since 1921, when the figure was about 800 above that now reached. Regular workers show an increase, as compared with 1925, of 713. Males over 21 have increased by 1,053, while those under 21 have diminished by 413 (nearly 2 per cent. in each case); women and girls have increased by 73, or about 1 in 300.

These returns have now been obtained for six successive years. The figures for the last two years are not entirely comparable with those of previous years, since in 1925 and 1926 fuller inquiry was made in cases where it appeared to be probable that labour had been omitted in the schedules. As the figures stand regular workers show in 1926 a decrease of only 900 (less than one per cent.) as compared with 1921. Regular male workers are more numerous by 1,200 (about 1½ per cent.), while women and girls have diminished by 2,100, or nearly 10 per cent.; in 1926, however, the latter show an increase for the first time. Casual workers are practically the same in 1926 as in 1921, while in 1924 they were 25 per cent. fewer. Variations of their numbers are not, however, of much significance.

The remarks made in the concluding paragraphs of the previous article are not affected by the correction of the figures.

Publications of the International Institute of Agriculture.

The International Institute of Agriculture has recently made certain changes in the form of its periodical publications. The new "International Review of Agriculture" combines the old quarterly publications, the "International Review of the Science and Practice of Agriculture" and the "International Review of Agricultural Economics," and embraces the various kinds of information formerly contained in these, besides giving certain additional statistics, &c. The new Review is published monthly, the annual subscription being 17*s*. 6*d*. post free. The two Reviews, formerly issued quarterly, will however be continued in monthly form, the annual subscription for the "International Review of the Science and Practice of Agriculture" being 10*s*. 6*d*. post free and that for the "International Review of Agricultural Economics," 9*s*. post free.

It has also been arranged that reprints will be available of the Technical Section of the International Review of Agriculture, the subjects being arranged in groups so as to meet the needs of specialists in different branches of the science and practice of agriculture. For the present, subscriptions can be received for the following series of reprints to be issued monthly :—

"International Bulletin of General and Tropical Agriculture and of Rural Engineering," annual subscription, 6*s*. post free.

"International Report of Plant Protection," annual subscription, 4*s*. post free.

The Institute's monthly "International Crop Report and Agricultural Statistics" is already widely known and has not undergone material alteration. The annual subscription is 9*s*. post free, but if the "International Review of Agriculture" is also taken a combined subscription of 25*s*. per annum has been fixed.

Applications for copies of the English editions of any of these publications should be sent to the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

THE following is a note of agricultural scholarships awarded annually by the Board of Agriculture for Scotland.

Scholarships.

Scholarships for Children of Agricultural Workers.—Arrangements have been made for the continuance on a modified scale of the scheme for the award of scholarships to the sons and daughters of agricultural workers and others which was instituted in 1922 in accordance with the provisions of Section 3 of the Corn Production Acts (Repeal) Act, 1921. The four classes of scholarships are as follows :—

Class I.—Short course allowances, not exceeding 35*s*. per week for the period of the course, to enable the holders to attend short courses of from four to ten weeks' duration in agriculture, horticulture, dairying, poultry-keeping, &c.

Class II.—Certificate Course Scholarships, each not exceeding £30 in value, to enable the holders to attend courses of instruction in agriculture, horticulture, dairying, poultry-keeping, &c. These courses as a rule require attendance at classes during one session of about twenty weeks.

Class III.—Diploma Course Scholarships, each not exceeding £120 in value, or £40 per session, to enable the holders to attend the courses of instruction for diplomas awarded by Agricultural Colleges in Scotland.

Class IV.—Degree Course Scholarships, each not exceeding £280 in value or £70 in any one year, tenable for courses of instruction for the degree of B.Sc. (Agriculture) of a Scottish University during three academic years or thereby, or for the qualification of M.R.C.V.S. at the Edinburgh or Glasgow Veterinary College.

In addition to the allowances described above, class fees are paid in respect of all scholarships awarded. Travelling expenses may be paid either in addition to or wholly or partly in place of the allowances.

The scheme is administered by the Board, with the assistance of the Scottish Education Department, Education Authorities, Colleges of Agriculture and the Scottish Farm Servants' Union.

Benefits under the scheme are confined to :—

(*a*) The sons and daughters of agricultural workers.

(*b*) The sons and daughters of other rural workers, including smallholders, whose financial circumstances are comparable to those of agricultural workers.

(*c*) Persons who are themselves *bona fide* workers in agriculture, or its allied pursuits, whose financial circumstances are comparable to those of agricultural workers.

Applications should be made to the Education Authorities not later than 30th April 1927.

Agricultural and Veterinary Research Scholarships.—These scholarships, which are awarded under a scheme administered jointly by the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland, are intended to provide training for research work for graduates who show distinct promise of capacity for advanced study and research in one of the sciences bearing on agriculture.

The scholarships to be awarded during the present year are tenable for a period of three years from 1st October 1927 and are of the value of £200 per annum, with the addition, where necessary, of allowances for travelling and subsistence for any periods spent abroad.

The scholarships are open to graduates with honours in science (or equivalent qualifications) of a British University. In the case of Veterinary Research Scholarships, applicants must have obtained the Diploma of the Royal College of Veterinary Surgeons or have shown evidence of proficiency in medicine or some other related branch of science.

Applications must be received not later than 30th June 1927 on the prescribed form, which, together with a copy of the conditions attaching to the scholarships, may be obtained from the Secretary, Board of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh.

The selection of candidates under this scheme is made by the Development Commissioners' Advisory Committee on Agricultural Science, on which both the Ministry of Agriculture and Fisheries and the Board are represented.

Agricultural Scholarships for Students intending to become Agricultural Organisers, Lecturers, &c.—This scheme, which is also administered jointly by the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland, is intended to further the education of selected agricultural students who propose to take up posts as agricultural organisers, teachers or lecturers in agriculture. Candidates must be British born and should be graduates of a University, but exceptional candidates otherwise qualified, who have not had an opportunity of graduating, are regarded as eligible.

The scholarships, of which five are available for award during the present year, are of a maximum value of £200 per annum, and are tenable for a period of two years from 1st October 1927, the second year to be spent abroad, when special additional allowances to meet travelling and other expenses will be granted.

Applications must be received by the Board not later than 30th June 1927 on the prescribed form, which may be obtained, together with a copy of the conditions attaching to the scholarships, from the Board.

The selection of candidates under this scheme also is made by the Advisory Committee on Agricultural Science.

Post-Graduate Scholarships in Agricultural Science.—This scheme, under which the Board previously awarded annually nine scholarships of the value of £120 per annum tenable for a period of one year, has been discontinued.

Merchandise Marks Act, 1926.

Marking of Imported Eggs.—The appropriate Departments for the purposes of this Act have received an application from the National Poultry Council and the National Farmers' Union for an Order in Council to require the marking of imported eggs. The application has been referred by the Departments to the Standing Committee, which has been set up in terms of the Act. It is expected that the formal enquiries of the Committee will commence early in May.

The Secretary of the Committee is Mr. H. J. Johns, 10 Whitehall Place, London, S.W. 1, to whom any communications with regard to the matter should be addressed.

Agricultural Conditions.

During December unsettled weather was general in the extreme north and in some of the western islands, but elsewhere the last month of 1926 was mainly fine and dry, and good progress was made with all kinds of outdoor work. The conditions during January were as usual very changeable, snow, frost, rain and bright dry weather alternating until the last week of the month when an unusually violent gale swept over the whole country. In the eastern districts good progress was made in the first fortnight of the month with lea ploughing and the carting of manure, but in northern and western areas when the land was not frozen hard it was often too wet for cultivation, with the result that all outdoor work was much interrupted. During the latter part of the month broken weather was general in all parts of the country; little progress was made with ploughing during this period, but as outdoor work was well advanced at the end of December, seasonal operations were, generally speaking, not seriously in arrear. Throughout most of the northern and eastern districts little rain or snow fell during the first half of February, but frosts were frequent. The remainder of the month, however, was generally mild and open and, with the soil in good condition, ploughing was pushed forward rapidly in these areas, and arrears of field work were overtaken. In the western and southern districts mild but broken weather was general during the whole month and at times the land was too wet for cultivation.

Owing to wet weather in November it was generally found difficult to obtain a good seed-bed for the sowing of wheat and a proportion of the work was, in consequence, delayed. The weather in December, fortunately, was much more suitable for sowing, and a considerable acreage was seeded under very satisfactory conditions. The crop brairded well, even where it had been sown in unfavourable weather, and at the end of January in practically all districts the young plants were reported to have a strong healthy appearance. Estimates of the area sown are at present more or less speculative, but from the preliminary reports furnished by the Board's Crop Reporters it would appear that in several districts there will be an appreciable increase in the acreage under wheat this year. At the beginning of March the prospects of the crop were favourable and the plants were stated to be healthy and vigorous. In some parts of central and south-west Perth, however, many fields were reported to be patchy, a proportion of the plants having rotted out owing to flooding.

At the end of January the Board made special enquiries into the condition of stocks of potatoes in the pits. The reports showed wide variations. In the south-western districts the tubers appear to have kept remarkably well, while in the northern and western mainland areas there was little cause for apprehension, as the wastage in the pits was not generally reported to be above the average. In Orkney and Perth, however, and in practically all the counties bordering the North Sea, from the Moray Firth to the English border, a considerable proportion of the potatoes was frosted before being lifted, and in some cases the tubers were pitted under unfavourable conditions, with the result that much of the crop rotted, the estimated loss varying from county to county from 15 up to 35 per cent.; where lifted early, however, and free from disease, the potatoes in these districts were reported to be sound and of satisfactory quality.

Ewes have wintered well in most districts and are generally reported to be healthy and in good average condition; in Kincardine and the Border counties the flocks have thriven unusually well, while the report received from south-east Perth states that hill sheep in that district never came through the winter in better condition. At the beginning of March lambing had begun among special flocks and on arable farms in the southern and eastern counties. The fall of early lambs is reported to be satisfactory, and, generally speaking, the prospects at the beginning of March were considered to be rather better than last year.

Turnips are said to be plentiful generally, especially in the south-western areas. In some localities, however, stocks were becoming rather low at the end of February, and in Aberdeen, Ross and Cromarty, Lewis, Kirkcudbright and North Argyll it was feared that there might be a shortage later on. In most cases the roots have kept well in the pits. In some parts of Perth, however, the condition of the crop is varied, those lifted before the frost set in last autumn being satisfactory, whereas those pitted later are not nearly so good.

The supply of regular workers is generally ample for requirements. The report received from north Ayr at the beginning of March, however, stated that in that district experienced milkers were rather difficult to obtain.

SCIENCE AND PRACTICE.

The following extracts and summaries are supplied by members of the staffs of Scottish agricultural colleges and scientific institutions. Full references to the original publications may be obtained on application to the Secretary, Board of Agriculture, York Buildings, Edinburgh.

CROPS AND SEEDS.

Experiments with Oats of Different Size sown in various Quantities at a Depth of approximately two inches to four inches. *By Ved N. J. Neilsen and P. O. Overgaard (English Summary), Tidskrift for Planteval.* 32 *Binds,* 5 *hafte.* 1926.—The experiments were carried out on sandy soils at the State Experimental Stations at Studsgaarde, Lungaarde and Tylstrup in Denmark. The yielding capacity of ordinary sized well-fanned seed of "Victory" or "Yellow Naasgard" oats was compared with very large seed selected from the same lots. The results obtained showed that an increase in the size of seed grain procured as a result of more intensive sorting, when fairly normal amounts of seed were sown, had not produced an increase in the crop of oats in sandy soils. The theory sometimes advanced that rather deep sowing on sandy soils should give the crop better resistance against drought was not confirmed by the experiments. A difference of approximately 36 lb. per acre in the amounts of seed sown (approx. 190 lb. and 150 lb.) had not given a significant difference in the size of the crop whether the same or different numbers of kernels were contained in the amount of seed sown.

Investigations on Clover Eelworm (Tylenchus devastatrix). *By Sofie Rostrup, Tidskrift for Planteval.* 32 *Binds,* 5 *hafte.* (*English Summary.*) 1926.—Red clover was sown in soil infested with eelworms contained in drain pipes. When clover had not been grown in the soil for four years, the attack appeared in the summer of the year in which the seed was sown. If no clover was sown for five years, the attack of eelworm was not distinct until the middle of August in the following year, and after six to seven years there was no attack either in the year of lea or in the following two years, but on repeated sowing it appeared in the third year. It is concluded that an attack of eelworm might be expected in the year of lea when a two-years' clover field is employed in the seven-years' crop rotation, and in the eight-years' rotation it would appear in the summer of the first harvest year. In a nine-years' rotation, with six clover-free years, the attack possibly could be avoided in the first harvest year, but would probably appear in the second. A rotation of a long period did not free the soil of nematodes, but in comparison with short-term rotations it essentially checked the attack. Where the soil was infested the most reliable way to get rid of clover eelworms was to let out the clover once from the rotation and substitute for it bird's-foot trefoil. Experiments with infection through hay confirmed that hay kept as long as four winters was still contagious. Examination of nematode-attacked clover plants once monthly in the course of a year showed that eggs were laid throughout the year.

Economic Plant Diseases common in Kansas and their Control. *By Professor L. E. Melcher, Kansas State Agricultural College, Manhattan, Kansas. Circular* 129. *October* 1926.—The nature of plant diseases is very briefly mentioned. Most of the plant diseases were the result of abnormal conditions in plants, brought about by (1) fungus infection, (2) bacterial infection, and (3) a weakened condition in the plant not the result of an organism, but caused by the environmental factors or by a virus. The large group of non-parasitic or virus diseases were most difficult to control. The mosaic diseases of tomato and potato were common examples. Spindle tuber of potato, a virus disease that is very serious, was responsible for cutting down yields. The symptoms of many plant diseases are described, and methods of control or prevention are suggested. Methods of treating seeds with corrosive sublimate, hot formaldehyde and copper carbonate are also discussed.

The Use of Catalase as a means of determining the Viability of Seeds. *By Wilmer E. Davis, Boyce Thomson Institute for Plant Research. Professional Paper No.* 2.—It was found that in seeds of various varieties of lettuce (*Lactuca sativa*) the relation of Catalese to vitality was not always such as to give reliable data on the viability of the seeds. When the ratio of the volume of oxygen liberated by the soaked seeds of lettuce to that liberated by the dry seeds amounted to about 1·0, the seeds were found to show high percentages of germination, but when this ratio fell to values much below 1·0 the sample showed poor germination. The test was of no value when the embryo or endosperm of seeds or both were badly infested with fungi. Some of the advantages of this method of determining the viability of seed were that the value of seeds with dormant endosperms could be estimated quickly, that it might be used in estimating the viability of quickly germinating seeds where despatch was necessary, and that it might also be used as a confirmatory test.

SOILS.

Losses of Added Phosphate by Leaching from North Welsh Soils, *G. W. Robinson, M.A., and J. O. Jones, M.Sc., University College of North Wales, Bangor. Journ. Agric. Sci., XXII,* 1, 94 (1927).—The authors point out that the improvement in pasture produced by the application of slag is by no means permanent, and that there is a tendency for the pasture to revert to its original poor state unless more slag is applied. This appears to be the result of loss of phosphate. In order to investigate whether this is due to reversion of the phosphate to an insoluble form or whether it is due to leaching of the phosphate from the surface layer, the authors carried out experiments at various centres on three sets of plots of acid character and under extremely humid conditions.

(1) Those which had received 200 lbs. phosphoric acid as basic slag in 1914.

(2) Those which had received 200 lbs. phosphoric acid as basic slag in 1914, plus the same in 1922.

(3) Control plots.

Sections of soil were taken 18 inches deep, divided into 3 inch sections and samples of each examined.

The resulting figures indicate that after six to ten years the surface layers had returned to their original phosphate content, showing that reversion to insoluble phosphate had not taken place. The surface layers of the plots dressed in 1922, however, still showed an increase of phosphate content.

The figures for the lower layers also show little change in phosphate content from the control plots, although a few did show a very slight increase in the phosphate soluble in nitric acid. This seems to suggest that if leaching does take place then the layer of accumulation must be below 18 inches deep.

It is suggested that the soil phosphorus may be divided into the naturally occurring stable form and the phosphate of added dressings, which under the North Welsh conditions is unstable and removable by percolating waters.

The Phenomena of Contraction and Expansion of Soils when wetted with Water. *George John Bouyoucos, Michigan Agricultural Experimental Station. Soil Science, XXII,* 2, 119 (1927).—Investigations are described which were carried out to ascertain the volume changes that take place when absolutely dry soils are wetted with water. The results of the experiments indicate that if a soil is wetted with water there is a contraction,—the total volume of the soil plus water diminishing. This contraction differs in amount for different soils, sands giving a small decrease, while clay loams and silt loams and muck soils give a much higher figure. The author points out that there appears to be a close relationship between this contraction figure, the organic matter content, and the heat of wetting. A relationship is also seen, although less consistent, between the contraction figure and the colloidal content. This contraction in volume is attributed principally to the condensation of some of the water on the surface of the soil particles or colloids. A small portion may also be due to hydration.

The Effect of Lime and Fertilisers on the Potash Content of Soil and Crop. *J. G. Lipman, A. W. Blair and A. L. Prince. Proceedings of the International Society of Soil Science, II,* 3, 201 (1926).—From the results of analysis of soil taken from a number of plots which had received definite fertiliser and lime treatment for 15 years, the authors indicate that the unlimed plots show in nearly all cases a slightly higher potash content than do the corresponding limed plots. The potash content of the corn (maize) stalks also show consistent variation when the crop is grown on limed and unlimed plots or on plots with different fertiliser treatment.

The authors point out the danger of calculating the amount of plant food removed by a given crop from various tables of analysis unless reliable information is at hand regarding soil type and fertiliser treatment.

Colloidal Behaviour of Soils and Soil Fertility: Cation Replacement and Saturation of Soil with Calcium. *J. S. Joffe and H. C. M'Lean, New Jersey Agricultural Experiment Station. Soil Science, XXIII,* 2, 127 (1927).—The reaction of the various exchangeable bases in the soil complex and the function of calcium in the soil are discussed. It is shown that the sub-soil has generally a higher content of exchangeable base than the surface soil, and it is suggested that sub-soiling practice might result in preserving the bases that are being leached from the surface soils. The present methods of determining the " lime requirement " of soils are criticised, and a new method is introduced.

The lime requirements of the soil from plots receiving equivalent amounts of different nitrogenous fertilisers have been determined at intervals during the years 1914-1922. During this time the lime requirement of the control plot and of that receiving sulphate of ammonia increased, that of the plot receiving nitrate of lime remained the same, and that of the plot receiving calcium cyanamide (nitrolim) decreased. The yields of crops from these plots are compared with those from a series of similarly treated plots which received in addition a dressing of 2 tons of carbonate of lime every five years. In most cases this application of lime appears to meet the requirements of the soil, the yield from the limed sulphate of ammonia plot being as high as any, and much above that of the corresponding unlimed plot. In some instances, however, the increase of yield on the limed plots is small, and in one case there is a loss. From these results it is argued that there may be a danger of over-liming, and from other considerations the inadvisability of attempting to saturate the soil completely with calcium is pointed out.

The Relation of Manganese and Iron to a Lime-induced Chlorosis. *Basil E. Gilbert, Forman T. M'Lean and Leo J. Hardin, Rhode Island Agricultural Experiment Station. Soil Science, XXII,* 6, 437 (1926).—A chlorotic condition of such crops as oats, spinach, lettuce, maize, beets and beans has frequently been observed on neutral and alkaline soils. This has often been attributed to an iron deficiency, and to test this experiments were carried out in which iron was applied to the soil, sprayed on the plants and injected into the plants. Negative results were obtained, and analysis of plants showed that the iron content of chlorotic plants equalled or exceeded that of normal plants.

It was also shown by experiment that the trouble was not caused by magnesium deficiency.

Manganous sulphate, which had been shown by other workers to cure chlorosis, was next tried, and this treatment was found to be successful. In the case of oats the plants when they were 54 days old and beginning to appear chlorotic were sprayed with manganous sulphate at the rate of 4 lbs. per acre. A distinct improvement of the treated area was visible in six days, and this result was confirmed by weighing the forage on treated and untreated areas.

(Lime-induced chlorosis, although not common, is by no means unknown in certain areas in Scotland.)

ANIMAL BREEDING.

Inherited Defects of Live Stock. *F. B. Hadley and B. L. Warwick,* 1927, *Journ. Am. Vet. Med. Ass.,* 70, 492-504.—This is a comprehensive review of the subject. It is useful to have a catalogue of such defects as are known to be inherited in a fairly simple manner. Most of the defects are of academic rather than practical interest. Among the ones less known in this country are a defect of hair and teeth in cattle, and also defects due to arrested development of the Mullerian ducts. Cryptorchidism (i.e. the " rig " condition) seems to be inherited in other animals besides goats, as also entropion (i.e. invasion of the eyelids so that the lashes rub against the eye), which has been observed in lambs, dogs and horses, since it seems to occur with greater frequency in some breeds than in others. Among the hereditary defects of the horse which the authors cite are amaurosis or glass eye (wall eye?), cataract, bog spavin, melanosis (cancerous tumour), joint ill, roaring, periodic opthalmia (moon blindness), pulmonary emphysema (heaves), ring-bone, side-bone, roach back and undershot or overshot mouths.

Amongst cattle a new defect is described which has appeared in the Holstein Friesian. It is seen in new-born full term calves, and may be described as defective formation of the skin below the knees and hocks and the absence or incomplete development of one or more claws. The ears also are deformed, and there are defects in the muzzle, nostrils, tongue, hard palate and cheek. Forty-three such calves were obtained from thirteen herds. Thirteen of the calves were in one herd where inbreeding had been practised to a considerable degree. The pedigrees of all calves were studied, and it was found that they all traced to the same foundation stock imported from Holland about 1871. A similar defect has been reported in Holland in herds carrying similar blood lines. The inheritance of this appears to be due to the action of a simple pair of recessive factors. The calves die in a few weeks from infection of the lesions. There are also notes of the inheritance of the ruptured condition in pigs. This is described in another abstract.

Horses.

The Inheritance of Coat Colour in Domestic Live Stock. *W. S. Anderson, University of Kentucky,* 1926, *Journ. Amer. Vet. Med. Ass.*, 70, *pp.* 338-344.—This paper consists mainly of a summary of work in the inheritance of coat colour in horses. There are little new data beyond the statement that an albino thoroughbred horse was born in Germany in the spring of the year. The writer asserts that horses in their wild state are dun coloured, and that their colour, which is dominant to all other colours, is a pantechnicon of the remainder which have arisen by recessive mutations. This is quite a probable theory, but the data available barely warrant too definite an assertion.

Breeding Activities of the U.S. Army. *Capt. R. I. Lovell, Front Royal Depot, Virginia, U.S.A.*, 1926, *Jour. Amer. Vet. Ass.*, 70, *pp.* 345-358.—This article gives a review of the horse-breeding operations of the United States Army, which were commenced in 1918. In the section dealing with fertility, it is pointed out that in order to secure maximum fertility stallions should be well exercised and hardened up for three months before the mating season. There appears to be a big difference in the relative fertility of various stallions. For instance the figures of foals for services of four stallions are 1·74, 2·16, 3·44, 5·12. This is in accord with the suggestion of Sanders, as contained in an abstract of his paper in the last issue of this Journal.

There are many non-productive mares in the stud, though fewer than the average in America. A routine examination was made of all the non-pregnant mares. The outstanding feature was the discovery of cystic degeneration in one or both of ovaries of nine of eleven mares examined.

In 1925 there were ten abortions from 73 mares, in 1926 two out of 62. These were attributed chiefly to streptococcus hemolyticus. A polyvalent bacterin was accordingly prepared and administered at about the fourth month of pregnancy. In 1926 it was administered to all the mares before the breeding operations commenced, and a second series was given at the fourth month of pregnancy. It is worth noting that, following upon these injections in the foal crop of 1926 foals, navel ill or joint ill was entirely absent, although it is prevalent in most breeding establishments.

An experiment was made of running the stallions with the mares, ten virgin three-year-old fillies being turned out with a stallion which was retired from the track, but entirely fertile though not in breeding condition. He was with the fillies for 49 days. Five of the fillies foaled this spring, i.e. 50 per cent. (This is about the average for horses.) No service was made except at dawn or sunset. This last fact should be of interest to horse breeders as showing at what time of day a horse is normally most active sexually.

Cattle.

Sterility in Cows. *Deut. Tierarzt. Wochens*, 34, *January* 1926. *W. Frei of Zurich and A. Staheli.*—The authors examined some 1809 cases of sterility. Of these, 133 cases (7·3 per cent.) were due to the failure of cows to come in season. Of these 133 cases, 87 (65·4 per cent.) were found to be due to the persistence of the corpus luteum; 10 cases (7·5 per cent.) were due to ovarian cysts, and 36 cases (27 per cent.) to other ovarian abnormalities. The writers are inclined to doubt that the persistence of the corpus luteum is always due to endometritis (inflammation).

The cysts could be regarded as the cause of the failure to come in season of the cows possessing them. They inhibit the ripening of follicles. The removal of the cysts was followed by heat in seven cases out of the ten, though only four became pregnant. In the other cases endometritis probably prevented conception. Regarding these cases where the cause could not be attributed to the retention of the corpus luteum or to cysts, the ovaries were either inactive or atrophied. Treatment such as massage, injection of ovarian hormone and the implantation of normal ovaries proved successful in the large majority of cases.

As regards extra-genital causes (i.e. nutrition, husbandry, milk-yield, &c.), it was found that the non-occurrence of heat was more frequent in younger than older cows, though the evidence on this point is not critical, but it may be connected with increased lactation in younger animals. The treatment mentioned above proved of use in many of these cases.

Nutritional Factors affecting Reproduction. *R. H. Ruffner and R. S. Curtis* (*North Carolina Sta. Rpt.*, 1925, *pp.* 22, 23).—The results of two experiments, one of which is a continuation of previous work (E.S.R., 53, p. 770), are noted.

Effect of heavy cottonseed meal feeding upon reproduction and lactation of dairy cattle.—In earlier experiments cows receiving rations of cottonseed meal and cottonseed hulls and having access to green feed produced apparently normal calves, but later when no green grass was available the cows produced immature, weak and blind calves on the same ration.

In later experiments definite supplements to the cottonseed meal and cottonseed hull ration have been studied. Among the supplements which have been tried are crude casein, calcium carbonate, butterfat, steamed bone meal, cod liver oil, vitamin B, and green alfalfa meal. So far the more complex nutrively balanced rations have given the best results. Beneficial results have followed the addition of vitamins A and B and calcium.

Effect of Age and Sex upon Rate and Economy of Gain: Experiments with Beef Cattle at the Nebraska Station. (*Nebraska Station Report* (1925), *pp.* 18, 19.)—Lots of 2-year-old steers, 2-year-old spayed heifers, yearling steers, yearling spayed heifers, and yearling open heifers, steer, spayed heifer and open heifer calves have been used in making the comparison of the influence of age and sex upon the rate and economy of gain. All lots were fed for a 175-day period on shelled corn and alfalfa hay. The calves proved to be more efficient in their use of feed than either yearlings or 2-year-olds, but the animals of the last age made the most rapid gains. The steer lots made the most rapid gains in the 2-year-old and in the calf classes, while the open heifers excelled in the rate of gain in the yearling class.

The Effect of Age of Parents on the Quality of Offspring in Cattle, *by A. C. Chaudhuri, Animal Breeding Research Department, University of Edinburgh.* 1926. *Jour. Hered., vol.* 17, *No.* 10, *pp.* 368-370.—Using as data the prize-winners at the Highland Show in Scotland and grading the parents according to the performance of their progeny in the Shorthorn classes, then classifying the parents into age groups, the writer finds no indication that the quality of offspring varied with the age of the parents. These results are confirmed by a comparison with the total number of cows calving at the different ages drawn from vols. 58-70 of Coates' Herd Book for the period covering the time of the births of the dams of the prize-winning cattle.

An interesting sidelight is that the maximum number of prize-winning cattle belong to dams which calved at three or four years and are sired by bulls at the age of two years.

The Relation between Age, Weight and Fat Production in Dairy Cows. *C. W. Turner, A. C. Ragsdale and Samuel Brody.* (*Miss. Agr. Exp. Sta. Bul.* 221, 1924, *pp.* 3-12, *figs.* 5.)—Facts are here presented showing that the fat production of dairy cattle gradually increases up to an age averaging between seven and eight years and then gradually decreases. Conversion factors have been determined for cows of the Jersey, Guernsey and Holstein breeds, and this makes it possible to estimate the mature fat production for cows at various ages. It is also shown that after the Jersey cow reaches the body weight of 470 pounds, there is an average increase of 104 pounds in fat production per year for an increase of 100 pounds of body weight with age.

Factors affecting the Percentage of Fat in Cows' Milk. *C. W. Turner* (*Miss. Agr. Exp. Sta. Bull.* 222 (1924), *pp.* 3-22, *figs.* 11).—The studies reported in this bulletin take into consideration two fundamental classes of factors which cause variations in the composition and yield of milk produced by dairy cows. Data are reported showing the hereditary variations due to differences in the genetic make-up of breeds and individuals. The bulk of the data included in this report, however, has to do with variations due to physiological changes in the individual animal caused by such factors as time of milking, interval between milking, completeness of milking, the effect of exercise, season of the year, temperature, condition at calving, effect of underfeeding, effect of pasture, influence of heat period, effect of feed and of drugs on the percentage of fat, the effect of age and of the advance of lactation.

The Inheritance and Transmission of the Characters "Capacity for Fat Production." *C. W. Turner*, 1926, *Missouri Agr. Exp. Sta. Bull. No.* 236, *page* 49.—A study of the progeny performance of 263 Guernsey sires having 19 or more daughters has been completed.

The yearly fat records of the daughters and their dams were converted to their "mature equivalent" production, so that comparisons could be made on an equitable basis. By grouping the sires into classes on the basis of the daughters' average yearly fat production and then determining the quality of the daughters out of dams of various productivity, it was found that for each 100 pounds of fat per year increase in the production of the dams there was a corresponding increase in the production of the daughters of approximately 15 pounds of fat.

The results were expressed in the form of equations as follows :—

(1) Daughter's fat production $= 0{\cdot}15 \times$ Dam's fat production $+ 0{\cdot}85 \times$ Sire's potential transmitting ability.

(2) Sire's potential transmitting ability $= \dfrac{\text{Daughter's fat production} - 0{\cdot}15 \times \text{Dam's fat production}}{0{\cdot}85}$.

By means of genealogy charts, the ability of the sires and dams to transmit the favourable factors concerned in fat production through their sons to their grand-daughters was studied. It was found that sires were more able to transmit their potential production through their sons to their grand-daughters than were the dams able to transmit *their own production* (as indicated by their best converted fat record) through their sons to their grand-daughters.

Studies in Milk Secretion: Transmitting Qualities of Guernsey Sires for Milk Yield, Butter-fat Percentage, and Butter-fat. *J. W. Gowen.* (*Maine Sta. Bul.* 329 (1926), *p.* 48.)—In continuing this series, the 551 Guernsey sires having two or more tested daughters from tested dams, both with 365-day records, are tabulated, showing the net change in the age, corrected milk yield, and butter-fat percentage, and the quartile changes in the milk and butter-fat production of the daughters as compared with their dams. The difference between the average production of the sire's daughters and their dams is considered as the transmitting quality of the sire. The probable errors of the difference between the milk and fat yield are tabulated for the entire population according to the number of daughters which a bull has. Special attention is called to the large probable errors in the case of bulls having few daughters. The bulls which raise the milk yield or butter-fat percentage of their daughters as compared with their dams more than three times the probable error are tabulated, and available photographs of such animals were studied.

The large amount of variation observed in the conformation of both groups indicated that no incompatibility existed as far as conformation was concerned between milk production and butter-fat percentage. Conformation as far as size is concerned has been found related to milk production, but neither the conformation of the daughter nor her parents has been found related to the fat percentage in the milk.

Dairy Qualities of the Crossbred Cattle (at the Kodiak Station), *by C. C. Georgeson* (*Alaska Stas. Rpt.*, 1924, *pp.* 30-38).—A progress report is given of the Galloway-Holstein cross-breeding experiment, including illustrations of certain of the foundation animals and the crossbreds which have been produced. Two Galloway foundation cows averaged 3,139 lbs. of milk in five lactation periods, and the two Holsteins averaged 6,381 lbs. in six lactations. The milk yields of five crossbred animals during the year ended December 31, 1924, ranged from 4,269 to 5,393 lbs. The average butter-fat content of the milk of the crossbreds was 3·8 per cent., of the Galloways 5·27 per cent., and of the Holsteins 3·07 per cent.

Better Cows from Better Sires. *J. C. M'Dowell and J. B. Parker* (1926), *U.S. Dept. Agr., Dept. Circular* 368.—This bulletin shows how the true value of a dairy bull may be measured through cow-testing association records by comparing the yearly production records of the daughters of the sire with those of the dams of the daughters. The conclusions are based on a comparison of the yearly production records of 2,182 daughters of pure-bred bulls with those of the dams of the daughters. As some of the dams had two or more daughters, the number of dams was somewhat less than 2,182.

The study of individual sires, each having five or more daughters, showed that in some cases all the daughters excelled the dams; in other cases some of the daughters excelled and some did not; and in still other cases every daughter produced less than her dam. This shows the necessity of using great care in the selection of a dairy sire. Some sires increased the records of the daughters over fairly high-producing dams more than 40 per cent.; other sires lowered the production of the daughters almost as much below that of similar dams.

The individual cow records show which cows should be kept and which should go to the butcher. The comparative records of dams and daughters show which bulls should be kept and which should go to the butcher. Thus the same records serve a double purpose.

The proved sire seems to be the best solution of the dairy-breeding problem. In the nature of things, all proved sires must belong to the aged bull class, and if such sires are to be in general use some method must be worked out by which the young dairy bull, after being tried out on a limited number of cows, may be kept until proved through the records of dams and daughters.

Inheritance of Twinning in a Herd of Holstein Cattle. *J. L. Lush. Jour. Heredity*, 16 (1925), *No.* 8, *pp.* 273-279, *figs.* 5.—A study of the available data indicated that 0·98 per cent. of the births in dairy cattle are twins, as compared with 8·84 per cent. of the births among the Holstein cattle at the Kansas Experiment Station. The twinning percentage of the Holsteins in this herd was considerably higher than that for the other breeds. There was a tendency toward more frequent twinnings among the offspring of certain bulls and among the dams related to certain bulls. One bull produced 19·15 per cent. twins, which is attributed to his relation to Hengerveld de Kol, his maternal great-grandsire and his paternal grandsire. The influence of the breeding of the dams was apparent but did not appear to be as important as the breeding of the sire. Age, season and production had no noticeable influence on the amount of twinning.

Pigs.

On the Relative Growth and Development of Various Breeds and Crosses of Pigs. *John Hammond. Jour. Agr. Sci., v. XII, pp.* 387-423, 1922. —From the records of the Smithfield Club's Fat Stock Show, a study was made of the relative merits of the various breeds and crosses of pigs. The highest carcase percentage was obtained in the Middle White, while the order of merit for the other breeds was Berkshire, Large White, Tamworth and Large Black. The percentage of pluck and alimentary canal was inversely proportional to the carcase percentage. The carcase percentage shows a steady rise from 74·5 per cent. at three months old, to 83 per cent for eleven months old, the greatest rate of rise occurring between the age of five and seven months. The rate of increase in carcase percentage is greatest in early maturing breeds, and therefore, for the greatest economy in mass production at early ages, early maturing breeds, in which the age changes are hastened, should be used.

It was found that the following first-crosses—Berkshire × Middle White, Berkshire × Large White and Berkshire × Tamworth—were larger than the heavier of the parent breeds. In most of the cases the crosses are heavier than the mean of the parent breeds. However, in the Berkshire × Lincolnshire Curly Coated cross, the offspring are consistently smaller than the mean of the parent breeds. The tendency seems to be for cross breeding, not only to increase the actual weight, but also to increase the rate of maturity in live weight.

The Milk of the Improved Landschwein Pigs and its Composition. *J. Schmidt and E. Lauprecht. Zuchtungskunde, v.* 1, *pp.* 50-62, 1926.—The authors discuss the influence of various factors on the composition and the amount of milk produced by sows of this breed, based mainly on other investigations. The milk production was shown to be smaller in first litters than in succeeding ones, and also lower in case of small litters than in large litters. The anterior sections of the mammary gland appeared to be more productive than the posterior portions. The fat content of the colostrum was slightly less than that of normal milk, but the protein content of the former was much higher, averaging 16·27 per cent. as compared with 6·25 per cent. for normal milk.

A Study of Hernia in Swine. *B. L. Warwick*, 1926. *Wisconsin Agr. Expt. Station Research Bull. No.* 69.—This is the most exhaustive survey of the above subject which has yet been made, and there are several important conclusions that confirm the observations of the practical breeder. The results of this paper leave no doubt but that a rupture is an inherited characteristic. The writer, in selecting pigs for hernia, obtained 7·49 per cent. of cases where the male pigs were ruptured in the original herd, 14·28 in the first generation, 42·0 per cent. in the second, while the third generation had 43·18 per cent. of the males herniated.

Some of the results have just now a greater scientific value than practical, but the author has tabulated the chief practical considerations which are the outcome of this study. Some of them are as follows :—

"1. Never use for breeding purposes a boar which is or ever has been afflicted with inguinal hernia. This includes animals in which hernia has disappeared naturally, as well as those in which it has been reduced by operation. Whether hernias would appear among the immediate offspring of any such boar would depend upon the hereditary make up of the females with which he was mated. In any case all of his offspring would carry some of the factors responsible for inguinal hernia. This would make it very probable that hernia would reappear in later generations whenever individuals of certain genotypes, even though themselves normal, happened to be mated together.

"2. Discard any normal boar which has sired one or more herniated pigs. Such a boar will transmit factors for hernia to more than half his offspring and hence tend to carry it on in the herd, even though the sows to which he is mated should be entirely free from the taint.

"3. Do not select breeding stock from sows which have produced one or more inguinally herniated pigs. The same reasons apply here as in the case of the male.

"4. Do not retain for breeding purposes litter mates to inguinally herniated boars, especially the males. Some of these will probably be free from the hernia factors, but it would require extensive breeding tests to determine which ones these are.

"5. Elimination of all of the progeny of boars which have been known to sire inguinally herniated pigs would also be advised. Probably, in many cases, this would not be practical."

Sheep.

Relation of Sheep to Climate. *E. L. Johnston. Jour. Agric. Research*, 29.10, *pp.* 491-500. *Nov.* 1924.—A study of the temperature, rainfall and relative humidity of important sheep producing areas indicated that sheep are limited to certain climatic conditions, dense centres of distribution occurring within comparatively narrow limits of these climatic factors. Critical periods occur at lambing time, in the rutting season, and during gestation; bad sheep years have unfavourable conditions in one of the critical periods. Mild winters, cool summers and sufficient rainfall for the production of good grazing constitute the optimum conditions. The growth of lambs is retarded by high temperature and humidity, also by excessive rainfall and cold weather. The rutting season comes with falling temperature and varies from year to year ; if the critical periods are greatly disturbed, sheep are not likely to be numerous or profitable. While the limits of successful sheep production can be extended by proper methods of housing, the author is of the opinion that more attention should be given to finding breeds best suited to particular localities.

Goats.

Milk Goat Improvement. *New Mexico Sta. Rpt.*, 1925, *pp.* 46, 47.—In continuing the study of the effect of crossing pure-bred Toggenburg bucks with native goats, it has been found that the Toggenburg buck is prepotent in fixing breed characteristics when bred to native or scrub does, but the colour is not transmitted as consistently to the offspring when the dams are white as when they are dark in colour. So far, half-blood, three-quarter-blood and seven-eighths-blood Toggenburgs have been produced and tested for milk yield and butter-fat percentage. By this method of breeding up there has been a marked increase in milk production, a slight increase in butter-fat production, but a decrease in the percentage of butter-fat in the milk of each succeeding generation.

Poultry.

Correlation of Sexual Maturity to Annual Egg Production. *H. L. Kempster*, 1926, *Missouri Agri. Expt. Sta. Bull.* 236, *p.* 67.—Data on 1100 White Leghorn pullets over a period of six years showed that the shorter the time required to mature, the better the production. Quick maturing pullets were superior egg producers. Quick maturing birds made the best winter records. There was a slight negative correlation between rate of sexual maturity and spring egg production. There was less variability in spring production than for the winter or summer period. There was a slight negative correlation between rate of sexual maturity and summer egg production. There was no correlation between rate of sexual maturity and rate of laying as measured by the best month's production or best two months' production. Late hatching tended to reduce the age at which the first egg was laid.

ANIMAL NUTRITION.

Swine Feeding Experiments. *Scott, J. M. Florida Sta. Rept.*, 1925. *E.S.R.* 55, *No.* 9, 1927.—*Skim Milk as a Hog Feed.*—In this experiment two lots of 8 hogs each, averaging approximately 180 lbs. of live weight, were fed for 61 days on a ration of shelled corn and fish meal. In addition one lot was supplied with skim milk. This supplement to the ration increased the average daily gain per head from 1·48 to 1·88 lbs., and reduced the total amount of grain required to make 100 lbs. of gain by 64·9 lbs.

Dried Buttermilk as a Feed.—In this experiment four lots of 8 pigs each, averaging approximately 100 lbs. in weight, were fed for 61 days on a ration of shelled corn with supplements in lot 1 of fish meal and skim milk, in lot 2 fish meal and dried buttermilk, lot 3 fish meal and shorts, and lot 4 shorts. The results from feeding skim milk and dried buttermilk were practically equal, the average daily gains being 1·15 and 1·12 lbs. When shorts replaced the milk protein as a supplement to corn and fish meal the average daily gain was only 0·83 lb., and when shorts was the sole supplement to the shelled corn the average daily gain was 0·59 lb. It was also found that the addition of 5 per cent. of fish meal to the ration of corn and shorts saved 155·7 lbs. of grain per 100 lbs. of gain.

Fish Meal v. *Meat Meal.*—A ration of shell corn and fish meal was compared with shelled corn and meat meal, using two lots of 9 hogs each during a 30-day feeding period. The results showed that the pigs, which averaged approximately 80 lbs. in live weight, made an average daily gain of 0·7 lb. on the ration of corn and fish meal, and 0·42 lb. on the ration of corn and meat meal. The estimated amounts of feed required per unit of gain were 50 per cent. larger on the latter ration.

Fish Meal, Meat Meal, and Cottonseed Meal.—In this experiment two lots of 9 hogs each, averaging approximately 100 lbs., were fed on rations of shelled corn and fish meal and shelled corn and a mixture of equal parts of meat meal and cottonseed meal. These results indicated that a mixture of meat meal and cottonseed meal produced better gains than meat meal alone as supplements to corn. The hogs receiving the ration of corn and fish meal made an average daily gain of 0·78 lb., and those receiving the combined supplement of meat meal and cottonseed meal an average gain of 0·88 lb.

Rickets in Chicks: Variations in the Antirachitic Potency of Different Grades of Cod Liver Oil. *Heuser and Norris. Poultry Science, VI, No.* 2, 1926-27.—Previous investigations have shown that there are marked variations in the antirachitic value of different brands of cod liver oil when these oils are fed to chicks in limited but equal quantities. Because of these results it was thought possible that there might be similar variation in the potency of different grades of cod liver oil if used as a preventive of rickets in chicks.

An experiment was conducted therefore to study the value of the various grades of oil when fed to chicks, and to determine whether cod liver oils of Norwegian origin are richer in vitamins than those of American origin. Four different grades of oil were studied: American refined cod liver oil tested biologically for vitamin content, American refined cod liver oil, Norwegian refined cod liver oil and brown cod liver oil. Forty chicks were put in each lot 48 hours after hatching. One lot of chicks served as a control and received no cod liver oil in its ration. The experiment was conducted for a period of eight weeks, and the chicks were confined indoors and never exposed to direct sunlight. The ration consisted of grain and mash mixture known to produce normal growth without the occurrence of rickets when the chicks were exposed either to direct sunlight or to ultra-violet light. In every lot receiving cod liver oil 0·2 per cent. of the appropriate oil was mixed into both grain and mash. The results indicated that only the tested oil and the brown oil provided complete protection against rickets throughout the experiment. The American refined oil, however, gave almost complete protection, but the Norwegian refined oil was decidedly inferior to the other grades of oil used. All the chicks in the control lot developed rickets at eight weeks of age. Certain of the analytical data indicated that no marked reduction of the mineral content of the bones of chicks is obtained until the chicks become stiff and lame and beading of the ribs takes place.

The Salt Consumption of Sheep: Fattening Lambs. *Evvard and others. Iowa Sta. Res. Bull.* 94, 1926.—A study has been made of the relation of the ration to salt consumption and the normal salt requirements of fattening lambs, and is based on the results of seven winters' lamb-feeding experiments conducted on 31 different rations and 1306 lambs. In all the experiments salt was self-fed.

Variations in the average salt consumption in individual lots were as great as from 0·001 to 0·019 lbs. per head daily, the average daily consumption being 0·011 lbs. per lamb. These wide variations were evidently related to the salt content of the various rations. Feeding beet molasses tended to decrease the salt consumption, whereas alfalfa hay had the opposite effect. When cane molasses, which has a lower salt content than beet molasses, were substituted the salt consumption increased.

Fattening lambs consume much more salt per unit weight than steers fed under similar conditions, and whereas the daily salt consumption of lambs increases during the feeding period, that of the steers decreases. Lambs in the finishing lots consume more roughage in proportion to concentrates than do steers; this ratio of roughage to concentrates is the more marked as the period of feeding progresses. The greater the proportion of roughage, the larger apparently is the salt consumption. The salt required for a hundred pounds' gain on 1306 fattening lambs averaged 3·78 pounds, the range being from 0·21 to 11·18 pounds.

The factors probably affecting salt consumption are discussed, from which it appears that the salt consumption probably increases as larger amounts of protein and fibre are consumed, but evidently other factors are also responsible.

The Immediate Influence of Feeds upon the Quantity and Quality of Cows' Milk: The Effect of Ground Flax. *Petersen, W. E. J. Dairy Science, X, No.* 1, 1927.—Certain feeds it is known will cause a temporary stimulation in milk yield in cows, but the author states that there is no evidence in the literature to indicate how soon after administration of a feed the stimulating effect occurs. If the sudden introduction of a feed into the ration will cause an immediate increase in yield and alter the quality or both, it becomes possible to take advantage of this in getting more credit for a cow on semi-official test than she actually produced. An experiment was undertaken with these objects in view, and the effect of introducing ground flax, believed to be capable of influencing both quality and quantity, was studied. All the cows on official test were used, and 1 lb. ground flax, substituted for 1 lb. grain mixture, was introduced immediately after the official test for a 48-hour period.

As a result of the test it has been shown that the response of animals to the feeding of ground flax depends on unknown individual factors. When ground flax is fed at the rate of 3 lbs. daily the majority of cows will show an increase in fat percentage. Such increases ranged from no effect to 7·1 per cent. and averaged 2·9 per cent. The feeding of ground flax will in the majority of cases cause an increase in amount of milk averaging 1·1 per cent., but going up to 8·9 per cent. On the average the combined influence of flax upon amount of milk and fat percentage increased the total fat production 4·5 per cent. With cows showing appreciable responses, on the average, the response was uniform from month to month, making it possible to secure more than actual credit for cows on official test. The response to the alteration in the feed was immediate with most cows, appearing in most cases within eight hours after the first feeding.

A Study of Calf Rations: Powdered Buttermilk and Semi-Solid Buttermilk. *Ellington and Knott. State College of Washington Agri. Expt. Stn. 36th Annual Report*, 1926.—This experiment was carried out with a view of finding some cheaper substitute than whole milk for feeding calves. Some work has already been done on the use of condensed buttermilk, and it was thought advisable to extend this work and to include powdered buttermilk, as these two by-products are readily available.

Two groups of four calves each were used in this experiment. Group No. 1 consisted of two Holstein males and two Holstein females. Group No. 2 consisted of two Holstein males, one Ayrshire male and one Holstein female.

The calves in group 1 were fed semi-solid buttermilk. Three lbs. of the semi-solid were mixed with 9 lbs. of water and fed to the calves according to age, size and vigour, as skim milk would be fed. The calves had access to alfalfa hay and were fed grain twice a day. The amount of grain varied from 1¼ lbs. per day for the smallest calf to 2¼ for the largest. The grain mix was made up of 4 milk run, 2 ground barley, and 2 ground oats and 1 linseed meal.

The calves in group 2 were fed the same as those in group 1 except that in place of the semi-solid solution they were fed a powdered buttermilk solution made up of 1 lb of powdered buttermilk to 9 lbs. of water.

The result showed that compared with the Eckles standard of 0·064 inches per day for normal growth the semi-solid group increased in height by 0·065 inches and the powdered buttermilk group by 0·061 inches per day. The average gain in weight per day also compared favourably with Eckles' standard of 1·42 lbs., semi-solid group putting on 1·85 lbs. per day and the powdered buttermilk group 1·91 lbs.

The author states that skim milk if available at a reasonable cost would be cheaper than either of these substitutes.

Live Stock Feeding Experiments. *Journal. Dept. of Lands and Agriculture (Ireland), XXVI, No.* 3, 1927.—*Calf Feeding.*—Previous experiments carried out at various centres in Ireland have shown that whole oats or crushed oats could be relied upon as a suitable supplement to separated milk for calves, and the experiment here reported was undertaken to demonstrate again the value of home-grown crushed oats and to compare it directly with imported food, maize meal.

The experiment was conducted at ten different centres with a total of 80 shorthorn calves from six to seven weeks old, and the experiment ran on an average for 104 days. Crushed oats to lot 1 and maize meal to lot 2 were the only meals fed during the experiment, the oats being given dry and the maize meal cooked or steeped in boiling water. The average increases per head per day were for lot 1 1·37 lbs. and for lot 2 1·32 lbs., while at a number of centres it was reported that the animals receiving crushed oats presented a much better appearance than the animals receiving maize meal.

Pig Feeding.—With a view to encouraging the use of home-grown foods and at the same time to demonstrate the efficiency of crushed oats as a food for fattening pigs when fed to the extent of one-third of the total meal ration, a series of experiments was carried out at 12 different centres. The average age of the pigs at the beginning of the experiment was 12 weeks and the duration of the experiment 84 days. The ration of lot 1 consisted of maize meal 2 parts and pollard 1 part, and that of lot 2 consisted of 1 part each of maize meal, crushed oats and pollard. In addition small quantities of fish meal were fed at two of the centres and meat meal at one. Separated milk was included in the ration at seven centres, and at three of these potatoes and roots were fed. The average daily gains were for lot 1 (no crushed oats) 1·36 lbs. and for lot 2 (crushed oats) 1·64 lbs. The pounds of meal equivalent to produce 1 lb. live weight gain were 3·59 and 3·57 respectively. The carcases were all of first-class quality and showed no difference between the groups.

The result of the experiment shows that crushed oats can with advantage be used to replace maize meal to the extent of one-third of the total meal ration, but it does not follow that it can with equally good results be employed in greater proportions. Crushed oats, except in very small quantities, and in a finely ground condition, are not recommended as a food for very young pigs.

DAIRYING.

Soybean Hay *versus* Wheat Bran and Mixed Hay for Milk Production. *H. R. Bierman. Md. Sta. Bul.* 277. 1925.—Two groups of four cows each were used in four periods of 30 days each with 5-day transition periods. The basal ration consisted of ground maize and maize silage, and to this was added soybean hay in two periods and mixed hay and wheat bran in two periods. The yield of milk and butter-fat was highest on the wheat bran and mixed hay ration, but the feed cost of production was then also highest.

Ground Alfalfa for Dairy Cows. *O. E. Reed and J. E. Burnett. Mich. Sta. Quart. Bul.* 9, *No.* 1, *pp.* 3-5. 1926.—Two groups of six cows each were fed through three periods of 20 days each with 10-day transition periods. Each lot was fed silage and a grain mixture throughout, while long and ground lucerne hay were fed in alternate periods. There was a small increase of milk and butter-fat when the ground hay was fed, but the difference was not enough to render the grinding of the hay profitable.

Soybeans and Soybean Oilmeal for Milk Production. *C. C. Hayden and A. E. Perkins. Oh. Sta. Bimo. Bul.* 11, *No.* 4, *pp.* 137-141. 1926.—As the result of two trials it was found that ground soybeans or soybean oil meal were of about the same value as linseed oil meal.

Soybeans for Dairy Cows. *J. S. Moore and W. C. Cowsert. Miss. Sta. Bul.* 235. 1926.—Soybean hay was found to be about equal to lucerne hay for milk production, while ground soybeans were better than cottonseed meal, and soybean oil meal was about equal to cottonseed meal.

Relation of Conformation and Anatomy of the Dairy Cow to her Milk and Butterfat Producing Capacity: Udder Capacity and Milk Secretion. *W. W. Swett. Jour. Dy. Sci., Vol.* 10, *No.* 1, *pp.* 1-14. 1927.—As the result of experimental work it is concluded that some of the former ideas regarding the capacity of the udder are erroneous. It is concluded that milk secretion is to a considerable extent a continuous process, and that a large proportion of the milk secured at any one milking is collected and stored within the gland before the milking process is commenced. The internal capacity of the udder of a cow in milk appears to be greater than the value of the milk secreted.

INSECTS AND PESTS.

Collembola or Springtails injuring Mangolds. *W. M. Davies, in Bull Entomol. Research, Oct.* 1926.—The group of collembola consists of individuals so minute that they have scarcely been regarded as of any economic importance. Mr. Davis shows, however, that in sufficient numbers their attack may be serious enough, since they crowd together on the leaves, and by united action damage the surface so that the plant juices may exude and keep open the wound thus caused, so that excessive bleeding results.

Springtails leap, flea-like, on the slightest disturbance, and one of the problems of control was the devising of an apparatus which could circumvent their very active movements. Various adhesives were tried, but the most successful consisted of a couple of Planet hoes fastened by two cross-bars, over which hung a sack tarred up to 9 inches from the bottom. This apparatus was dragged through the mangold ridges, and was so successful in apprehending collembola that it may be said to have saved the crop. Several modifications of this apparatus were tried with corresponding success.

Ox-Warble Control in the Field. *M. Innes in Jour. Parasitology, Sept.* 1926.—Endeavours have been made to find a control for warble-flies, suitable for use with large herds under the conditions of ordinary stock-raising. Dipping has been found to be useful to a certain extent, for repeated dipping in the recognised cattle dips undoubtedly reduces the amount of infestation. So also does treatment of the cattle in walking vats charged with a 2 per cent. solution of coal-tar creosote dip or processed crude petroleum. Neither of these methods reaches the stage of completely eradicating warble infestation, but the latter undoubtedly prevents heavy infestation, and is practical and economical for use on farms.

Legislative Control of Warble-Fly.—Striking results have been attained in Denmark as a result of legislative control of the warble-fly. They are recounted by the Agricultural Commissioner, Mr. Harald Faber, in the *Journal of the Ministry of Agriculture* (Jan. 1927). The first and second laws were passed in 1923 and a third in 1926. They laid upon each farmer the duty of ridding his cattle of warble-maggots. Failing voluntary compliance by the stock-owner, maggots found in his herd were to be killed by representatives of the Parish Council at his expense. Refusal to admit these representatives was subject to heavy penalties. Of some 193,250 herds in Denmark, 124,893 were freed from the maggots in 1923. The progressively beneficial results of these laws has been very marked. The percentage of hides damaged by maggots in 1922 (before the passing of the first law) was 20 per cent.; in 1923 (after partial application of the law) the percentage had fallen to 15 per cent.; in 1924 it had fallen to 4½ per cent. and in 1925 to 4 per cent. The actual monetary loss is estimated to have been reduced between 1922 and 1924 to one-tenth.

Insect Pests of Stored Grain. *E. A. Back and R. T. Cotton, Farmers' Bulletin, No.* 1483, *U.S. Dept. of Agriculture.*—The annual loss in grain-growing countries due to damage by pests of stored grain is enormous. In 1924 it was estimated that a recent outbreak of Angoumois grain moth had caused annually, in the State of Pennsylvania alone, a loss of $1,000,000 to $3,000,000. And in 1912, when a survey was made of Alabama's crop of 54,000,000 bushels of corn, it was estimated that weevils cost the farmers of that State at least $4,000,000, and that was not an exceptional year. It is generally taken for granted that infestation by stored grain pests takes place in the granary, but initial infestation has been found to occur in the field. The rice weevil and Angoumois grain moth live over winter in the grain of last year's crop, and when the new corn crops are ripening these insects fly to near-by fields and lay their eggs upon the heads. On this account it is the more necessary that strenuous attempts should be made to destroy the pests in the granaries, since even a small infection over winter may result in much damage the following year.

The many tests of control methods which have been made in the United States of America and elsewhere have shown that fumigation is the only satisfactory method. This is best and most cheaply carried out in tight cribs or bins, but even in their absence it is wonderfully effective. Of the three heavier-than-air gases which are available for the control of stored-grain insects the best is carbon disulphide, but the ethyl acetate-carbon tetrachloride mixture and carbon tetrachloride alone are also good, and conditions may occur when any one of the three may be the most convenient for use. The pamphlet describes the characteristics of each of the fumigants and indicates the best methods of using each. It should appeal to a far wider circle than the farming community, since the destruction of stored grain by insects is a problem which confronts farmer, grain-dealer, transporter, whether he transports by rail or by steamer, and miller alike.

Skin Parasites of Horses and their Destruction. *Marion Jones in Farmers' Bulletin* 1493, *U.S. Department of Agriculture.*—Horses are liable to infection by three kinds of external parasites—lice, mange mites, and ticks; but of each of these there are many different species, and several may occur on a particular horse at the same time. Unfortunately the same method of destruction is not equally effective for all the types, so that the parasite must be identified before the best remedy can be employed. For sucking lice, arsenical, coal-tar creosote and nicotine dips are best, the horses being dipped or sprayed twice at an interval of from 14 to 16 days. It is advisable to eradicate lice by dipping in the autumn before cold weather makes it difficult or impossible. Of the kinds of mange mites, the common or sarcoptic is most difficult to deal with, and unfortunately it is the most injurious as well as the most common. For mange mites, nicotine solution or lime-sulphur dip are both excellent remedies, but while two dippings at 10 to 12 days apart will suffice to eradicate psoroptic and chorioptic mange, for sarcoptic mange four or more dippings at intervals of from 5 to 7 days are usually necessary. Of the many kinds of ticks which have been found on horses the spinose ear tick is one of the commonest and most distressful, and for it a mixture of 2 parts of pine tar and 1 part cottonseed oil injected into the ear of an infested horse is recommended.

STATISTICS.

PRICES of AGRICULTURAL PRODUCE, FEEDING STUFFS and FERTILISERS in December 1926, and January and February 1927.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	December.			January.			February.		
	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.
Aberdeen-Angus ...	65 3	58 11	44 9	63 1	57 8	43 3	61 7	55 10	41 11
Cross-bred (Shorthorn)	59 10	52 11	37 1	58 6	52 0	36 6	56 11	49 9	35 7
Galloway	58 7	51 10	...	56 2	51 0	..	54 0	49 3	...
Ayrshire	59 10	51 10	35 7	59 9	51 9	36 0	59 0	51 3	35 0
Blue Grey	62 8	...	...	57 0	...	...	55 3	...	...
Highland	...	...	...	...	...	...	...	...	...
	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
VEAL CALVES	16	9½	7	17	9¼	6¼	17	9	6
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot	13¼	11¾	9¾	13¼	11¾	9¾	13¼	11¾	10
Half-bred	13	12¼	7¾	13	12½	8	13	12¼	8
Blackface	12½	12½	9¼	12¾	12¾	9½	13	12¾	9½
Greyface	13½	12¼	8¾	13½	12¼	8½	13½	12	8¾
Down Cross	13	12	6½	13¾	12½	7	13½	12¼	7½
PIGS—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs	14 0	13 1	...	14 2	13 2	...	14 0	13 1	...
Porkers	14 7	13 9	...	14 7	13 8	...	14 6	13 8	...

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description.	December.			January.			February.		
	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality
STORE STOCK :—									
CATTLE—	Per head.	Per head.	Per head.	Per head.	Per head.	Per head.	Per head.	Per head.	Per head
Aberdeen-Angus :	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Yearlings	17 1	13 17	12 15	17 7	14 13	12 19	17 19	14 8	13 0
Two-year-olds ...	23 12	19 3	15 0	23 2	18 18	15 8	23 18	18 18	...
Cross-bred (Shorthorn) :									
Yearlings	15 15	13 6	12 2	16 3	13 6	12 0	16 18	13 9	12 5
Two-year-olds ...	21 12	17 14	15 2	22 0	18 1	15 0	21 10	17 8	...
Galloway :									
Yearlings	13 0	...	...	17 15	...	...	14 15	...	...
Two-year-olds ...	...	...	...	19 0	18 0	...	..	...	...
Ayrshire :									
Yearlings	...	...	...	17 0	...	...	...	...	...
Two-year-olds ...	...	...	...	19 10	...	...	...	...	..
Blue Grey :									
Yearlings	...	...	.	17 10	...	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	...	...	...
Highland :									
Yearlings	...	...	...	...	...	...	...	...	...
Two-year-olds ...	15 14	13 15	...	...	...	...	...	...	...
Three-year-olds ...	19 0	16 15	...	...	...	...	...	...	...
DAIRY COWS –									
Ayrshire :									
In Milk	30 18	24 4	12 0	30 8	22 14	12 0	29 8	22 9	12 0
Calvers	30 13	23 4	14 19	31 4	23 3	15 0	29 10	22 12	14 13
Shorthorn Cross :									
In Milk	34 18	26 10	21 10	33 17	26 1	...	33 1	25 2	...
Calvers	33 0	23 13	17 10	30 19	23 4	16 16	30 3	22 10	16 6
SHEEP—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Cheviot Hoggs ...	...	...	...	...	...	...	55 0	42 0	40 3
Half-bred Hoggs ...	...	...	...	57 4	45 9	39 6	57 9	45 7	33 0
Blackface Hoggs ...	34 9	28 2	21 6	33 0	27 9	23 8	29 10	23 6	...
Greyface Hoggs ...	...	...	...	49 4	39 11	34 0	47 10	36 10	32 3
Down Cross Hoggs ...	...	...	...	53 6	...	...	50 3	...	...
PIGS—									
(6 to 10 weeks old)	43 7	31 1	...	44 2	30 9	...	49 2	33 2	...

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH, AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	December.			January.			February.		
		Dundee	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
		per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
BEEF :—										
Home-fed—										
Bullock or Heifer ...	1	$8\frac{7}{8}$	$8\frac{7}{8}$	$11\frac{1}{4}$	9	$8\frac{5}{8}$	$11\frac{1}{4}$	$8\frac{3}{4}$	$8\frac{7}{8}$	$10\frac{3}{4}$
	2	$8\frac{3}{8}$	...	$10\frac{1}{4}$	$8\frac{1}{4}$	...	$10\frac{1}{2}$	$8\frac{1}{8}$	...	$10\frac{1}{8}$
Bull	1	$7\frac{1}{8}$	$7\frac{1}{8}$	$7\frac{1}{8}$	$7\frac{1}{2}$	$7\frac{1}{8}$	$7\frac{3}{8}$	$7\frac{1}{8}$	$7\frac{1}{4}$	$6\frac{3}{4}$
	2	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{1}{8}$	7	...	$6\frac{3}{8}$	$6\frac{1}{4}$	6	$5\frac{7}{8}$
Cow	1	6	$5\frac{1}{2}$	$6\frac{5}{8}$	6	$5\frac{5}{8}$	$7\frac{1}{8}$	$5\frac{3}{4}$	$5\frac{1}{2}$	$6\frac{3}{4}$
	2	$5\frac{1}{4}$	5	$5\frac{5}{8}$	$5\frac{1}{2}$	...	$6\frac{1}{8}$	$5\frac{1}{8}$	...	$5\frac{3}{4}$
Irish—										
Bullock or Heifer ...	1	$8\frac{1}{4}$	...	$8\frac{1}{8}$	...	...	$8\frac{3}{8}$	...	...	8
	2	8	...	$7\frac{1}{8}$	...	...	$7\frac{5}{8}$	...	...	$7\frac{1}{2}$
Bull	1	...	...	$6\frac{1}{8}$	...	...	$6\frac{3}{8}$	...	...	$5\frac{3}{4}$
	2	...	...	$5\frac{3}{8}$	...	...	$5\frac{5}{8}$	...	...	$5\frac{1}{8}$
United States & Canadian—										
Killed at Birkenhead ...	1	...	...	...	...	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	...
Killed at Glasgow ...	1	...	...	$8\frac{1}{8}$	...	...	$8\frac{1}{2}$	...	...	8
	2	...	...	$7\frac{1}{8}$	...	...	$7\frac{3}{4}$	...	...	$7\frac{3}{8}$
Argentine Frozen—										
Hind Quarters ...	1	$5\frac{3}{8}$	$5\frac{1}{2}$	...	$5\frac{3}{8}$	$5\frac{1}{4}$	...	$5\frac{1}{4}$	$4\frac{7}{8}$	...
	2	$5\frac{1}{4}$	$5\frac{1}{8}$	...	...	5	...	...	$4\frac{1}{2}$	...
Fore ,, ...	1	4	$4\frac{1}{4}$	...	$3\frac{3}{4}$	4	...	$3\frac{3}{4}$	$3\frac{7}{8}$	...
	2	...	$3\frac{7}{8}$	...	...	$3\frac{3}{4}$	...	...	$3\frac{5}{8}$	...
Argentine Chilled—										
Hind Quarters ...	1	$6\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{3}{8}$	6	$5\frac{5}{8}$	$5\frac{5}{8}$	$5\frac{3}{4}$	$5\frac{1}{2}$	$5\frac{5}{8}$
	2	...	$6\frac{3}{8}$	$5\frac{7}{8}$	...	5	$5\frac{1}{8}$	...	$5\frac{3}{8}$	$5\frac{1}{8}$
Fore ,, ...	1	$4\frac{1}{8}$	$3\frac{5}{8}$	4	$3\frac{7}{8}$	$3\frac{3}{4}$	$3\frac{3}{4}$	4	$3\frac{3}{4}$	4
	2	..	...	$3\frac{3}{4}$	...	$3\frac{5}{8}$	$3\frac{1}{2}$	...	...	$3\frac{1}{4}$
New Zealand Frozen—										
Hind Quarters ...	1	...	...	5	...	...	$4\frac{5}{8}$	...	...	$4\frac{1}{2}$
	2	...	...	$3\frac{7}{8}$	...	...	$3\frac{1}{2}$	...	...	...
Fore ,, ...	1	...	...	$3\frac{3}{4}$	...	...	$3\frac{1}{2}$	...	...	$3\frac{5}{8}$
	2	...	...	...	...	...	...	...	...	...
MUTTON :—										
Hoggs, Blackface ...	under 60 lb.	$11\frac{3}{8}$	$11\frac{1}{4}$	$10\frac{5}{8}$	12	11	11	12	$10\frac{7}{8}$	$11\frac{1}{2}$
	60 lb. & over	...	...	$10\frac{1}{8}$	...	...	$10\frac{1}{2}$	11	...	11
,, Cross	under 60 lb.	$11\frac{3}{8}$	$11\frac{1}{4}$	$10\frac{1}{2}$	12	11	$10\frac{3}{4}$	12	$10\frac{7}{8}$	$11\frac{1}{4}$
	60 lb. & over	...	...	$10\frac{1}{8}$	...	...	$10\frac{1}{2}$	11	...	$10\frac{3}{4}$
Ewes, Cheviot	1	$7\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{1}{2}$	8	7	8	$8\frac{3}{8}$	$7\frac{3}{4}$	$8\frac{3}{4}$
	2	$6\frac{3}{4}$	$6\frac{1}{2}$	7	7	...	$7\frac{1}{2}$	$7\frac{1}{2}$	...	$8\frac{1}{4}$
,, Blackface ...	1	$7\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{1}{4}$	8	7	$7\frac{3}{4}$	$8\frac{3}{8}$	$7\frac{3}{4}$	$8\frac{3}{8}$
	2	$6\frac{3}{4}$	$6\frac{1}{2}$	$6\frac{3}{8}$	7	...	$7\frac{1}{4}$	$7\frac{1}{2}$	...	$7\frac{7}{8}$
,, Cross	1	$5\frac{3}{8}$	$6\frac{3}{4}$	$6\frac{1}{4}$	6	$6\frac{7}{8}$	$6\frac{3}{4}$	$6\frac{1}{4}$	$7\frac{3}{4}$	$6\frac{3}{4}$
	2	...	$6\frac{1}{2}$	$5\frac{3}{4}$	5	...	$6\frac{1}{8}$	$5\frac{1}{4}$	..	$6\frac{1}{4}$
Argentine Frozen ...	1	...	...	$5\frac{1}{2}$	..	...	$5\frac{1}{2}$	...	...	$5\frac{1}{2}$
	2	...	...	$4\frac{1}{2}$	...	...	$4\frac{1}{2}$	...	...	$4\frac{1}{2}$
Australian ,, ...	1	...	$5\frac{3}{4}$	...	...	$5\frac{7}{8}$	...	...	$5\frac{5}{8}$	...
	2	...	$5\frac{3}{8}$	...	...	$5\frac{3}{8}$	...	...	$5\frac{3}{8}$	...
LAMB :—										
Home-fed	1	...	...	$11\frac{5}{8}$	...	..	12	...	...	12
	2	...	...	$10\frac{5}{8}$	...	...	11	...	...	11
New Zealand Frozen ...	1	...	$10\frac{5}{8}$	$8\frac{5}{8}$	...	$10\frac{5}{8}$	...	...	$10\frac{5}{8}$	...
	2	...	$10\frac{1}{8}$	$8\frac{3}{8}$	...	10	...	...	10	...

AVERAGE WHOLESALE PRICES OF PROVISIONS AT GLASGOW.

(Compiled from Reports received from the Board's Market Reporter.)

Description.		Quality.	December. s. d.	January. s. d.	February. s. d.
BUTTER:					
Argentine (Unsalted) ...	per cwt.	1	176 0	180 0	177 6
Australian	,,	1	168 2	176 6	180 0
Danish	,,	1	185 0	183 3	193 3
,, (Unsalted) ...	,,	1	190 2	189 0	199 3
Friesland (Unsalted) ...	,,	1	193 4	196 6	...
New Zealand	,,	1	174 10	179 3	179 3
Swedish	,,	1	178 9	177 9	189 6
CHEESE:					
Cheddar	,,	1	106 10	111 0	114 3
		2	93 5	96 0	96 0
Cheddar Loaf	,,	1	114 0	114 0	115 3
		2	...	112 0	112 0
Dunlop	,,	1	96 0	102 6	106 9
		2	89 10	93 3	95 9
Canadian...	,,	1	95 5	99 0	102 6
New Zealand (Coloured)	,,	1	94 5	98 6	99 0
,, (White)	,,	1	92 6	98 6	98 0
BACON:					
Ayrshire (Rolled) ...	,,	1	159 10	155 6	154 6
Irish (Green)	,,	1	139 10	143 0	140 0
,, (Dried or Smoked)	,,	1	147 5	151 3	149 0
,, (Long Clear) ...	,,	1	140 7	139 6	136 6
Wiltshire (Green) ...	,,	1	141 7	143 0	145 3
,, (Dried or Smoked)	,,	1	149 7	151 0	153 3
American, Long Clear Middles (Green)	,,	1	115 5	107 0	101 0
,, Short Clear Backs...	,,	1	...	...	107 4
Canadian, Sides	,,	1	98 10	95 6	94 6
Danish, Sides	,,	1	111 5	101 3	97 6
Dutch, Wiltshire Style (Green)	,,	1	101 7	95 3	92 6

Description.		Quality.	December. s. d.	January. s. d.	February. s. d.
HAMS:					
Irish (Smoked)	per cwt.	1	188 5	177 6	185 0
		2	175 5	166 0	174 0
American, Long Cut (Green)	,,	1	129 10	115 9	115 0
American, Short Cut ...	,,	1	119 2	114 0	113 6
EGGS:					
Country	per doz.	1	2 10	2 4	2 2
		2	2 8	2 2	2 0
Irish (Fresh)	per 120.	1	28 6	20 11	19 0
		2	26 7	19 8	18 2
,, (Cold Stored) ...	,,	1	15 5	14 5	13 3
		2	14 2	...	13 0
,, (Duck)	,,	1	22 7	19 5	19 4
Australian	,,	1	20 2	16 9	15 0
		2	19 6	...	...
Belgian (Fresh)	,,	1	20 11	18 3	17 5
		2	19 6	...	...
,, (Pickled) ...	,,	1	13 9	12 8	12 6
		2	13 0	...	...
Chinese	,,	1	...	14 8	14 5
		2	...	13 8	13 3
Danish	,,	1	28 10	22 9	20 6
		2	27 2	19 6	18 2
Dutch	,,	1	21 4	18 3	17 7
		2	19 0	...	...
Egyptian...	,,	1	10 10	10 8	9 10
		2	10 2	9 8	9 2
Polish	,,	1	13 11	13 7	13 6
		2	13 5	13 2	13 0
Swedish	,,	1	27 10	18 8	18 2
		2	26 9	...	...

Average Wholesale Prices of First Quality Fruit and Vegetables at Glasgow.

(Compiled from Reports received from the Board's Market Reporter.)

Description.		December.	January.	February.
Fruit:—				
Apples—		s. d.	s. d.	s. d.
British ...	per barrel.*	20 8	18 3	28 3
Imported:				
American ...	... per case.†	9 10	9 5	13 2
Vegetables:—				
Beet	... per cwt.	5 2	5 4	5 0
Brussels Sprouts ...	... ,,	15 0	15 6	16 6
Cabbage, Savoy ...	... per doz.	1 9	1 8	1 11
,, Red ...	... ,,	2 5	2 3	2 0
Carrots	... per cwt.	5 0	5 0	5 0
Cauliflowers—				
Broccoli, *Cornish*	... per doz.	4 6	4 3	4 6
,, *French*	... ,,	5 8	5 3	5 9
Celery	... per bunch.	2 5	2 7	1 8
Cucumbers ...	... per doz.	18 0	...	...
Greens	... ,,	1 0	1 0	1 0
Leeks ...	... per doz. bunches.	2 5	2 5	2 6
Onions—				
Spring	... per bunch.	...	...	0 6
Dutch	... per bag.‡	6 0	6 3	6 3
Valencia ...	... per case.*	11 1	11 5	12 0
Parsley	... per cwt.	12 0	18 0	25 0
Parsnips	... ,,	8 0	8 0	7 9
Rhubarb	... ,,	...	33 4	33 0
Tomatoes, *Canary*	... per lb.	0 6½	0 6	0 6¼
Turnips	... per cwt.	2 0	2 0	1 11

* 9 stone (approx.). † 40 lb. (approx.). ‡ 7½ stone (approx.).

Average Wholesale Prices of Potatoes at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Markets.		Quality.	Late Varieties. Red Soils. Langworthy and Golden Wonder.	Red Soils. Other.	Other Soils. Langworthy and Golden Wonder.	Other Soils. Other.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.
December.						
Dundee	per ton.	1	...	...	...	5 14 0
Edinburgh	,,	1	...	...	...	5 15 0
Glasgow	,,	1	10 0 0	8 0 0	8 16 0	5 17 0
January.						
Dundee	per ton.	1	...	...	...	5 10 0
Edinburgh	,,	1	...	...	...	5 15 0
Glasgow	,,	1	10 10 0	8 0 0	9 4 0	6 1 0
February.						
Dundee	per ton.	1	...	...	...	5 9 0
Edinburgh	,,	1	...	...	...	5 15 0
Glasgow	,,	1	10 8 0	7 15 0	8 18 0	5 13 0

Average Prices of Roots, Hay, Straw, and Moss Litter at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Market.	Quality.	Roots. Carrots.	Roots. Yellow Turnips.	Roots. Swedes.	Hay. Rye Grass and Clover.	Hay. Timothy.	Straw. Wheat.	Straw. Barley.	Straw. Oat.	Moss Litter.
		s. d.	s. d.	s. d.	s d.	s. d.	s. d.	s. d.	s. d.	s. d.
December.										
† Dundee ... per ton.	1	...	16 7	20 0	105 0 (a) 90 0 (b)	...	64 0	...	64 0	51 5
‡ Edinburgh ,,	1	...	...	...	97 6 (a) 92 6 (b)	...	56 0	50 0	55 0	45 0
‖ Glasgow ,,	1	...	...	...	70 0	75 0	45 0	...	45 0	32 6
January.										
† Dundee ... ,,	1	...	17 0	20 0	105 0 (a) 90 0 (b)	...	66 3	...	66 3	51 6
‡ Edinburgh ,,	1	...	...	...	99 5 (a) 94 5 (b)	...	55 0	48 9	55 0	45 0
‖ Glasgow ,,	1	...	...	...	70 0	75 0	44 5	...	44 5	32 6
February.										
† Dundee ... ,,	1	...	15 0	16 0	105 0 (a) 90 0 (b)	...	70 0	...	70 0	51 0
‡ Edinburgh ,,	1	...	...	...	100 0 (a) 95 0 (b)	...	54 5	47 6	54 5	45 0
‖ Glasgow ,,	1	...	...	...	70 8	75 8	43 2	...	42 6	32 6

† Quotations for Straw, baled and delivered.
‡ ,, ,, delivered loose in town.
‖ ,, for baled Hay and Straw f.o.r.

(a) Baled and delivered.
(b) Delivered loose.

Average Prices of Feeding Stuffs at Glasgow and Leith.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	December.		January.		February.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Linseed Cake—						
Home	11 19 0	11 9 0	12 0 0	11 10 0	12 5 0	11 12 6
Foreign	11 9 0	10 17 6	11 0 0	10 15 0	11 13 0	11 1 11
Decorticated Cotton Cake	10 8 0	...	10 0 0	...	9 19 5	...
Undecorticated Cotton Cake—						
Bombay (Home-manufactured)...	...	6 10 0	...	6 12 6	...	6 15 8
Egyptian (do.)	7 4 0	...	6 16 11	6 11 11	7 3 9	6 18 2
Coconut Cake ...	10 5 0	...	...	...	10 5 0	...
Groundnut Cake, Undecorticated—						
37 per cent. Oil and Albuminoids	7 15 0	...	7 12 6	...	7 10 0	...
40 per cent. do.	7 16 6	7 8 0	7 13 9	7 12 6	7 16 11	7 11 11
Maize Germ Cake—						
Home	10 13 0	...	10 18 9	...	10 13 2	...
Foreign	10 10 0	..	10 10 0	...	10 11 3	...
Maize Germ Cake Meal	10 19 6	9 12 6	10 15 0	...	10 8 9	...
Barley Meal ...	10 0 0	...	10 0 0	...	10 5 0	...
Bean Meal	13 9 0	12 12 0	12 16 3	12 10 0	12 1 11	12 7 6
Maize Meal—						
Home Manufactured	9 10 0	8 15 0	9 1 11	8 14 5	8 19 5	8 11 6
South African Yellow	9 10 6	...	9 5 0	...	9 0 8	...
Do. White ...	9 10 6	...	9 6 11	...	9 2 6	...
Rice Meal	6 15 0	...	6 15 0	...	6 16 3	...
Locust Bean Meal ..	10 1 6	9 9 0	9 17 6	9 7 6	9 13 9	8 16 3
Locust Beans (Kibbled and Stoned)	...	8 12 6	...	8 10 0	...	8 2 6
Maize Gluten Feed (Paisley) ...	8 10 0	...	8 8 9	...	8 6 11	...
Maize—Plate ...	8 6 6	8 4 0	7 17 6	7 15 8	7 18 9	7 19 5
Oats—Home ...	8 15 0	8 2 0	8 9 5	8 0 0	8 10 0	8 0 0
,, Plate ...	8 12 0	...	8 10 0	..	8 10 0	...
Barley—Feeding ...	9 16 3	8 10 0	9 3 4	9 0 0	10 6 3	9 5 0
,, Bran ...	8 16 0	...	9 0 0	...	9 0 0	...
Malt Culms... ...	7 10 0	...	7 5 0	...	7 2 6	...
Distillery Mixed Grains - Dried	8 5 6	8 12 0	8 7 6	8 10 0	8 3 9	8 9 5
Brewers' Grains—Dried	8 3 6	7 5 0	8 1 3	7 10 0	7 19 2	7 8 2
Distillery Malt Grains—Dried ...	8 1 3	...	8 3 2	...	8 0 8	...
Wheat—						
Middlings (Fine Thirds or Parings)	10 9 0	8 9 0	10 3 9	8 6 3	10 5 0	8 10 0
Sharps (Common Thirds) ...	7 1 6	7 7 0	7 3 2	7 5 0	7 17 6	7 7 6
Bran (Medium) ...	7 8 0	7 7 0	7 7 6	7 2 6	7 19 5	7 9 5
,, (Broad) ...	7 15 0	8 8 0	7 13 9	8 2 6	8 5 8	8 8 9
Feeding	...	...	...	...	12 15 0	12 0 0
Feeding Treacle ..	7 1 0	6 13 0	7 5 0	7 0 0	6 16 3	6 16 3
Crushed Linseed ...	22 16 0	...	22 15 0	...	21 12 6	...
Fish Meal	22 0 0	20 12 0	22 5 0	21 0 0	22 0 0	21 0 0
Beans—English ...	11 16 6	...	11 14 5	...	11 16 3	...
China	11 5 0	...	11 10 0	...	11 0 8	...
Rangoon, White	10 1 6	...	9 15 0	...	9 4 5	...

Average Prices of Fertilisers at Glasgow and Leith.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Guaranteed Analysis.	December. Glasgow.	December. Leith.	January. Glasgow.	January. Leith.	February. Glasgow.	February. Leith.
	%	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Nitrate of Soda ...	N. 15½	...	...	...	13 0 0	13 15 0	13 2 6
Nitrate of Lime ...	N. 13	...	...	...	...	11 0 0	...
Sulphate of Ammonia (Neutral and Granular) ...	N. 20·6	11 17 7	11 18 0	12 0 0	12 0 0	12 2 3	12 3 0
Calcium Cyanamide	N. 19	...	...	...	...	9 14 0	9 14 0
Superphosphate ...	S.P. 30	2 15 0	2 15 0	2 15 0	2 15 0	2 18 9	2 15 0
,,	S.P. 35	3 0 0	3 0 0	3 0 0	3 0 0	3 3 9	3 0 0
,,	S.P. 38	3 5 0	...	3 5 0	3 5 0	3 8 9	3 5 0
Bone Meal—Home	N. 5 I.P. 40	8 10 0	7 15 0	8 10 0	8 0 0	8 13 9	8 0 0
,, ,, —Indian	N. 3¾ I.P. 45	10 0 0	7 15 0	10 0 0	8 0 0	10 7 6	8 0 0
Steamed Bone Flour	N. 1 I.P. 60	6 10 0	6 0 0	6 10 0	6 0 0	6 10 0	6 0 0
Basic Slag	T.P. 24	*2 7 6	...	*2 7 6	...	*2 7 6	...
,, ,, ...	,, 26	*2 11 6	...	*2 11 6	**2 12 0	*2 11 6	**2 12 0
,, ,, ...	,, 28	*2 15 0	...	*2 15 0	...	*2 15 0	...
,, ,, ...	,, 30	*3 0 0	...	*3 0 0	...	*3 0 0	...
,, ,, ...	,, 36	...	**2 19 0	...	...	...	...
,, ,, ...	,, 38	...	**3 2 0	...	...	...	...
,, ,, ...	,, 40	...	†3 5 0	...	†3 5 0	...	†3 5 0
Sulphate of Potash (on basis of 90 per cent. purity)	Potash 48·6	10 2 6	10 0 0	10 2 6	10 0 0	10 2 6	10 0 0
Muriate of Potash... (on basis of 80 per cent. purity)	,, 50	8 5 6	8 0 6	8 5 6	8 0 0	8 5 6	8 0 0
Potash Salts ...	,, 20	3 2 6	3 1 0	3 2 6	3 1 0	3 2 6	3 1 0
,, ,, ...	,, 30	4 8 0	4 8 0	4 8 0	4 8 0	4 8 0	4 8 0
Kainit—In bags ...	,, 14	2 15 6	2 14 0	2 15 6	2 14 0	2 15 6	2 14 0
‡Ground Mineral Phosphate ...	I.P. 60	3 0 0	...	3 0 0	...	3 0 0	...

Abbreviations:—N. = nitrogen; S.P. = soluble phosphate; I.P. = insoluble phosphate; T.P. = total phosphate.

* Carriage paid (4-ton lots) to Ayrshire and Renfrewshire; quotations for delivery in Lanarkshire and Stirlingshire 2*s.* per ton higher. † At Leith.

‡ Fine grist: 80 per cent. through standard 100 mesh sieve: price through 120 mesh sieve 2*s.* 6*d.* per ton higher.

** Carriage paid (4-ton lots) to Lothians.

Printed under the authority of His Majesty's Stationery Office
By J. Skinner & Co., Ltd., Thistle Street, Edinburgh.

(6476.) Wt. 10701/348. 1625+11, pp. 247-262. 4.27. J.S.&Co.,Ltd. G.19.

The Scottish Journal of Agriculture.

Vol. X.—No. 3.] JULY 1927. Price 1s. Net.

HORNS *VERSUS* POLLS.

Sir Robert Greig, M.C., LL.D., and A. D. Buchanan Smith, M.A., B.Sc. (Agr.).

To-day when the proposal to remove the horns from Ayrshire cattle is under discussion, it is interesting to consider the origin of polled sections of horned breeds and the success which has attended the polling of Shorthorns and Herefords in America. Before reaching that point, however, the general question of horns *versus* polls is worth discussion. More than thirty years ago Mr. Elliot, of Messrs Laurie & Symington of Lanark, told the senior writer that Ayrshires should all be polled. He said that the cruelty and deterioration of Ayrshires due to horning in trucks and yards was considerable and might be largely reduced by removal of the horns. This, we think, is incontestable. It seems unlikely that a cow will give less milk without horns than with them, though all dairy breeds are horned, but as the question is incapable of answer it must be left there. *Prima facie* a polled Ayrshire would be more sedate and less belligerent, and using up less muscular and nervous energy would give more milk, but one cannot prove it. An Ayrshire bull would be less dangerous if hornless, and this is not unimportant, as the tale of casualties inflicted by Ayrshire bulls is a long one and has much to do with the early slaughter of these sires. How much time has been lost in the development of the breed by the slaughter of good bulls before their powers as sires of milkers could be proved is not easy to estimate, but it must be considerable. If polling will reduce the inconvenience of keeping a bull, the retention of sires of proved merit may become commoner. There is no doubt that Ayrshire cows, and particularly heifers, inflict a good deal of pain upon each other, and as pain has to be paid for by reduction in growth, or in weight, or in flow of milk, or in all three, and made up for by increased food, the aggregate cost of horns to the dairy farmer is worth thinking about. There seem to be more " Little Jock Elliots " with the motto of " wha daur meddle wi' me " in the Ayrshire than in any other breed. It is probable that if Little Jock Elliot had been deprived of all lethal weapons his attitude would have become less provocative, and the same might happen to the Ayrshire. It has been asserted that the removal of the horns will make the age of the cow more difficult to fix. Possibly that is so, but apart from the indications given by the teeth, the question arises whether it is worth while to put up with a useless and dangerous appendage to provide against, what for the reputation of the West country, we must assume to be a small number of dishonest coupers. We now come to the æsthetic argument against polling. To some the Ayrshire cow without horns will appear a monstrosity, a blot upon nature; to others a neat polled head will be no drawback. It is a question of taste, not utility, and there the matter ends.

The advantage of polled over horned dairy cattle will probably be admitted, but the case has still to be stated for the beef breeds. It may astonish some to learn that there are in America as many pure-bred registered "polled" Shorthorns as there are horned Shorthorns in Scotland, and many more pure-bred registered "polled" Herefords than there are horned Herefords in England. These Shorthorns are mostly of the same original strains as the Booth, Bates, Cruickshank and Duthie cattle of this country. Polled Shorthorns and Herefords were produced in America partly because there was a demand for them. It was found that in the cattle feeding belts horned cattle took up more room in the feeding courts and railway cars and suffered more in transit than polled stock. Moreover packing-house buyers and butchers suffered a loss on bruised meat in the carcases of horned cattle, and made a difference of 5 to 10 cents per 100 lb. in favour of dehorned and polled cattle. The Shorthorn being the favourite and most widely distributed breed, some American breeders set themselves to supply polled Shorthorns.

Polled Shorthorns.—About 1870 several breeders produced several strains of polled cattle by mating Shorthorn bulls with polled cows of various, and sometimes unknown, ancestry. The bull calves of these matings were slaughtered and the hornless heifers for several generations mated to Shorthorn bulls. Finally, hornless heifers of this four-fifths Shorthorn blood were mated with hornless bulls of similar mixture. In twenty years, only animals showing 96 per cent. purity were eligible for registration, and thirty-five years later, in 1905, the book was closed. This method produced high-grade, useful Shorthorn stock for which there was good demand, but they could not be called "pure-bred pedigreed." They were known as "Single Standard," i.e. polled Shorthorns which do not contain 100 per cent. pure blood but are descended from crosses with polled breeds of cattle.

What is known as the "Double Standard" strain of Polled Shorthorns consists of pure-bred pedigreed registered animals descended from polled "sports" of 100 per cent. pure blood, none of which nor any of their immediate ancestors have been outside of the American Shorthorn Herd Book. These "sports" were five, three heifers and two bulls. One of the heifers had slight scurs, but the bull and the other two heifers were apparently polled. Their names and numbers in the American Shorthorn Herd Book were :—

Oakwood Gwynne 4th, Volume XV, page 803, A.S.H.B.
Young Hamilton (114,169), A.S.H.B.
Mary Loudon, Volume XXXVIII, page 561, A.S.H.B.
Orphan Girl, Volume XLI, page 503, A.S.H.B.
Rose's Red Rover (113,569), A.S.H.B.

All these were calved before 1890 except Young Hamilton, who was born that year. All these animals trace to foundation stock of English origin.

The animal which seems to have had most influence on the breed is the first-named, Oakwood Gwynne 4th, the cow with scurs. Mated to 7th Duke of Hillhurst (34221, A.S.H.B.), she produced twin heifer calves, both roan and both hornless. Mated to Bright Eyes Duke (31894, A.S.H.B.), this cow produced a red hornless bull calf that was named " King of Kine." One of the heifer calves put to " Favourite " (48182, A.S.H.B.), a horned Shorthorn, bred a hornless heifer calf. The other twin heifer, mated with her red hornless half-brother " King of Kine," dropped a hornless heifer calf. These animals then became the property of a Mr. Miller of Ohio, who inbred them a little, and using his bulls on pedigreed horned Shorthorn cows obtained 75 to 100 per cent. polled calves and quickly built up a herd.

The remaining " sports " had considerable influence in developing the polled strain, but were not apparently so prominent as the progeny of Oakwood Gwynne.

Many breeders of the cattle which descended from these animals registered their stock only in the American Shorthorn Herd Book, though others registered them both there and in the book of the Polled Durhams, under which name the polled cattle bearing 97 per cent. of Shorthorn blood, but with a trace of " mulley " foundation stock, from which they got their polled characteristics, were recorded. In 1920 the Polled Durham Association ceased to exist, and was replaced by the Polled Shorthorn Society (Secretary, J. L. Tormey, Chicago). The single standard herd book ceased to exist, and all the present-day polled Shorthorn cattle trace to the above five original " sports." Many of them trace to the famous horned bull " Whitehall Sultan," which was bred by Mr. J. Deane Willis of Bapton Manor, England. Although at several of the shows, notably the Chicago International, there are separate classes for polled Shorthorns, they are regarded as an offshoot of the main breed rather than as a separate breed. Many of the polled bulls, especially " Ceremonious Sultan," are of a high show standard.

In the herd of pedigree Shorthorns belonging to Mr. William Niven of Pitlivie, Carnoustie, there was born in 1918 a pedigree polled calf which was registered as Winsome of Gowrie, V. 65, p. 999, sired by Crown of Pearl, 135998. Her dam was of the English family of Wildeyes, and was purchased from Mr. W. E.

Hunter of Arngask, Glenfarg. Winsome's first calf by Royal Gem was a polled bull with loose scurs, born in 1920. He was used on dairy cows and sold as fat. Other two bulls were born, both horned, and then came a polled heifer, got by Garbity Royal Flush, 171821. This heifer (named Sunbeam, 77751) is of a rather nice type, and has calved a horned bull calf by Royal Victor (bred by Mr Kenneth M'Gillivray). Mr. Niven is at present retaining these animals in his herd.

Polled Guernseys.—A similar sport occurred recently in the Guernsey herd belonging to Mr. C. M. Selby, Four Marks, Hants. Again the mutation arose in a cow, Holbury Mermaid, 19342 (polled), sired by Clanville Bullet, 3480, and out of Brenda of Godaines, 15095. She was born in May 1923, and has produced two heifer calves. Her first was horned, but her second polled. These animals have been purchased on the dispersal of the Holbury herd, and placed in another pedigree Guernsey herd in order that the strain may not be lost. The Animal Breeding Research Department has full records of this case, including a certified copy of the certificate of service of the parents of Holbury Mermaid.

Polled Herefords.—Polled Herefords are of later origin than the polled Shorthorns and did not attract notice until 1889. As in the Shorthorns, one section is made up of so called Single Standard Polled Herefords arising in various ways, but not from "sports." Single Standards are therefore high grade Herefords, but not pure-bred pedigreed. The origin of the two main lines of Single Standard Herefords is interesting; one line emerges from Kansas in United States, America, and the other from Ontario, Canada. In 1889 a Kansas rancher noticed a bull calf among his cattle, polled, but with perfect Hereford markings. The calf's dam was a Hereford-Shorthorn cross, three Hereford to one of Shorthorn. His sire was doubtful, but was certainly one of two Hereford bulls. This calf, named "Discovery," when mated with horned Hereford cows sired many hornless calves, and these bred together constituted by 1898 a small herd of high grade Hereford polls. Their exhibition at Omaha attracted attention and stimulated the creation of the pure-bred or double standard strain.

The other main line of Single Standards has an equally interesting but very different origin.

Mr. Boyd of Bobcaygeon, Ontario, in 1893 mated two pure-bred Aberdeen Angus bulls, each with five pure-bred Hereford cows. Nine calves were produced, mostly black with white face and polled. One black polled calf, with white markings precisely as in his Hereford mother, was retained. He was named "Cross Patch," and in 1895 and 1896 served thirteen pure-bred Hereford cows each year. Twenty-three calves were born. Nine were black and white and fourteen were red and white. Two bull calves and three heifers from the red and whites were retained. They and their progeny have been used to breed animals which are polled and have all the correct markings of the Hereford, but are not of course as prepotent as a pure-bred. These Single Standard Herefords of both main strains are eligible for registration in the Polled Hereford Herd Book only and not in the Record of the American Polled Hereford Breeders' Association, in which only pure polled pedigreed animals are recorded.

The "Double Standard" strain is perhaps the most interesting of all in its origin, as it indicates one way by which Ayrshires or Shorthorns might become polled without the introduction of any blood outside of the existing Herd Books.

Messrs. Gammon & Sons of Des Moines, Iowa, stimulated by the sight of the Kansas polls at Omaha and realising the economic importance of polled Herefords, issued enquiries to all the members of the American Hereford Cattle Breeders' Association to the number of 2,500 and elicited the fact that fourteen pure-bred pedigree registered polled Herefords existed, viz. four bulls and ten cows. From two of these bulls, "Giant" and "Variation," practically all the present day polled Herefords trace. It is interesting to note that the owner of "Giant" sued for damages the man from whom he had purchased the bull because he was siring polled calves out of horned cows! All the bulls and seven of the cows were used to found a polled herd, the bulls being used on horned cows as well as on the seven hornless. About the same time Mr. Boyd of Bobcaygeon discovered two pure Hereford hornless "sports." Both were bulls and both proved highly prepotent in removing horns. From these "sports" in U.S.A. and Canada the American polled Hereford cattle of double standard blood emerged. They are recorded in the American Hereford Cattle Record and are shown in competition with the horned Herefords, and their owners do not wish them to be recognised as a separate breed. One of the most famous polled Hereford bulls is "Bullion 4th," who at several shows won the grand championship over horned Herefords. There are now 50,000 in the Record, and over 12,000 herds are headed by polled Hereford bulls. They are in strong demand by Western ranchmen and breeders, have spread nearly all over the United States and into Canada, and have been exported to South America and Australia.

Polled Jerseys and Polled Holsteins.—There is also in the United States a Polled Jersey Association formed some ten years ago, but it does not appear to have "caught on" to any great extent. While the foundation animals are alleged to have been sports, the writers have not been able to obtain authenticated evidence of their origin, although there is no reason for supposing it to be other than through sports.

The writers have also heard that there exists in the States a Polled Holstein Association which is also alleged to have had its origin in sports or mutants. Hitherto they have not been able to obtain reliable confirmation of this.

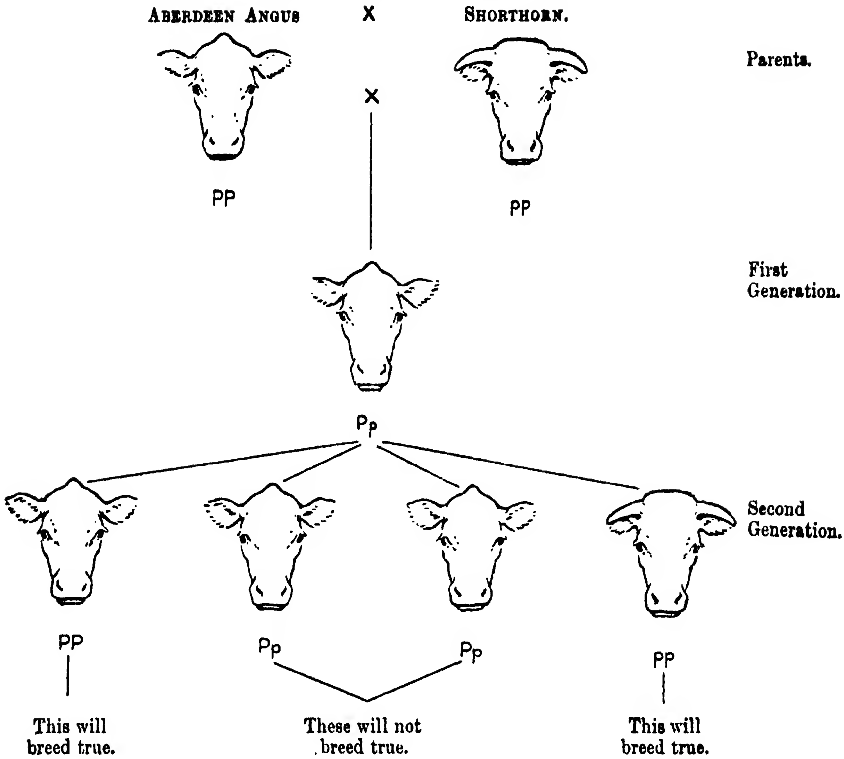
How Sports Arise.—We have seen that, working by empirical or haphazard methods, one dairy breed of cattle and two beef breeds have produced hornless strains. How such mutants or sports may arise is explained below.

According to most authorities the prehistoric ancestors of cattle were polled, but were succeeded by a race in which the bulls were horned and the cows polled. Later the females also acquired horns, and horns became the rule rather than the exception in cattle.

From the earliest historical times there have been occasional references to polled cattle, and there is the evidence of Bellenden to the effect that "homyll" cattle are mentioned in the laws of Scotland in the eighth or ninth century. Certain herds of the wild park cattle of England are reputed to have been bred pure for the polled condition since time immemorial. In Scotland there certainly existed polled cattle in specific localities in the eighteenth century before the creation of the modern breeds.

However, it is not the purpose of this paper to give an historical account of polled cattle. The object is to give some account of the polled varieties of cattle that have arisen in different parts of the world within the last hundred years, and to discuss their possible economic significance. These varieties have arisen as "sports" from recognised horned breeds of cattle, and it is well to understand the relation of the horned and polled condition to each other as regards inheritance and the production of sports.

The mechanism of heredity is extremely delicate, and can be seen only through a high-powered microscope. The existence of this mechanism has been amply proved. As regards horns, the horned condition is inherited in a recessive manner. That is to say, the mating of a horned individual, say a Shorthorn, with one of a pure polled breed, e.g. an Aberdeen Angus, produces calves that are all completely polled, or at anyrate with only "scurs." The polled condition is dominant. If two of these hybrid polled animals are mated together, then on the average three out of every four calves so produced will be polled and one will be horned. This indicates that the parents, although they were polled, were both "impure" for the polled condition. Of their three polled offspring, two are also impure and one is pure. Their horned calf is also pure for the horned condition, and mated to other horned cattle will produce only horned calves. This can be seen more clearly by referring to the accompanying diagram :—



Thus, from a breeding point of view, there are two kinds of polled animals, the pure, which will breed true to type, and the impure, which will not. It is impossible to distinguish these two types except by breeding from them. There is, however, only one type of horned animal, the pure. No matter that its immediate parents were polled, or that two of its grandparents were of a pure polled breed, the horned progeny, when mated to other horned cattle, will never throw a polled calf. This is the important point, and explains why after the foundation of a polled breed a good proportion of horned calves are produced, while on the foundation of a horned breed no polled calves appear.

Now and then, however, the mechanism of heredity breaks down, and there occur what are called in scientific language "mutations," which the practical man knows as "sports." Scientists have not adequately explained the occurrence of these mutations, though, on reflection, it is not surprising that the mechanism of heredity should occasionally break down, for it is so minute and delicate. The most recent work goes to show that these mutations occur more frequently than was commonly supposed, and it is possible to breed sports from families of animals in which these breakdowns occur more frequently than in the average for the species as a whole.

Given that the polled condition is desirable and that it is advisable to break with "fashion," the question arises as to how Scottish breeders can turn their horned cattle into polled ones. From the example of breeders in other countries we see that there are two ways of doing this. The first is to introduce the blood of some polled breed as has been done by Mr. George Will at the Crichton Royal Farm at Dumfries.

Prior to 1911 some trouble had been occasioned by the horns of the Ayrshires which then formed the cattle stock at this farm. In that year a Red Poll bull was introduced and mated to a few of these pedigree Ayrshire cows. To the female offspring of this cross another Red Poll bull was mated and upon their progeny was crossed another Red Poll bull, and so on till at the present time there are some cows with as many as five or six top crosses of Red Poll blood. The object of the experiment was threefold : the removal of the horns, improvement of milk yield, and the betterment of beef qualities. The horns have been practically removed, scurs alone cropping up. While there has been a distinct amelioration of the beef type, the milking abilities of the different individuals have varied greatly, and in order to improve this point a backcross is now being made to the Ayrshire. Thus, while the polled condition has been obtained, it has been at the expense of certain other qualities. By mating back to Ayrshire bulls, and retaining only those animals which are both polled and good milkers, some useful animals might result.

Such animals cannot, of course, be registered as pure-breds, and are therefore of no use to pedigree breeders. Also, because very careful selection is required of the progeny of such a cross, this practice is of doubtful advantage save in a large herd. While such an operation as this might be of some use to the commercial breeder, it cannot be regarded as a solution of the problem.

The Value of Polled Sports.—The other way is to make use of a polled sport. Sooner or later these turn up in every breed, and the owner should either make use of it himself or pass the animal over to those to whom such an opportunity means something. When such a sport has been traced it is a fairly easy matter to propagate the polled condition, particularly if a polled bull be obtained. It must be remembered that half the calves produced by the mating of such a sport with the horned cattle of the breed will be horned and the other half polled. The mating of two such polled individuals will give a larger proportion of polled offspring in the ratio of three to one. Some of these polled calves will be pure for the polled condition, and mated to horned cows will produce only polled calves. An example of this is seen in the American polled Shorthorn bull Ottawa Duke, a double grandson of the first mutant polled Shorthorn cow, Oakwood Gwynne 4th, produced by the mating of half-brother and sister. This bull lived till he was ten years old and left 129 registered offspring. He never sired a horned calf.

The polled Shorthorns in America produced by the infusion of outside blood (single standard) are now completely out of

PLATE 1.

Polled Hereford Bull, "Model Bullion," 1374897.
Grand Champion Bull at the Polled Hereford Week Sale, 1927.

PLATE 2

NATURALLY POLLED SHORTHORNS AT THE FARM OF MR. WM. NIVEN, PITLIVIE, CARNOUSTIE.

FIG. 1. Winsome of Gowrie, V. 65, p. 999. This cow was the original polled sport. She was born in 1918.

FIG 2.—Her daughter, Sunbeam, 77751

PLATE 3.

NATURALLY POLLED GUERNSEYS.

FIG. 1.—Holbury Mermaid, 19312. She was the original polled sport, and was born in 1923 in the herd of Mr. C. M. Selby, Four Marks, Hampshire.

FIG. 2.—Her daughter, also polled. Her first calf was a horned heifer.

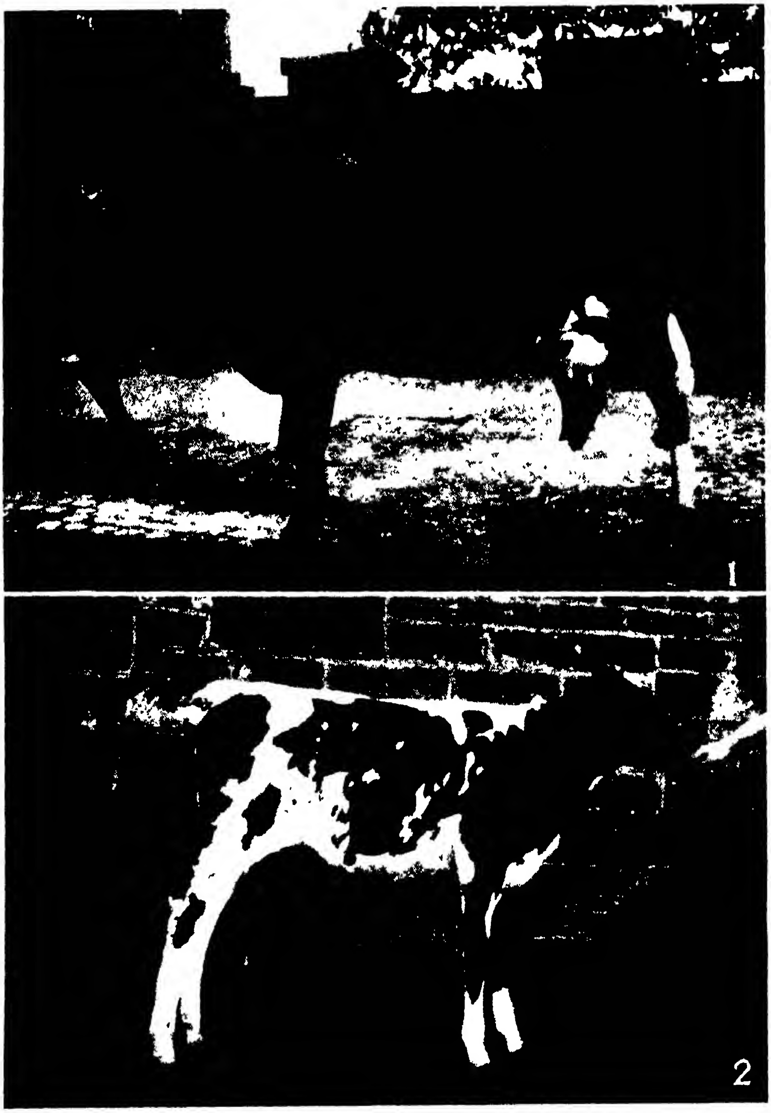


PLATE 4.

Ayrshire Red Poll Crosses at the Crichton Royal Farm, Dumfries.

Fig. 1.—Type of polled cow produced by several top crosses of Red Poll on Ayrshire. Yields over 1,000 gallons a year.

Fig. 2.—Calf, sire Ayrshire; dam, cow as above. Notice polled condition.

existence, and much the same applies to the single standard polled Herefords. Not only are there, as has been indicated, very considerable and always increasing numbers of registered pure polled Shorthorn and Herefords, but there are many more equally pure but unregistered because they are bred under range conditions. Their popularity amongst the commercial cattle raisers of the ranges is very great, and is ample proof that the polled condition is a paying proposition.

Already many of the leading pedigree breeders of horned cattle in Britain are realising this, and with considerable courage have faced up to the uselessness of following the fashion of horns in their breeds by dehorning their cattle at birth. The fact that they have realised this will make the path of the polled sport all the easier when he or she is born into this world. The pedigree Shorthorn breeders of Scotland have already found their market, and there is little fear of their letting it slip out of their hands. The Ayrshire men must possess their souls in patience. There is every reason to think that sooner or later—it may be months or it may be years—their animal will turn up. It is to be sincerely hoped that when it does arrive its value to the breed will be recognised by its owner, and that it will not be sent to the butcher because it does not conform to " breed type." The Board of Agriculture for Scotland and the Animal Breeding Research Department will be glad if any breeder who secures such a sport will communicate with them. The Animal Breeding Research Department will be glad to offer advice and assistance to a breeder who may wish to utilise a " sport," but in any case it is of great importance that " sports " should be preserved.

It is a commonplace to say that Great Britain is the stock farm of the world. To keep our place we must not forget what our foreign customers desire. The demand for polled cattle of our pedigree breeds will increase from year to year. Now is the time to prepare for the demand.

ELECTRO-FARMING.

R. Borlase Matthews, Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

Agriculture, though many years behind other industries, is becoming more of a power-using industry. The total amount of power used annually on a farm is greater than that required in any other industry, yet the available horse-power in other industries does twice and sometimes three times as much actual work as the horse-power in agriculture.

Sixty per cent. of the total cost of farm produce is chargeable to power and labour, so that a reduction in these costs by the more efficient use of power offers considerable promise. In fact it appears that agriculture's only chance of holding its own is by becoming more and more industrialised, and by so reducing the cost of production that the output of the farm can be exchanged in the markets of the world for that which other industries produce at an equivalent cost.

It is admitted on all hands that the industry is passing through a critical period, so that any new suggestion should not be turned down lightly, but rather studied from all angles. It should be recognised that those who are putting new schemes forward are prompted solely by a desire to see what is still the most important industry in the country placed on a sound economic footing. The introduction of electric power to farming would undoubtedly have an enormous commercial value; but there is a far more important aspect to the question, and that is the raising of the standard of life of those who dwell in rural areas. There are yet a few who are inclined to view the matter from a narrow statistical point of view, with the result that they arrive at conclusions which at first appear to be discouraging, but an electric service for the villages and farms is greater than anything within the narrow bounds of mathematical formulæ; it is in fact a social service of the first importance.

Financial Considerations.—Dealing with the question of cost, if electric power can be obtained from a public supply, there is no doubt that it is the best and the most satisfactory way of obtaining it. It is profitable for the farmer to pay 8*d*. per unit for light and 4*d*. for power. In fact, in many cases, an even higher price would still be cheaper than any other form of power, for when electricity is used for any purpose for which manual labour is at present employed it would be profitable to replace the manual by electricity at a cost of from 10*s*. to 20*s*. per unit. Similarly horse power could be replaced by electric power, with the cost of electricity at from 2*s*. to 3*s*. per unit.

Where manual operations are carried out daily, such as cream separating, water pumping, &c., the capital cost of installing electrical machinery for doing the work would be recovered in twelve months. One unit of electricity will separate 280 gallons of milk or churn and work 170 lbs. of butter, so that it is not difficult to see that, when a source of supply is available, these duties will inevitably be carried out by electric power, as manual labour cannot possibly compete at such a price.

The rice fields of California illustrate how the introduction of machinery has raised rather than lowered the level of the wages of the workers. Some time ago a tariff protection was obtained for the Californian rice growing industry, but during recent years this has become unnecessary, because machinery has been installed in the Californian rice fields to such an extent that the rice grown there can compete with the rice grown in China, even in the Chinese markets. At the same time the Californian rice workers are paid 5 dollars (£1) per day as compared with the Chinese workers wage of 15 cents (8*d*.) per day.

This instance shows that man as a source of power is insignificant. His output is about one-tenth of a horse-power, and his value judged by comparison with electricity is about 1¼*d*. per hour.

Where it is impossible to obtain electric power from a public supply a small generating plant could be installed. This plant will, of course, supply electric light to the farmhouse, and it should be of sufficient capacity to carry out a good deal of the power work in the buildings. Generally speaking, if the farmhouse has not to be lighted, the installation of a private plant cannot be recommended for a farm of less than 150 acres, except in the case of a poultry farm, where a small plant might be used, if the number of poultry kept exceeds 500.

In Scotland many a waterfall has been harnessed to provide electric power for farms—there is still much water waiting to be developed.

Electric Light.—There is ample evidence, if such should be required, that the use of electricity for lighting the farm yards and buildings has proved of considerable assistance to those farmers fortunate enough to possess it. By using electric light in the cow byres on his own farm, the writer found that the cost of the light was more than paid for by the saving of milk which was previously spilled owing to faulty lighting conditions, while careful tests show that at least half an hour a day can be saved in the feeding of livestock by the aid of electric light.

On commerical poultry farms electric light can be provided for the lighting of the poultry houses during the winter months at a cost of one egg per hen per annum. This method, as is now well known, increases the hours of exercise and feeding, and results in 15 to 35 per cent. more eggs at the time of the year when eggs fetch their highest prices. This is kindness to the birds, for they have time to feed properly and have ten hours sleep nightly, instead of having to be partially starved, as is the usual practice. One of the largest electrically-heated brooder equipments for chicks is situated just outside Edinburgh.

Electrically lighted and heated bees produce about 17 lbs. more honey per hive per annum and are freer from disease than any other bees.

The Dairy.—The less the human hand is brought into contact with any form of food the better it is for the health and well-being of the consumers. This is particularly true of all milk and dairy produce. Cream separators and churns, equipped with electrical drives, usually of about one-eighth to one-quarter horse-power, are now marketed by all the large manufacturers of dairy appliances. During the hot weather it is also necessary to reduce the temperature of the milk below that which is possible with the ordinary water cooler, and a simple refrigerator driven by a small electric motor is found very convenient.

Where the milk is bottled, an electrically operated bottle filling and capping machine reduces the cost of the operation considerably, while in a number of modern dairies, where graded milk is produced, electric clippers, specially suitable for grooming the cows, are often used. Milking machines, which are extensively used abroad, are now to be found on many of the large dairy farms of Great Britain, and more especially in the south of Scotland. The vacuum pump of the milker can be driven by a small electric motor of from one-half to 3 horse-power. With the smaller machines one unit of electricity will milk 40 cows, while labour charges are also considerably reduced. The following figures, taken at a recent test on a dairy herd consisting of 70 cows, show how great a saving is affected by the introduction of machines for a medium-sized herd.

Old Method (without machines).

Number of workers—Three men, three boys.

Wages.		
Three men at £2	£312 0 0	
Three boys at 30*s*.	234 0 0	
		£546 0 0

New Method (with machines).

Number of workers—One man, two boys.

Wages.		
One man at £2	£104 0 0	
Two boys at 30*s*.	156 0 0	
		£260 0 0
Interest on capital expenditure at 5 per cent.	£16 10 0	
Depreciation at 10 per cent. ...	33 0 0	
Cost of current at 1*s*. 3*d*. per day	22 15 0	
		72 5 0
		£332 5 0

Total cost of old method ...	£546 0 0
Total cost of new method ...	332 5 0
Saving on new method with milking machines	£213 15 0

Electric Motors.—The electric motor has a number of advantages over the usual oil engine or gas engine for the driving of machinery in the farm buildings. It has a much longer life and it does not need a heavy foundation; in fact it can be purchased mounted on handles, on wooden frames, or on wheels, and taken to the machine which is to be driven. It has a large overload capacity and very little care is required in running it. A five horse-power motor is the most suitable for driving the machines usually found on the farm, excepting large threshing machines and electric ploughs. While portable motors reduce installation costs, as one motor can be used for driving a number of machines, it is advisable to provide separate motors for such machines as are in constant use, such as hay chaffers and root pulpers.

The following table shows the sizes of motors required for driving the usual farm machinery.

Sizes of Motor required for various Farm Duties.

	Size of Motor.		
	Usual.	Smallest.	Largest.
Bottle washing machines	$1\frac{1}{2}$	$\frac{1}{2}$	3
Butter churns	$\frac{1}{4}$	$\frac{1}{4}$	5
Butter workers	$\frac{1}{4}$	$\frac{1}{8}$	2
Cake breakers	1	$\frac{1}{2}$	2
Centrifugal milk fat testers	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$
Chaff cutters	3	2	10
Circular saw 24 inch	10	5	10
" " 48 "	30	25	35
" " 60 "	40	40	50
Cheese curd breakers	$\frac{1}{2}$	$\frac{1}{2}$	1
Cyclone dust extractors	2	1	3
Cord wood saws	5	3	10
Cream separators	$\frac{1}{8}$	$\frac{1}{10}$	$1\frac{1}{2}$
Emery wheels	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$
Ensilage cutters	10	6	30
Feed grinders	5	3	10
Grindstones...	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{4}$
Groomers	2	1	3
Hay balers	$7\frac{1}{2}$	3	25
Hay hoists	5	3	15
Horse clippers	$\frac{1}{2}$	$\frac{1}{2}$	1
Manure pumps	2	$\frac{1}{2}$	5
Milk bottle capping machines	$\frac{1}{4}$	$\frac{1}{10}$	1
Milk bottle filler	1	$\frac{1}{2}$	5
Milking machines	3	$\frac{1}{2}$	5
Oat crushers	5	2	10
Ploughs	60	12	150
Refrigerating machines	3	$\frac{1}{2}$	25
Root cutters...	2	1	5
Sheep clippers	$\frac{1}{2}$	$\frac{1}{2}$	1
Threshers (54-inch drum)...	15	8	18
Threshers with baler	30	25	40
Threshers (32-inch drum)...	40	30	50
Water pumps	2	$\frac{1}{2}$	5

Hay-Making.—Given ideal weather conditions, there is no better way of making hay than while the sun shines. However, as adverse weather conditions are often experienced, some artificial means which produce as good, if not a better, quality than the so-called natural hay should be considered.

It was in Scotland at Comrie, Perthshire, during 1920 in conjunction with the late Mr. W. W. Hood, the well known mining engineer, that Mr. A. Boyd and the author were associated with the first successful series of trials of the modern artificial method of curing hay. A 5 ton stack, containing a lot of rush and marsh plants, was treated and successfully cured. The test was carried out on the standard cock of the district. The grass was cut green with the rain on it and immediately stacked. Air at ordinary temperature and heated air were tried, no advantage being found in the latter. The results were so successful that during the following year the author made 15 to 20 ton ricks, and his experiments have been so successful during the past few years that stacks of from 15 to 100 tons can now be cured artificially. The underlying principle of the operation is that air is driven into the stack through wooden ducts by means of an electrically-driven fan. In this way the air drives away the moisture and dissipates the heat evolved by expiration and various other causes. The curing process is obtained by temperature control, which allows certain bacteriological and chemical changes to take place. When at the correct point, the processes are arrested and a sweet smelling hay is produced. This artificially-cured hay looks better and has a better aroma than naturally dried hay and its food and nutritive value is greater.

The following table is based on an analysis of actual hay-making costs for average crops and weather conditions on the author's farm, and shows how large a saving can be effected by adopting the artificial curing method.

	Sun made Hay.	Electric Fan-made Hay.
	£ s. d.	£ s. d.
Cutting	0 10 0	0 10 0
Turning (twice) *	0 6 0	nil.
Raking (once) *	0 3 0	nil.
Windrowing...	0 3 0	0 3 0
Carting and stacking	0 18 0	0 18 0
Cost of electric power	nil.	0 1 3
Interest and depreciation of blowing plant costing £60	nil.	0 1 0
Total cost per acre	2 0 0	1 13 3

* These operations would be repeated in unfavourable seasons, and the cost would consequently be greater. The fan-made hay cost is independent of the weather conditions.

A number of other experimenters have also attempted to cure hay artificially. Mr. Charles Tinker of Kilmartin, Inverness, has experimented on the drying of crops since 1918 and has obtained some very satisfactory results. Mr. Tinker has tried both the cold air and the pre-heated air method. In accordance with his method, the grass is brought to a specially constructed barn, where it is dried over conical frames by the aid of a fan and then removed for stacking. The Institute of Agricultural Engineering have also carried out a number of tests. They have not tried the author's method, however. Also all their work seems to have been done on small ricks with grass that has lain out in the field for one or two days before treatment, and further, the ricks have always been on the small side. They have published a full account of their trials. Their last test with air at a temperature of over 180° F. seems to be very promising. The author's experience is that air at a lower temperature is of no greater value than unsaturated air at ordinary temperature.

Electric Ploughing.—The problem of mechanical cultivation is an ever important one, as the greater portion of the power used on the farm is absorbed in work on the land. There are over 200 electric ploughs in operation in Europe to-day, which indicates that the application of electricity to ploughing is both practical and economical. While at the present time the greatest progress has been made in France, Germany and Italy, it must not be supposed that nothing is being done in our own country. The first electrical equipment used in England was on a farm at Cotgrave, Nottinghamshire, in 1910. This was on the double winder rope system. The second was on the writer's farm, and is on the improved Douilhet Roundabout wire-rope system, with a single stationary haulage and anchor pulleys carrying a rope round the corners of the field. On the haulage waggon is mounted an electric motor of 12 horse-power with a starting switch and reduction gear. There are also two cable drums on the waggon, either of which can be driven at will by the motor. A double furrow anti-balanced plough is drawn to and fro across the field by a winding steel rope connected to each drum on the waggon in turn. The positions of the two pulleys, between which the plough is worked, are moved the width of the furrow ploughed each time the plough traverses the width of the field. With this type of plough it is possible to plough from one-third to one acre per hour, varying with the nature of the soil and the depth of the furrow. The average work carried out on the writer's farm is about five acres per day, while the amount of electricity used is 15 units on heavy land 6 inches deep and 25 units when 10 inches deep. This method has the advantage that the haulage gear remains in one place until it is required to work in another field. Thus the objection of moving a heavy machine over the field is avoided.

The third equipment used in Great Britain is due to Major A. McDowall of Drem, East Lothian. The writer made a special visit to Scotland to see this machine in operation, and, like many others who have seen it, was greatly impressed. One of the novel features of this equipment is the ingenious manner in which the electric cable is kept from dragging on the ground. This is done by means of a portable cable trolley which is placed at right angles to the furrows and half way across the field. The cable from the feeding point is run on to a drum on this trolley. The tractor itself carries a cable drum on which the cable is coiled and uncoiled as the machine moves up and down the field. Each time the machine passes the cable trolley it pushes it over a few feet, so that it is out of the way for the return journey. The tractor is driven by a 20 horse-power electric motor, and the greater part of the weight is taken by a single full creeper track which runs on the unploughed land. In this way the pressure per square foot on the land is reduced to a very low figure, and packing the land and the formation of a pan underneath it is avoided. The tractor is provided with a side-stepping device to enable it to move over to the new furrow without overstepping any of the work already done. Major McDowall is to be congratulated on the perseverance and ingenuity shown in the design of this equipment, especially as it was constructed in a farm workshop with the help of only one mechanic.

When the question of ploughing is being considered, it should be remembered that it is not by any means a seasonal occupation; in fact it can be extended over at least 200 days of the year, which is quite a reasonable period over which to spread interest and depreciation. To compare the cost of electric ploughing with other methods of mechanical and horse ploughing is apt to be misleading, as the cost of mechanical ploughing is usually based on the horse ploughing competition in the particular area; however, the contract prices collected by the Institution of Electrical Engineers Electricity in Agriculture Committee serve as a useful basis.

The following are average British prices :—

Steam ploughing, 15*s*. to 25*s*. per acre about 6 inches deep.

Tractor ploughing, 17*s*. 6*d*. to 30*s*. per acre, according to depth and nature of the soil.

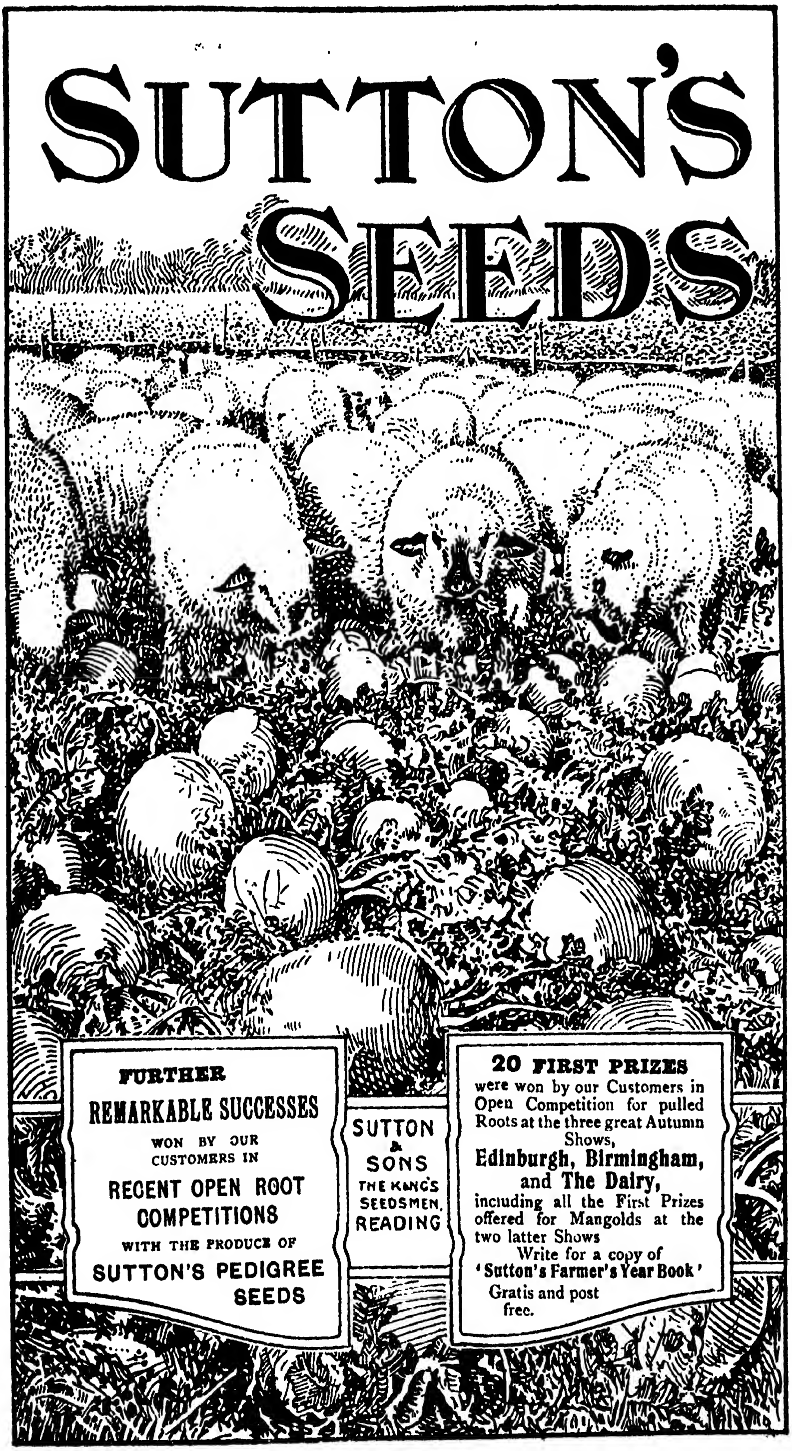
Horse ploughing, 20*s*. to 35*s*. per acre.

As there are no contract prices for electric ploughing in England, none can be given. The following were the French contract prices in 1924 :—

Depth of		Price per acre.	
Ploughing.	Subsoiling.		
Inches.	Inches.	*s.*	*d.*
10–12	5–6	34	3
8–10	5–6	32	6
12–14	...	32	0
10–12	...	30	0
6–8	5–6	30	0
8–10	...	23	0
6–8	...	16	6

The English monetary figure is given at the rate of 80 francs to the £, a figure which gave a fairly accurate rate of exchange at the time, though such a comparison is not as satisfactory as one might wish it to be owing to the difference between the external and internal values of the franc. However, it does show that electric ploughing even at its present stage can compete favourably with all other methods.

In the following table actual results obtained with electric ploughing are given, and from the figures the cost of current in


SUTTON'S
SEEDS
FURTHER
REMARKABLE SUCCESSES
WON BY OUR CUSTOMERS IN
RECENT OPEN ROOT COMPETITIONS
WITH THE PRODUCE OF
SUTTON'S PEDIGREE SEEDS
SUTTON & SONS
THE KING'S SEEDSMEN,
READING
20 FIRST PRIZES
were won by our Customers in Open Competition for pulled Roots at the three great Autumn Shows,
Edinburgh, Birmingham, and The Dairy,
including all the First Prizes offered for Mangolds at the two latter Shows
Write for a copy of
'Sutton's Farmer's Year Book'
Gratis and post free.

any district can be estimated. Interest, depreciation, labour, &c. will naturally vary according to the type of equipment, so each case should be considered on its merits.

Results obtained with Electric Ploughing.

Depth of Furrow in inches.	Consumption in Units per acre.
6	12–18
8–8·75	16–22
8·75–10	18–24
12–12·5	22–26
10–12 plus 6 subsoiling	36–45

A number of power companies are now supplying current to farmers in their rural areas. The Power Supply undertakings in Fife and Kilmarnock are noteworthy for extending their power lines in the surrounding districts. The writer recently had the opportunity of looking round some of the Fifeshire farms, and found that the Fife Electric Power Co. are now covering 30 towns and villages and supplying current to many of the farmers in the area. In general the uses made of electricity by the farmers in these districts are for lighting the homestead and farm buildings, for domestic purposes such as ironing, heating and cooking, in the dairy, threshing, the preparation of food and the transport of hay fodder, &c. from waggon to barn or threshing machine platform, as the case may be. Regarding this latter use it was most interesting to observe the manner in which adaptations had been made. Scottish farm buildings are low, and would appear to be by no means really suited to the installation of modern haulage gear. The fact that such is to be found, therefore, shows that it is not, as many farmers seem to imagine, necessary to build special buildings before electrically-operated machinery can be utilised. Some of the Fife farm threshing installations are an example to many parts of the world, for everything is done electro-mechanically. The straw is carried, as soon as it comes out of the machine, by conveyors to the straw barns. The chaff is blown through pipes to the chaff rooms, while the various grades of grain are elevated by Jacob's ladders to the granaries.

It will thus be appreciated that Scotland is more than playing her part in advancing the interests of electro-farming to the advantage of her farmers and through them the whole of her population. Also she is setting an example to other parts of the world.

TOMATO GROWING IN SCOTLAND.

DUDLEY VHOWELLS, Dip. Agric.,
The West of Scotland Agricultural College.

WHEN one considers the tremendous shrinkage in the area of cultivable land which has taken place since the war due to housing schemes, the provision of sports grounds and for other social purposes, it is not difficult to visualise the greater part of Great Britain covered with glass, with forage and other crops grown intensively under controlled conditions. Meanwhile in Scotland it is the tomato industry which occupies about 95 per cent. of the total area under glass.

This industry, which has now reached very large dimensions, is of comparatively recent development. The first houses erected in Lanarkshire were built about thirty-seven years ago, and consisted of two houses each 60 feet long and 14 feet wide. These houses had brick sides right to the roof plate. Incidentally they were blown down during the severe gale in January last.

During the following ten years a few houses were built, but it was not until after the year 1900 that there was any great development. Between the years 1905 and 1912 there was a marked increase in the area devoted to tomato growing. Previous to the war the peak point was reached in 1912, when so rapid was the erection that some writers expressed the fear that many growers would be driven out of the industry. Certainly, prices in some years fell below the costs of production, but the increased demand rectified this.

The growth of the tomato industry is inseparably bound up with the improvement in the standard of living of the working class, and its success is directly dependent on the well-being of the mass of the population. The increased demand for tomatoes illustrates, in a remarkable manner, how a luxury of one generation may become a necessity of another. With the increased demand for tomatoes more glass was erected. Increased competition led to cheapening in costs of production and this in turn led to increased consumption. The tomato has now taken its place as a standard article in the nation's diet.

During the war period very little extension was possible, and the excessive costs of building which obtained from 1919 to 1922 made the erection of glass prohibitive. Since 1922 the area under the crop has been almost doubled. The total area under tomatoes in Scotland cannot be less than 90 acres. Reliable, up-to-date figures are not available, as there has recently been a very large expansion. In Lanarkshire alone there are between 65 and 70 acres, while Ayrshire, Dumbartonshire, Dumfriesshire and Stirlingshire contribute about 15 acres. It is estimated that about 95 per cent. of the total area under this crop is situated in the west of Scotland. The three most important parishes are Carluke, Lanark and Lesmahagow, the latter having the greatest amount. These districts are all on the fringe of the great industrial area of Lanarkshire and within 25 miles of Glasgow. It is quite natural that the industry should be concentrated in the west, since about 60 per cent. of the fruit and vegetables sold in Scotland passes through the Glasgow market. The importance of the industry may be gauged from the following statement.

There are about 90 acres with an average production of 34 tons per acre. Supposing the average wholesale price is 6*d.* per pound this crop represents a gross value of £171,360. The contribution of the industry to the national and local exchequers is considerable. Tomato houses are usually rated on a basis of 9¼*d.* to 9½*d.* per square yard, which is approximately £187 per acre. There is an additional assessment for dwelling-houses, buildings, packing sheds, &c., and the industry is therefore, so far as local taxation is concerned, as important as from 15 to 17 thousand acres of mixed farm land situated in the same neighbourhood.

The grower is, in most cases, an owner-occupier; in fact there is not more than 0·25 per cent. of the area held by tenant-occupiers. The large growers are usually tomato growers only, while others combine tomato-growing with the growing of outside fruit. In a few cases farmers have erected tomato houses, and it is a common thing to find skilled artisans supplementing their earnings by working in their tomato houses during their spare time. The industry is a specialised one, tomatoes being in the majority of houses the only crop grown. In some instances chrysanthemums and bulbs are grown during the autumn and winter, but this is the exception rather than the rule. The markets are easily glutted with flowers, and most growers do not find it sufficiently profitable to supplement the tomato crop in this way. The preparation for the succeeding crop occupies most of the time during the close season, especially when the houses are old and the soil exhausted.

Most of the earlier houses were of a different type from the modern tomato house. They were much steeper in the roof, were narrower, and had considerably more side brickwork, in fact usually there was no glass at all in the sides. In some cases the crop was grown on raised beds. The houses were more often built singly than is the case now.

Modern houses are constructed on what is termed the "Aeroplane type" (fig. 1), a range of houses of Messrs. D. & T. Brown at Lanark. A block of houses really consists of a number of similar glazed span roofs running parallel with one another and joined at the gutters. The whole structure forms one roof, and by this means the cubic capacity is limited for heating purposes, while the pitch of the glass is maintained at a desirable point. Modern houses always have glazed sides 2 feet 6 inches to 3 feet high with brickwork below. For the area covered this is the most economical method of erection. In a block of six houses 200 feet long and 15 feet wide joined at the gutters, there would be only two end walls and two side walls. The amount of brickwork necessary, exclusive of supporting pillars, would be only 194 (linear) yards as compared with 460 yards necessary if six separate houses had been erected. There is also a great saving in the matter of land and a decided economy in labour and fuel. It is sometimes urged that the single or dual houses give the best results, and this may be so, so far as crop is concerned, but the greater area required, the increased cost of erection and the greater cost for heating are the deciding factors.

The dimensions of the houses usually erected are 150 to 250 feet long by 15 to 16 feet wide, and 5 feet 6 inches at the eaves and 9 or 10 feet to the ridge. Wider and higher houses have been erected, and it is probable that the tendency will be towards the wider house.

In constructing the modern establishment, attention must be paid to the following points.

I. *Site.*—This should be as nearly as possible level so that an even temperature may be maintained. Mildew is more prevalent in houses situated on a decided slope, and in such houses there is always a difficulty in keeping the subsoil moist during the summer months. This is a very important point in swelling the fruit. An inclination of 1 in 100 is desirable but not always attainable. The situation should be an open one. When houses are built in a very sheltered place mildew is often troublesome, but on the other hand it is difficult to maintain an adaquate temperature in a very exposed situation, and the plants are likely to suffer badly from sleepy disease if the fungus be present.

II. *Water Supply.*—Where the water supply is indifferent a grower is seriously handicapped. The crop requires a very large quantity of water, and this should be reasonably pure. Surface water has been known to convey disease spores, and, where possible, water from a public water supply or from springs or artesian wells, not liable to be contaminated, should be chosen.

III. *Drainage.*—Good drainage is essential. If this occurs naturally, so much the better; if not, it must be provided.

IV. *Soil.*—A medium loam is the most suitable soil, though the crop may be grown satisfactorily on light sandy soils or heavy clays. The treatment given to the land will be slightly different according to the nature of the soil, and in any case will tend to improve it. Large quantities of organic matter are added and the texture of the soil is improved thereby. Depth is the main consideration. There should be at least 12 inches of soil proper with an equal depth of suitable subsoil below. Old meadow land is usually satisfactory, though there may be a lot of trouble during the second and third years if this be infested with wireworm. On the whole the potato is the worst crop to precede tomatoes, and in numerous cases the first year's crop has been reduced very much, owing to diseases which affect both the potato and the tomato.

V. *Sunlight, air and heat.*—Sunlight is a controlling factor, and in order to trap as much light as possible the wooden framing is of very light construction. The heavy sash bars have disappeared and the modern astragals are usually 3″ by 1¾″. Lighter timber even than this is sometimes used. The size of glass used has also increased considerably, 19″ by 18″ being the standard size, and with this only one-quarter to one-half inch of overlap is allowed. The overlap usually obscures most of the light rays and should only be sufficient to prevent rain beating in. Top puttying is not practised, the panes being only bedded on putty.

Ventilation is very important and is provided for in the roofs; side ventilators are not used to any extent. The ventilators should occupy as much of the ridge as possible, due regard being paid to stability, and a large number of narrow ventilators is better than a few wide ones. The present practice is to hinge these at the top. For effective ventilation and freedom from chilling, ventilators hinged at the bottom and opening at the ridge are preferable. The ventilators might then be much narrower. Ventilation on both sides of the ridge is necessary to allow for changes in the direction of the wind.

The heating system in vogue is the hot water system. Tubular and sectional boilers are in use, and the tendency is to concentrate the heating in a few large boilers and save work and coal. The possibilities of central heating systems, by means of steam heated water, have not been tried so far in Lanarkshire, but it is probable that this will be the next step. It is claimed for this system that there is a saving of 20 per cent. in the fuel costs, and this saving in Scotland would represent at least 8 per cent. of the total costs. If in the future electricity can be supplied at a sufficiently low cost, it may be possible to utilise this for heating tomato houses. The absolute control which is possible where electricity is used would be a great asset. A large section of the tomato area is within easy reach of the Clyde Valley Hydro Electric Power Station, and tomato growers would be large users during the time when other consumption is light, and this would be an advantage to the company. At the present time the cost of electric heating is prohibitive. Much more piping is used in Scottish tomato houses than in those in the south of England. In some cases the difference is as much as 50 per cent. This is natural when one considers the climatic differences. In most cases the water pipes are run near the ground level. There are some growers who favour the overhead system. In this system the flow runs along at, or near, the eaves. Where a 4-inch overhead pipe is used there is a great strain on the sides of the house and this has to be allowed for in construction. It is claimed for this system that—

I. Cold draughts are prevented.

II. The plants dry up more quickly after overhead watering and therefore there is less danger of mildew.

III. There is a more rapid circulation and more even distribution of heat.

The overhead system is mostly favoured by those who grow chrysanthemums. They find that the distribution of heat high up in the house tends to prevent mildew in this crop.

The cost of constructing a modern range of houses varies considerably according to the size of the range and the nature of the structure. Naturally, extensive ranges can be erected at a much smaller figure per unit than can small ranges. The usual method of estimating glass house costs is per foot run, and the extent of the establishment is usually stated in so many feet run. This refers to the total length of the houses 15 or 16 feet wide as if they were placed end to end. Houses are rarely erected more than 250 feet long. A range of six houses each 250 feet long would be spoken of as 1,500 feet of glass. An acre of glass would be approximately 3,000 feet.

The approximate costs of erecting tomato houses of the dimensions mentioned previously are :—

For 250 to 300 feet, 42*s*. 6*d*. to 45*s*. per foot run.
,, 300 to 500 feet, 40*s*. to 42*s*. 6*d*. ,, ,, ,,
,, 500 to 700 feet, 37*s*. 6*d*. to 40*s*. ,, ,, ,,
,, 1,000 feet and over, 32*s*. 6*d*. to 35*s*. per foot run.

The situation, excavation necessary, weight of wood required and many other factors influence the cost. Previous to the war similar houses cost from 17*s*. 6*d*. to 20*s*. per foot run for establishments of 1,000 feet and over.

The tomato year starts in the autumn with the removal of the old plants. These are either burned or carted away from the place. All strings are taken down and the residue of top dressing is then wheeled out. This top dressing is generally held to have a very harmful effect if dug into the soil. The houses are then thoroughly scrubbed down and sprayed with cresylic soap-emulsion. Spraying is much more effective than washing with a brush or cloth, as the sprayer can force the solution into all crevices and aid in the destruction of the spores of fungi and the eggs of insects which may be lodged in the crevices in the wood or glass. After the crop has been cleared many growers fumigate their houses by burning sulphur to destroy fungus spores. The winter's work is greatly dependent on the length of time that the soil has been in use. Unfortunately, tomato growers cannot practise a rotation of crops, in the ordinary sense of the word, but they are often forced to adopt a rotation of soil. After about ten years' continuous cropping the soil does not yield good crops and has to be renewed. The length of time taken to exhaust the soil depends on its nature and on the treatment it receives. The first two or three years are usually very good years, but after that the crop may tail off owing to a variety of causes. There are some circumstances in which the first year may be a bad one, usually when the land has been previously under potatoes. When old lea is used there is a great danger from wireworm, and this is a serious matter, as the presence of one wireworm usually means the death of one or more plants when they are about 15 inches high. It therefore behoves the grower to see that the soil is not overrun with this pest. Several methods are adopted for its control, including steaming, soil injection with chlorpicrin and treatment with calcium cyanide. Treatment with chlorpicrin is a very difficult and to some operators a dangerous operation, though plants do extremely well after its use. Baiting with germinating oats and then treating with calcium cyanide has given good results. When soil has become "sick" or impregnated with disease spores resort is usually had to resoiling, chemical treatment or to steaming. *Resoiling* is a laborious operation, but is often chosen in preference to the other two methods. Before this can be done a grower must have plenty of land from which the top soil can be taken. The operation involves the removal of the top 10 or 12 inches and its replacement by new soil. Unless this soil be a good medium and free from wireworm, eelworm and fungus spores, the cure may be worse than the trouble. Too often little or no care is taken to see that the soil which is removed, and which will probably eventually be brought back, goes through a satisfactory rotation. The growing of rape and other catch crops is beneficial but growers should avoid potatoes. Houses which are resoiled do not usually crop well for so long as they did when first erected. The cost of resoiling depends on circumstances and varies from £180 to £200 per acre. If resoiled houses remain good for five years, this is cheaper than steaming.

Chemical Treatment.—Formaldehyde has been used to a considerable extent, and the beneficial results obtained on one occasion may be seen in figure 2. This shows the difference in the heights of the plants grown in treated and untreated soils respectively. The plants in the front of the picture were grown in untreated soil, those towards the back in soil treated with formaldehyde. The difference in height is seen by comparing the position of the left hand with that of the right hand. Variety, time of planting, and general treatment were the same in both cases.

Formaldehyde is a commercial product containing 40 per cent. of pure formaldehyde in water. This solution is diluted 1 in 50 for use. For practical purposes 9 lbs. of the concentrate are weighed out in a tin, and this is made up to 40 gallons with water. Barrels of 40 gallons capacity are more easily obtained than containers holding 50 gallons. One gallon of concentrated formaldehyde is sufficient to treat 50 to 100 square feet according to circumstances. For ordinary purposes about 10 gallons is sufficient to treat a house 100 feet long by 15 feet wide. This operation costs about half as much as resoiling. At least three weeks should elapse between the treatment and planting, and the soil should be watered thoroughly during this period. *Steaming* by means of the grid and tray method is the favourite form of sterilisation. This is not an economic proposition in the case of small establishments. Steaming, as generally practised in Scotland, is too scamped for disease control purposes, and an extract from Dr. Bewley's *Diseases of Glass-house Plants* may be opportune.

> " When, however, soils are heated until the temperature becomes approximately 97° C. (207° F.) important changes take place and the soil becomes ' partially sterilised.' . . . Partial sterilisation has a beneficial effect on soils which is most marked in infertile or sick soils. . . . Partial sterilisation effects a reduction in the extent of disease, but this varies with the nature of the disease. . . .
>
> " For the purpose of eliminating disease, the soil should be heated to a greater extent than is required for increasing fertility. Generally, however, a temperature of 200° to 205° F. maintained for an hour is sufficient to eliminate most fungus diseases. . . .
>
> " The steam is supplied from a portable steam boiler 12-30 horse-power and maintained at 60 to 90 pounds pressure per square inch. Steam is passed through the grids for 30 minutes, which under normal conditions is sufficient to raise the temperature of the soil to 200° F. Any leaks round the sides of the boxes must be stopped by packing with earth. The passing of the steam is continued for another 20 to 30 minutes and the box left on for another 30 minutes. To facilitate operations six boxes and four grids should be employed."

Taking standard Scottish houses it would thus take about 15 hours continuous working to steam a tomato house 100 feet long. This operation would cost from £150 to £200 per acre. Steaming has to be repeated each year. Greatly increased crops have been obtained by steaming as practised, but there has been a lot of trouble owing to stem rot. In local practice only about 15 minutes' steaming is given to each section.

Preparation for Seed Sowing and Potting.—Considerable loss is often occasioned by damping off amongst seedlings and, as a preventive, partial sterilisation by means of formaldehyde is adopted. The formaldehyde is diluted 1 in 50 for use, just as for treatment of the borders.

The soil having been mixed ready and allowed to mellow under cover, the site where the treated heap is to be built is first watered with the diluted formaldehyde. A layer of soil about 6 inches deep is then spread over this and thoroughly soaked with the solution. Layer by layer the heap is built and treated. The whole heap is then given a good soaking outside and covered with sterilised sacks or a tarpaulin. The heap is kept covered for two days, and afterwards should be turned once or twice before use. The treated soil should not be used until about three weeks have elapsed. All pots, boxes and shelving should be treated. Formaldehyde may cause serious scorching if the material is not allowed to evaporate from the soil before use. Pots treated with this should be soaked before use.

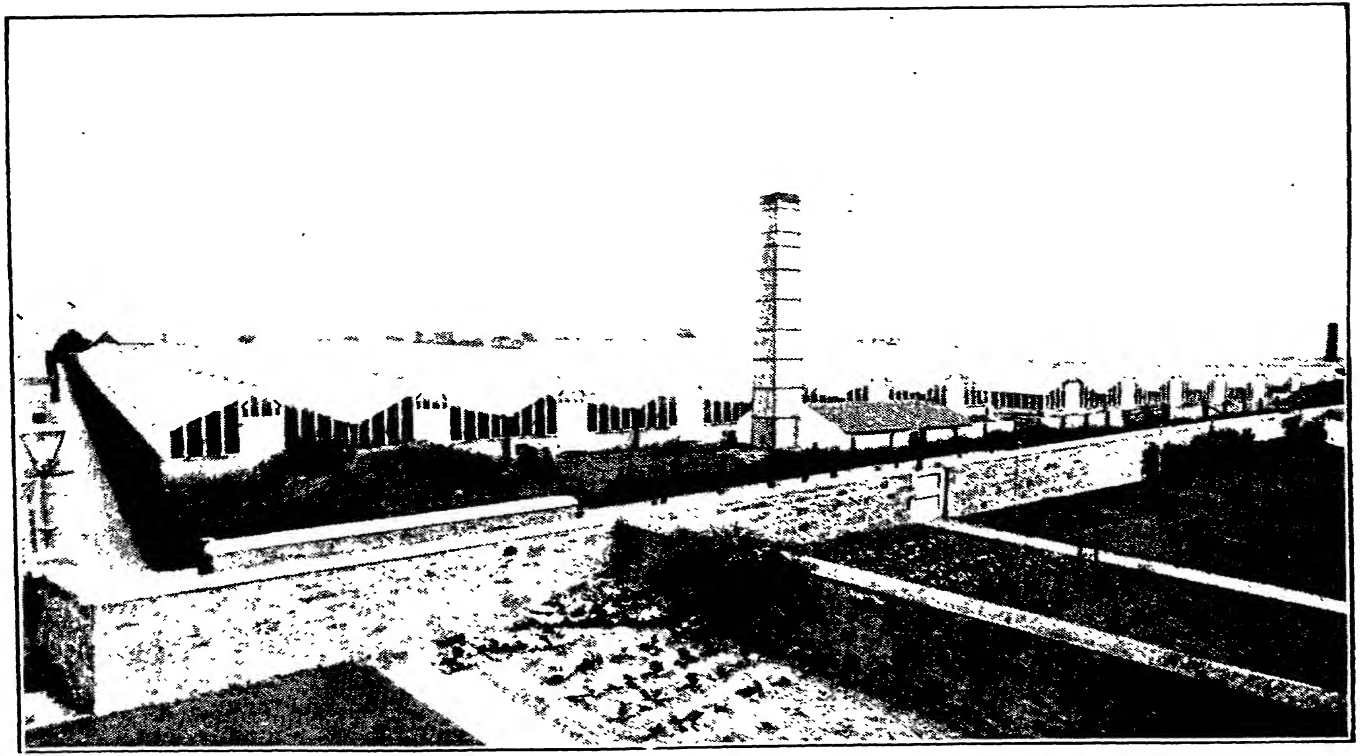


Fig. 1.

Block of Tomato Houses. "Aeroplane Type."

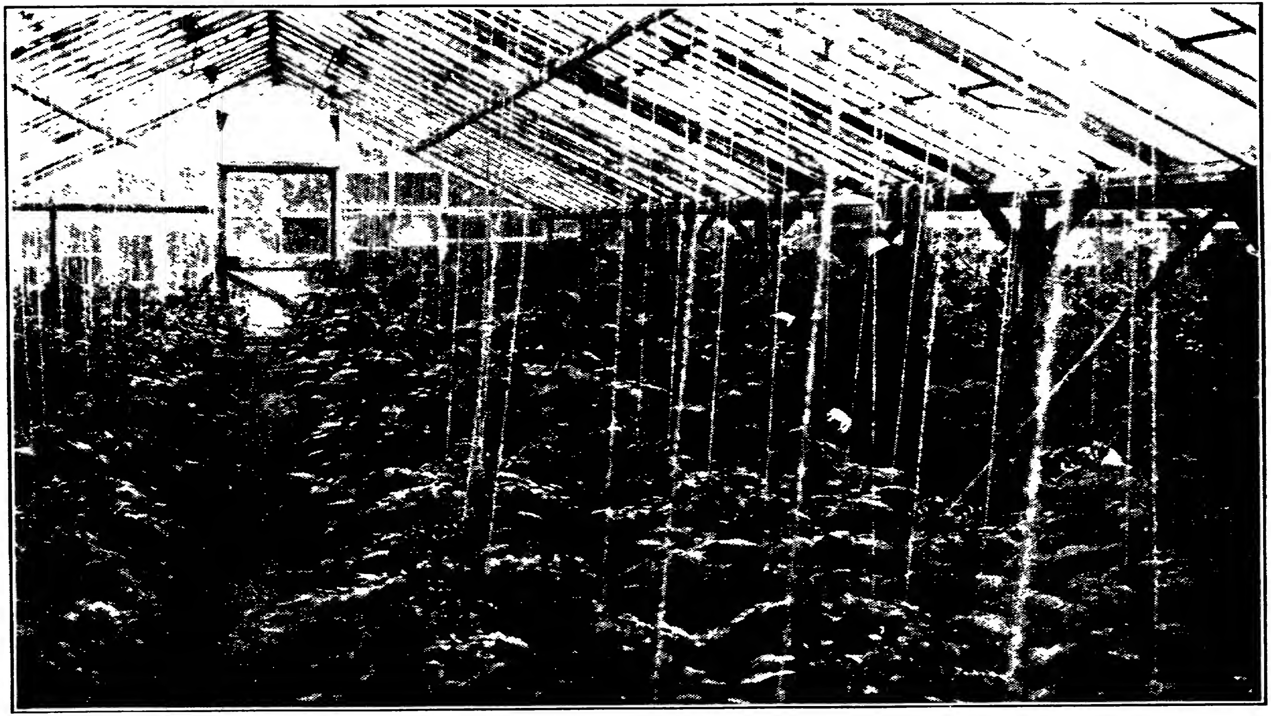


Fig. 2.

Partial sterilisation with Formaldehyde.

i. Left hand of figure shows height of plants in untreated soil.
ii. Right hand shows height of plants in treated soil.

Fig. 3.

Notenboom's Patent Fruit Grading Machine.

Cheshunt compound, a specific of Dr. Bewley's, consisting of 2 parts copper sulphate and 11 of ammonium carbonate, mixed and used at the rate of 1 oz. to 2 gallons of water, is used to a considerable extent for checking damping off amongst seedlings.

Seed Sowing.—Provision is usually made for the raising of plants by having one or more houses—termed forcing houses—which are self-contained and can be heated independently from the rest.

Stages are erected in these houses to bring the plants nearer the glass.

The soil should consist of—

Well decayed turf ...	2 parts	Mixed and passed through a sieve of ¼″ mesh.
Good garden soil ...	2 parts	
Decayed manure ...	1 part	
Sand or road grit free from oil or tar ...	1 part	

Boxes 15″ by 9″ by 2″ are used and these are provided with drainage holes. Rough soil is placed in the bottom to facilitate drainage, and the box is filled to within three-eighths of an inch of the top with the fine soil and well firmed. About 200 seeds are then sown. The seeds are placed singly in a shallow furrow and lightly covered with soil. The box is watered, a sheet of glass is placed over it, and the whole is shaded with brown paper. The temperature necessary for germination is from 60°-70° F.; in any case the temperature should not fall below 55° F. A second batch of seed is sown as soon as the first is up. In a few instances seed is sown as early as the middle of November, but most growers wait until the end of December or the first week in January. When the days are lengthening growth is much more active than when they are on the wane, and earliness, at present, can only be obtained by excessive coal consumption. When seed is sown in the first week in December, the seedlings are potted up in the first week in January and the plants are placed in their permanent quarters at the end of February.

When the first rough leaf appears the little plants are potted up. The standard size of pot is the 3 inch, but a few growers use 3½ inch size. These take much more room but have the advantage of not requiring so much water, and planting out can, if necessary, be delayed.

The essentials for potting are healthy seedlings, clean pots and suitable soil.

The mixture may consist of—

Decayed turf	1 part
Good garden soil	2 parts
Decayed manure	1 part
Sufficient sand to open.	

Since the plants are only in the pots for a short time there is no necessity for crocks.

The seedlings are always watered with luke-warm water. In some places special provision is made for heating the water. Where this is done it is much more satisfactory to have a separate heating system for this purpose than to take water from the heating installation. Water from the latter may have a harmful effect on the seedlings.

Planting.—Tomatoes for commercial purposes are always grown in borders, and it is necessary to see that these are thoroughly moist before planting. To ensure this the borders are often watered twice or three times during the winter. Steaming usually leaves the soil sufficiently moist. The ground is thoroughly manured and cultivated before planting.

Heat is turned on to the houses three or four days before planting, and the plants are brought in for at least a day, to acclimatise them, before they are set out into their permanent quarters. The two chief methods of planting are by means of a trowel or with a dibber. The trowel is always used when the plants are "layered." This consists in placing part of the stem almost horizontally in the soil with the object of ensuring that the bottom truss is borne low down on the plant. This system is being discarded and most growers use the dibber. The dibber may be made of wood covered with sheet iron or of iron, and is so shaped as to make a hole slightly larger than the pot. The soil is not brought round the neck of the plant until later. The planting distances vary considerably from 24″ by 18″ to 21″ by 15″. The pipes are marked at the distance chosen for the rows, which run across the house. In most cases four plants are set across the house on each side of the pathway. The plants are supported by means of strings suspended from wires running along the roof. The material used is either a 4-ply jute fillis or jute lea and is bought in 7 to 14 lb. balls, wound with 12 ends to the wind. This is much handier than single ended balls. As they grow in height the plants are turned round this support so that the string becomes a spiral. New string is necessary each year on account of the danger of the old string carrying disease.

Manuring.—In preparation for planting both natural and artificial manures are used. Well decayed stable or cow manure, according to the nature of the soil, is applied at the rate of about a ton per 100 feet run of house. After steaming, this dressing is not given, as it is found that plants in steamed soil grow too vigorously. Lime, basic slag and sulphate of potash are used, supplemented in some cases by a dressing of good quality bone meal.

A usual dressing is—

Basic slag	$\frac{3}{4}$ cwt.	Mixed and applied to the 100 feet run.
Sulphate of potash...	$\frac{1}{2}$,,	

During the growing season both artificials and farmyard manures are used. The artificials usually consist of sulphate of ammonia, superphosphate, steamed bone flour and sulphate of potash, mixed to give a manure having an approximate composition of 4 per cent. nitrogen, 15 per cent. soluble phosphate, 10 per cent. insoluble phosphate and 7-8 per cent. potash. Three or four dressings of this at the rate of 28-30 lbs. per 100 feet are given during the season. Comparatively large quantities of sulphate of potash are used, as much as 15 cwt. per acre being applied during the season. After the second truss has set, the plants are mulched with farmyard manure, which is watered as soon as it is spread to prevent scorching. This conserves the moisture and also feeds the plants.

The routine operations are the pinching of lateral shoots, defoliating and picking.

Artificial pollination is not practised to any great extent. Probably much better sets would be obtained on the lower trusses if it were, but it is really a question for the grower in his organisation of the labour available. Pollination is sometimes assisted by tapping the plants during the hottest part of the day. In some cases a rabbit's tail is used, while in two cases very beneficial results have been obtained by adopting the emasculation method. The greatest benefit from artificial pollination is that the bottom trusses are fertilised, and a greater quantity of fruit is ready for the early market when prices are comparatively high.

Grading.—Tomatoes, like other fruits, sell largely by their appearance, and appearance is usually an accurate indication of quality. They are graded into three, four or even five grades according to the opinion of the grower or in deference to the wishes of the salesman.

A's are perfect fruits of a suitable size.
B's are perfect fruits of a smaller size.
C's are blemished fruits and smalls.

Some growers have a fourth grade which takes in the "roughs" and cracked fruits.

In some cases, especially where a grading machine is used, it is possible to get two or even three sizes of A grade. Purchasers are not all alike in their requirements, and while some like tomatoes 6 to 8 to the pound others require 10 to 12 to the pound. The use of graders is in its infancy in Scotland, but it is beginning to be felt that grading by hand is not so expeditious nor so accurate as grading by a machine, and in tomato growing it is necessary to adopt the most up-to-date methods. A very suitable grader for tomatoes is the Notenboom's Patent Fruit Grading Machine. This grades the fruit into five or six sizes according to the size of the machine, and the smaller size at £23 f.o.b. Rotterdam is said to be capable of dealing with 1,500 lbs. per hour. One of these machines has been in use in Lanarkshire for several years and has given every satisfaction. It can be supplied for operation by hand or by motor. An illustration is shown for either hand or power.

Packages.—Two types of packages are used—the returnable wicker-work baskets termed "handles," and the non-returnable containers. All are made to hold 12 lbs. of fruit, and it is usual for the grower to send exactly 12 lbs. net in each basket. The salesmen prefer this, as it is a nuisance to them to have to record odd weights. During the last few years there has been considerable controversy concerning the respective merits and demerits of the returnable and non-returnable packages. The non-returnable should be a boon to the grower, because in the first place he has a free market, which is not the case if he uses containers stamped with the mark of a particular salesman; in the second place the non-returnable facilitates direct marketing and the establishment of individual connections; thirdly, it helps in the establishment of a distinctive trade mark or brand. The returnable basket may be the means of introducing disease into tomato houses as has been the case in gooseberry plantations. The salesman is saved the heavy outlay on returnable baskets, has less need of storage capacity, and is saved the clerical work necessary in checking empties. He should offer inducements to the grower by giving preferential treatment to the non-returnable. Marketing in non-returnables is more expensive to the grower. The usual non-returnable package is the 12 lb. chip basket. Boxes have been used to a limited extent but are not favoured, partly because they savour too much of a foreign package.

Costs.—The costs of running a tomato establishment are considerable, coal and labour being the heaviest items. In 1922 the total returns and costs for a 625 feet range were :—

Gross returns	£527	11	8
Costs	323	4	5
Balance—profit ...	£204	7	3

At that time the average wholesale price of tomatoes was about 9½*d*. per lb. Last year the average price of tomatoes was about 7*d*. per lb. and profits were much less. The average cost of coal during the years 1923-1926 for a 1,000 feet range was £235. If the average price of tomatoes is only 6*d*. per lb. the principal items in the costs represent the following percentage of the gross returns :—

Marketing costs (charges, freight, &c.) ...	12-15	per cent.
Coal	40	,,
Labour	20-25	,,
Total ...	72-80	,,

A grower who is entirely dependent on tomato growing must therefore have a large establishment or be his own workman. There is not much chance of a decent livelihood with less than 1,000 feet of glass, and this represents a capital expenditure of from £1,700 to £1,900. At the present time the tendency is to increase the existing establishments and so reduce the percentage costs. Many of the smaller growers follow some other vocation. The industry is expanding at a very rapid pace, and it is a matter of grave concern to many growers whether the great increase is justified. Outside crops have not paid for several years, and a great number of fruit-growers have increased their area of glass. The passing of the Merchandise Marks Act, if enforced by the authorities concerned, may do much to remove the grievance growers have that foreign tomatoes are mixed with Scottish and sold as Scottish. Recent legislation on behalf of the grower also includes the Commission Sales Act. The future of the industry is inseparably bound up with the question of scientific research. With the increasingly intensive cultivation there is very naturally an increase in troubles due to fungus, bacterial and insect attack, and new diseases and insects are making their presence felt each year. During the past two or three seasons mosaic has become of considerable moment, and marked variations in the symptoms of this disease are met with in the area. The most usual symptom is the decidedly pale colour of the affected plants owing to the lessened production of chlorophyll. In some cases distinct mottling of the leaves is found. Light green or yellowish areas alternate with dark green areas. Leaf malformation has also been noticed, a curling or ruffling of the leaf blades producing an effect somewhat resembling the leaf of a savoy. The "fern leaf" form found in other districts is not common. Odd plants, where the leaf blades have been reduced to about one half of the normal expanse, have been seen. The most serious result is the relative infertility of those plants which have become affected early in the season. A large percentage of the blossoms fall, when the attack is severe, and the crop is considerably reduced. The disease, which is attributed to a "virus," may be spread in a variety of ways. The chief infective agents are the workers and insects. While such operations as pruning, defoliation, tying and picking are in progress the juices may be conveyed from one plant to another, and this is sufficient to cause infection. Amongst the insects white fly (*Aleurodes vaporiorum*) is the chief offender and should be vigorously kept down. The introduction of calcium cyanide (cyanogas) and the simplicity of its use has greatly facilitated the control of this pest. Workers should realise that the juices from one plant may cause infection in another, and work on diseased plants should be left until the healthy plants have been attended to. Thereafter disinfection can take place before starting on a new section.

Among other troubles which the grower has to face the chief are :—

Wilt or sleepy disease (*Verticilium albo-atrum*).

Black stripe (*Bacillus lathyri*).

Mildew or rust (*Cladosporium fulvum*).

Stem rots, various (*Botrylis sp. Rhizoctonia solani* and *Sclerotium sclerotiorum*).

All these have their terror for the grower. Amongst the animal kingdom wireworm, green and white fly, and woodlice (slaters), are all very troublesome. In one instance serious damage was caused by the tomato moth (*Hadena oleracea*).

In the future development of the industry, electricity, for soil treatment and in the form of mercury vapour lamps, may play an important part. The possibilities of "Vitaglass" have also to be explored.

THE INFLUENCE OF SHEEP-GRAZING ON HAY.

W. G. Smith, B.Sc., Ph.D.,

Edinburgh and East of Scotland College of Agriculture.

The requirements of the sheep farm about the lambing season often involve the grazing of most of the available young grass, some of which is expected later to produce hay. This applies alike to stubble grass and to the permanent grass used for pasturage and hay. Often the hay crop is disappointing, especially when the grazing is continued late into spring. In a recent series of experiments involving the application of superphosphates and sulphate of ammonia to old grassland for hay on twenty-four sheep farms, mostly upland, it was found that twenty-two could not top-dress, because of sheep grazing, till between May 20th and June 7th, and one was even later. The year of experiment had a June drought, so that the manures had no great opportunity.

It is common knowledge that a plant needs its green leafage early in the season to build up plant material for the flowering period. This is especially the case with first or second year grass, but is equally true for old grass swards.

The hay crop consists mainly of earing shoots, along with a proportion of the longer leafy shoots that stand up sufficiently to be cut by the mower. With grasses like Cocksfoot, recent results from the Welsh Plant Breeding Station show that a cutting of earing shoots furnishes a heavier hay than a cutting made up mainly of leafy shoots. The latter makes a "soft hay" which many hill farmers consider more nutritious and more palatable to sheep than the harder Ryegrass, Cocksfoot, and other taller grasses. The Welsh results also indicate that for most grasses an increase in the number of times of cutting increases the amount of leaf. For example, Cocksfoot cut three times (hay and two cuts aftermath), was about half stems and half leaf blades, but when ten cuttings were made the proportion of stems was only one-fourth. It is also recorded that when ten to seventeen cuttings are made, the early ones being before the usual hay time, these give a much smaller total yield than where the first cut was made about the usual hay time. A large number of cuttings is the nearest approach we can get to what occurs when continuous grazing goes on, and the result from them is an increase of leafy shoots but a reduction in total crop. There is a scarcity of information as to the effect of grazing alone, hence the following examples from the College Farm at Boghall may be of interest.

The first example—the Lambing Park—was sown down to grass in 1924 with a permanent mixture. On part of it a series of small plots was laid out on the lines indicated by A. R. M'Dougal at Blythe (*Scottish Journal of Agriculture*, vol. VIII, April 1925, p. 136). Each plot was sown with one grass of the field mixture, and each plot was crossed by five strips of clover, viz. Wild White and four varieties of Red Clover which were under test in different parts of the field. The object is to be able to observe any grass by itself and also any individual clover at any season. The plots, about 70 square yards each, were sown with approximately the same number of seeds. These plots, sown in June 1924 with rape, had a rather unfavourable start, but the grasses and clovers were established by December. As with most young grass, there was distinct overgrazing during the winter. Observations in February and March 1925 showed that Perennial Ryegrass was the best cover; Tall Fescue, Cocksfoot and Crested Dogstail had a cover sufficient to give a fair hay crop, while Timothy, Tall Oat, Meadow Fescue, Foxtail and Hard Fescue were thin. During the lambing season the plots were again severely grazed till May 29th, when they were netted in against sheep, but this date, as appeared afterwards, was too late for hay production. The two plots that carried hay in July were Perennial Ryegrass and Crested Dogstail. Tall Oat, Foxtail, Meadow and Tall Fescue carried some ears, while the other three, Cocksfoot, Timothy and Hard Fescue, had very few. In September the nets were removed, but the aversion of sheep to grazing grasses in ear was seen by the number of ungrazed ears of Perennial Ryegrass and Crested Dogstail still on the plots a month later. The clovers also showed the effects of grazing. Wild White Clover, with numerous creeping stems close to the soil, became almost a close mat. Of the Reds, the taller growing Early-flowering or Broad-leaved Red had already almost disappeared a year after sowing; it has not done well in any grass mixture sown at Boghall. English Late-flowering Red withstood grazing better, but in June 1926, two years after sowing, little was left. A strain of Welsh Red proved hardier and a fair proportion still remained in the autumn 1926. Wild Red was more hardy, and its survival was evidently due to its being less grazed by sheep. The strain of seed, like several other wild reds tested, gave a low squat plant, closely branching at soil level, and with leaves more hairy than the usual red clovers. It was noted that these plants were not much grazed and flowering took place freely each summer. The flower-heads are short, 6 or 9 inches high, and remain long untouched by sheep, but are eaten by cattle. These notes indicate that the strains of Wild Red Clover at present on the market are neither suitable for hay nor appreciated by sheep.

The effect of grazing was further examined by making netted enclosures on uncultivated grass pasture in Boghall Glen at 900 feet altitude. The herbage tested was the infall grassland similar in composition to that found on the lower slopes of many upland farms, and often in old enclosed parks where the herbage has been pastured for many years without manuring except from grazing stock.

The first example, enclosure A, was made on a part much grazed over by sheep and carried white clover, which had increased considerably after top-dressing with rock phosphate in the winter 1923-24. The herbage was never allowed to get rough here, and most of it was closely grazed down when the netting was put up, 14th June 1925. That this date was too late for hay was shown by the poor production of grass ears later. The chief plants were a tall-growing white-eared Bent (a form of *Agrostis alba*), Pluff-grass or Yorkshire Fog (*Holcus lanatus*), patches of Crested Dogstail and Sweet Vernal. The closer bottom included Brown-eared Bent (*Agrostis vulgaris*) and Sheep's Fescue, mostly a short-eared, fine-leaved variety of *Festuca ovina*, with a large and taller one (*Festuca rubra*); White Clover was present. There was rapid growth after the netting was put up, but it was low and short, and if mown in the usual way would have yielded a poor crop of hay. This experiment was repeated in 1926, in an enclosure made on May 25th, on another place but with the same kind of herbage. It had been closely grazed, and in places was almost like a lawn. A vigorous growth set in at once, but only a few ears of Crested Dogstail and Sweet Vernal showed in autumn. In September there was a dense sole of leafy shoots, about a foot high, which on analysis showed the following composition :—

Agrostis (mixed varieties)	47 per cent.
Red and Sheep's Fescue	21 ,, ,,
Pluff-grass (*Holcus lanatus*)	17 ,, ,,
Sweet Vernal	7 ,, ,,
Crested Dogstail and other Grasses ...	3 ,, ,,
White Clover and Lotus	2·5 ,, ,,
Galium, &c.	2·5 ,, ,,

Enclosure B was made also on hill grassland, but on a low-productive herbage, consisting mainly of a narrow-leaved brown-eared Bent (*Agrostis vulgaris*) and fine-leaved Sheep's Fescue, with White Clover sparse or absent. The herbage is small-leaved and most of the ears are less than a foot high. This rather poor herbage is often associated with Whin (Gorse) on a dry type of soil. One object of netting this was to see how it was grazed by sheep, as there was some doubt whether it was much utilised. The contrast between the enclosed and the open parts showed that this poor-looking grass was considerably grazed though never eaten close down, and it was seen that the

short fine ears of the variety of Sheep's Fescue present were grazed off soon after being formed, whereas the dark wiry ears of Brown Bent were left till autumn. The results regarding earing shoots were interesting, because two methods of winter treatment produced quite different effects. The enclosure was netted on 7th April 1925 on grass which had been open pasture for many years, and grazed over daily up till time of enclosure. New growth was observed within a couple of weeks, and the yield of ears in July was quite as abundant as on unenclosed parts. The plot remained enclosed all winter, rough and carrying all the crop of the preceding summer. About the same date, April 6th, 1926, as the previous year part of the rough growth was cleared, not by grazing but by clipping with shears, thus removing a close mat of dry grass ears, &c., and leaving the bottom much bleached. The result was seen in July, very few ears and a close growth of short fine leafy shoots. The unclipped rough grass carried fewer ears than normal. The effect of the heavy mat of ungrazed herbage was to encourage some stronger shoots to emerge above the matted grass, while such shoots as grew later from the bottom were not earing, except a few late-developed ears of Sweet Vernal. Thus the 1926 treatment was very adverse to hay production, whereas in 1925 the ordinary picking and heading by sheep on open pasture did not affect the hay crop when enclosure was made in early April.

How ear production is affected has also been observed on Moor Mat-grass (*Nardus*). The roughness of this grass is often removed by burning, and a large area of this burned on 13th March, 1924, produced a crop of ears not very different from adjacent unburned parts. When burned later, 13th April, 1926, there was a great reduction in the number of earing grasses. Parts of this *Nardus* herbage included considerable proportions of Wavy Hairgrass (*Aira flexuosa*), Agrostis varieties and some Yorkshire Fog (*Holcus lanatus*), all of which failed to ear with the later date of burning.

The conclusions from these observations differ somewhat as between sown-grass mixtures and old " natural " grass. In recently sown-grass mixtures, intensive grazing carried on till late April or May reduces the earing of all grasses except Perennial Ryegrass and Crested Dogstail, leaving these to produce the bulk of the hay crop. There will be some proportion of non-earing long shoots of other grasses, which in a favourable moist season might yield well, especially if a top-dressing including nitrogen were applied. It also follows that late-continued grazing in the weeks when a normal grass plant is building up material for earing and seeding is injurious to the plant. Timothy is a grass that under favourable conditions tillers well, but where unfavourable it will be found that most plants either have no tillers or only one or two. If such weak plants are grazed late, and lambs are fond of it, then the main shoot is eaten out and the plant either dies or remains a weakling. Tall Oat-grass is similar on poor soils. Meadow and Tall Fescue, unless well established, are also weak in tillering. Thus a complex and expensive mixture can quickly become reduced to Perennial Ryegrass, Crested Dogstail, Cocksfoot, and Rough and Smooth Meadow-grasses (*Poa*), if these were sown. So also with clovers; Red and Alsike with their crowns near the surface of the soil are easier to graze or tread down than Wild White with its low growth and numerous runners. Our experience with Kidney Vetch and Burnet has been that in the first year the sheep nibble the plants so closely that there is scarcely an entire leaf to be seen and the plants die away. Chicory is more resistant and is still abundant in the Lambing Park (see above) sown in 1924.

Everything thus indicates that grass intended for hay should be left ungrazed from about March. If the requirements for lambing grass are such that this cannot be done, then the acreage of improved grass ought to be increased. This is an improvement required on many upland sheep farms, and by it the amount of home-grown hay, as distinct from carted-in hay, could be considerably increased.

Old grass differs from new grass in several ways. Old upland grasslands consist of a few hardy grasses, not easily suppressed, hence bad treatment does not alter their composition so much as their quality. If the stocking is heavy, as in lambing parks, late-continued and heavy grazing will reduce the hay crop as described above. On the open hill the risk of overgrazing is less, as shown by enclosure B, 1925.

There is, however, another source of damage to future hay, and that is "roughness." It is important that all roughness from the previous summer should be grazed down. These old grasslands produce their main crop of earing shoots, or hay, fairly late, about July. This rough growth forms the available grazing for the next winter and on till March or even April, according to weather. On sheep farms a considerable extent of rough grass is considered desirable as a winter reserve. It is possible, however, to overdo roughness, because in May there is often to be seen a large amount of rough herbage with little indication of grazing, and the long dry shoots will never be grazed because by then the sheep are working amongst the finer green shoots on less rough places. The description of enclosure B, 1926, given above, illustrates how this old roughness ruins the bottom sole and reduces the yield of earing shoots. If the ears of the previous summer had been even partly cleared off, the new growth would be cleaner. Cattle are more effective than sheep for this purpose, and should be summered while the grass ears are still fresh. Thus the winter pasturage would be improved for sheep. Some upland sheep farmers save "hill-hay," cut on suitable places of the hill pasturage. This practice helps to improve the winter herbage, since it clears away the surplus roughness and leaves the bottom open for later growth of leafy shoots good for winter grazing.

Summary.—(1) Grazing continued late into the lambing season, as practised on many hill farms, reduces the earing power of grasses and the hay crop, if the same fields are used for hay.

(2) The first example described here deals with over-grazed plots of young grasses, enclosed at the end of May. Formation of ears was reduced or prevented in all grasses except Perennial Ryegrass and Crested Dogstail. Wild White Clover survives over-grazing, but Red Clovers, with the exception of some strains of Wild Red, are damaged.

(3) Enclosure of close-grazed herbage on a hill pasture, late in May or June, almost completely prevented ear formation.

(4) Enclosure of hill pasture grasses in April, after ordinary grazing of hill sheep, had no influence on earing.

(5) Roughness of grass insufficiently grazed since the previous summer considerably damages the pasturage and the crop of ears next season. The effects of this roughness are discussed.

(6) Increase of improved grass on upland farms is recommended.

DAIRY BYELAWS.

ARCHIBALD STALKER,
Scottish Board of Health.

I. INTRODUCTION.

The Model Byelaws.—For nearly two years the Boards of Health and Agriculture have been actively concerned with dairy byelaws; beginning with the preparation of a model set, and after 1st September 1925 engaged in consideration of the actual byelaws put forward for confirmation by district committees and town councils in Scotland. Their experience has been so interesting that a summary of some of the principal points may be worth giving.

The model byelaws, which may be obtained from H.M. Stationery Office, 120 George Street, Edinburgh (price 2*d*.), were prepared by the two Boards in consultation. Thereafter they were submitted to the various associations of farmers and to several bodies representing local authorities and administrative officials. A considerable measure of agreement was reached before the model byelaws were issued, and this fact no doubt rendered the adoption of byelaws in each area a matter of less difficulty than it would otherwise have been. At the same time there are differences in the byelaws as adopted in different parts of the country, and dairymen should make themselves familiar with the requirements that apply to their own district. Any dairyman is entitled to apply to the district clerk or the town clerk, as the case may be, who will supply him with a free copy of the byelaws adopted by the district committee or town council.

It is understood, however, that many local authorities have already issued copies of their byelaws to each dairyman in their area.

The power to make Byelaws.—Every district committee and town council in Scotland is required by Section 8 of the Milk and Dairies (Scotland) Act, 1914, to make byelaws for their area providing—

(*a*) for the inspection of cattle in dairies;

(*b*) for regulating the structure, water supply, &c. of dairies;

(*c*) for the prevention of impurities in milk, and for securing cleanliness generally;

(*d*) for prescribing precautions to be taken by dairymen against infection or contamination.

The same section provides that there may be differentiation between existing and new dairies, and this power of differentiation has been encouraged by the two Boards and freely used by local authorities.

The byelaws are to be formally adopted by the local authority; public advertisement is to be given of the fact, and any person may lodge objections with the Board of Health. In all cases the concurrence of the Board of Agriculture for Scotland is required to the confirmation of byelaws.

The Act of 1914 came into operation only on 1st September, 1925, as the war broke out soon after it was passed, and it was considered advisable to postpone its operation for some time.

The old Dairy Regulations.—Local authorities in Scotland already had dairy regulations, framed under the Dairies, Cowsheds and Milkshops Orders (now repealed), but these regulations had a limited scope and were not applicable to some dairies, such as cheese-making farms. These old regulations commonly required 600 cubic feet of space per cow in existing byres and in new byres as much as 800 feet. No doubt some local authorities, particularly in burghs, enforced provisions such as these, but it is clear that in many areas such dimensions were not always insisted on. In other respects the old regulations were somewhat out of date. It was, for instance, very doubtful whether there was power to regulate the dungstead, even though it stood near the milkhouse door, and for this and other reasons a new system of dairy byelaws was called for. Further, a code that is not being enforced, and probably cannot be fully enforced, is unsatisfactory, and accordingly it was the settled policy of the two Boards to encourage the adoption of byelaws that were reasonable and could be applied in every detail, to take account of existing conditions, but also to sustain existing high standards where these standards had been properly made, and to take account of the interests and necessities of the dairying industry.

Byelaws regarding Methods.—There is evidence that under the old dairy regulations more attention was paid to the enforcement of the provisions relating to structure than to the regulations that dealt with methods of production and handling and with the prevention of contamination. It can scarcely be too strongly emphasised that the new byelaws, which require the washing of hands, the immediate removal of milk from the byre, the prevention of dust, and the maintenance of ventilation, are at least as necessary as any structural byelaws. These provisions can be enforced with little expense, and in some cases without additional expense, and the officers who are engaged in the administration of the byelaws should make it their business to see that they are enforced. The byelaws now adopted and being adopted throughout the country are meant to be applied, and there is nothing to prevent either a producer or a retail dairyman from complying with them.

It is worth emphasising that for the production of clean milk it is just those byelaws which can be easily applied and enforced that are likely to give the best results. No matter how good the buildings may be, the milk will be unclean if the methods are careless, while clean milk can with care be produced from buildings that fall far short of perfection. This point, of course, does not exhaust the subject. For the prevention of disease, for general cleanliness, and even for the health of the herd, good and well-designed buildings are better than old and ill-designed buildings.

The Byelaw System.—Dairy byelaws adopted by each administrative area are peculiar to Scotland (in so far as Britain is concerned), and it is useful to consider what there is to be said for the system. In England the Milk and Dairies Order contains many provisions which are dealt with in Scotland by means of local byelaws. In Scotland, however, the circumstances of one area differ so much from those of another that it is scarcely possible to provide a suitable code for the country as a whole. The byelaw system enables one agricultural area to ask for a rather higher minimum standard of structure than another area might be able to afford. It enables the local authority to take account of climate, convenient building material, the size of the cows, the established practice of the area, and the established nature of buildings. It gives the local authority a profound interest in the administration, since they themselves have considered beforehand what is necessary and advisable for their own area. Further, the system enables agriculturists to object to the adoption of particular byelaws or of particular requirements.

Another feature of the byelaw system has for forty years been peculiar to the old dairy regulations, and may in some respects and for a little time apply to the dairy byelaws. It is probably the case that among the many other matters regulated by byelaw—slaughterhouses, pigstyes, common lodging houses, removal of refuse and so forth— the byelaws as a whole are put into full operation immediately after they are adopted, and both premises and persons must conform fully to them. On the other hand, the operation of dairy regulations and dairy byelaws must, in the nature of things, be by way of securing gradual improvements, particularly in regard to structures. The Board of Health recognised this peculiarity of the dairy byelaw system, and in their circular of 16th September 1925 recommended local authorities to press for alterations as opportunity arose, and by methods of persuasion and encouragement where possible.

The alternative to the Byelaw System.—Here and there the byelaw system has been criticised on the ground that the two principal objects aimed at, viz. healthy cows and clean milk, may be attained without insisting on specific requirements, which cannot be altogether comprehensive and which may involve alterations of a structural kind. It is necessary, however, to consider what would be the alternative to the system of local administration by means of byelaw, &c. There would require to be a standard of cleanliness in milk, and all milk which did not reach this standard would have to be rejected. Instead of the present infrequent inspection, all milk would require to be examined every day either by the firms receiving it or by local authorities. If distribution were entirely in the hands of large firms who could test all their milk daily, it might be possible to deal with the matter on these lines, though the inducement to retain doubtful milk would still be strong. Looking, however, to the amount of local distribution in the hands of individual producers and small dealers, such a system is not feasible. Accordingly the control of the purity of milk through local regulation of buildings, cleanliness and prevention of infection is at the present time probably the best and least expensive method of control.

Relaxation of the Structural Byelaws.—An important concession to the dairying industry may be mentioned. Nearly every structural byelaw in the model set and in the byelaws as adopted here and there reserves power to the local authority to consider the circumstances of each individual case. For instance, the covering of the walls of byres to a certain height may be dispensed with if the local authority are satisfied that the walls themselves are so built that they do not require a smooth covering. Certain points in connection with drainage, &c. are left to the approval of the local authority. The width of passages and grips may be modified at their desire. Other points of this kind are noted in fuller detail below. Enough has been said, however, to indicate that the byelaws have in view consideration for the dairying industry, and particular consideration for those who may be producing clean milk in premises that may be structurally below the average good standard of Scotland. For on the whole the standard of structures in Scotland is high.

II. The Byelaws as Adopted.

Progress with adoption of Byelaws.—By the beginning of June byelaws had been submitted for confirmation by 88 out of the 106 district committees, and by 117 out of the 201 burghs. In every case the byelaws have been considered both by the Board of Health and the Board of Agriculture. The two Boards have worked together in harmony, and on the whole there has been very little objection by dairymen to the byelaws of individual local authorities. Formal objections were lodged in regard to nine sets of byelaws only.

There are eighteen byelaws which deal generally with structure, and twenty-two which deal with the prevention of impurities in milk, general cleanliness, and precautions against infection and contamination. The byelaws in regard to cleanliness, &c. have been adopted everywhere with little alteration on the model, and divergences from the model form are chiefly to be found in the structural byelaws. Details are given in the following paragraphs.

Floors.—The local authority may approve as flooring whatever material they consider suitable, though concrete, asphalt and granolithic are mentioned in model byelaw 5. In the county of Caithness flagstones were appropriately proposed as a permissible addition, and in some other northern districts causeway grouted with cement to form a smooth surface was adopted.

Grips.—Model byelaw 6 dealing with grips gave a great deal of trouble. In some cases, apparently where the ground outside the byre was more or less exposed rock, the local authority pressed for an open channel rather than a properly trapped drain outside the byre. The amount of slope in the length and in the breadth of the grip also gave rise to contention. Farmers appear to like as little slope as possible, owing to the possibility that cows may slip as they walk to or from the stall. Considerations of this kind were kept in view when dealing with the byelaws.

In the case of new byres it was generally arranged that the slope in the grips should be towards the passage and that the depth at the stall side should be materially greater than the depth at the passage, so that the level of the stall should be raised above the level of the walk.

Lofts.—There appears to be, on the part of administrative officers, a general objection to lofts over byres, partly because of the difficulty of obtaining sufficient ventilation in the byre; partly because of the defective nature of the floor in most lofts, encouraging dust and cobwebs; and in some cases because such lofts are used as henhouses and become foul-smelling and filthy. Model byelaw 7 prohibits lofts over new byres and this form has been adopted everywhere. There remain two classes of premises, viz. byres reconstructed from existing buildings and existing byres. Provision has been made at the discretion of the local authority for the retention of lofts where they exist in such cases, but in such cases the floor of the loft is to be so constructed that dust from above is not to pass into the byre. In some cases a clear space is to be provided, above the heads of the cows, communicating with ventilators in the roof, and in other cases communication between an existing byre and loft is permitted by means of an enclosed stair and door.

Trevisses.—In many byres the trevisses are of wood, but it is proposed that in new byres they shall be of cement, concrete or iron tubing. In existing byres trevisses and troughs are to be kept in proper condition and repair.

Lighting.—Model byelaw 9, which deals with lighting, gave rise to extraordinary variations. The byelaw specifies a light-giving area for new and also for existing byres. The well-known pamphlet of the Ministry of Agriculture on "The Construction of Cowhouses" specifies 3 square feet of lighting per cow, but it was doubtful how far the byres of Scotland met a requirement such as this. At an early date the districts of Dumfriesshire put forward byelaws providing for 1¾ square feet of lighting per cow in existing byres and 2 square feet in new byres. The two Boards considered that these figures were sufficient and appropriate. To have insisted on higher figures for existing byres in landward areas would probably have meant extensive reconstruction of windows, while to permit less would probably be a retrograde step. Accordingly these figures have been taken as standard figures for landward areas and have been generally adopted. In burghs, where a rather higher standard of structure has always been maintained, the figures agreed on were 2 square feet for existing byres and 3 square feet for new byres.

In some districts, and even in some burghs, however, great difficulty was experienced in securing adoption of 1¾ square feet per cow in existing byres, and some byelaws have been passed with the specification of 1¾ square feet, subject to the following proviso :—

> "In the case of existing byres, where the local authority are satisfied that the lighting is sufficient for the processes carried on, they may modify the dimension laid down, but in no case shall less than 1 square foot of window space per cow be required."

This proviso reserves power to the local authority to insist on more than 1 square foot where the situation of the windows or any general tendency towards darkness renders the lighting, in their opinion, insufficient.

In striking contrast to the provision of 1 square foot per cow was the request made by Kirkcaldy district of Fife for the figure of 3 square feet per cow in existing byres. It was known that a creditable effort had been made over a long period of years in Kirkcaldy district to raise the standard of dairying, and the two Boards were not prepared of their own accord to diminish this figure. Objections were, however, lodged against this provision, and though it was stated that some byres would require a measure of reconstruction to comply with the byelaw, the local authority considered that the number of byres affected was not so great as to warrant a smaller figure. In view of the objections received and of the figures adopted elsewhere, the Boards felt that they ought to exercise their power of disallowing 3 square feet per cow, and the figure of 2 square feet for existing byres was inserted in the byelaws.

In the case of one small burgh, a window space of 4 square feet per cow for new byres was confirmed.

An undesirable provision that " all new light shall be placed below the ties if possible " was inserted in some byelaws. This might have prevented the adoption of a ridge ventilating system which incidentally provided more light, and the provision was deleted.

Ventilation.—Model byelaw 10, which deals with ventilation, was generally adopted without much alteration. This byelaw, almost more than any other, is a test of good or indifferent dairy practice. It is to be hoped that in future a hot, steamy atmosphere in a byre will not be tolerated.

Cubic and Floor Space, Width of Passage and Grip, &c.—Model byelaw 11, which deals with these matters, provided the largest number and the greatest degree of variation. It was fairly well known to the Departments that the high figures laid down in the old dairy regulations had not been enforced in every case, and that the old standards of 600 cubic feet for existing and 800 cubic feet for new byres would require to be reconsidered. Accordingly, when the districts of Dumfriesshire put forward the minimum figures of 350 cubic feet per cow in existing byres and 500 cubic feet per cow in new byres, it was recognised that in the light of modern knowledge as well as in the light of current conditions these figures were not unsuitable. A large cubic space usually entails a large floor space, and where there is too much length and breadth of stall the result is not more but less sanitary. Plenty of space in the passage and grips is all to the good, but it was clearly inadvisable to prescribe for existing buildings a standard of width and space to which a large number of substantial buildings could not conform.

The minimum floor space agreed to in the case of Dumfries was 30 square feet per cow in existing and 35 square feet in new byres.

A sustained attempt was made to maintain all these minimum figures, and in many cases larger figures were approved. The only districts in which it was found advisable to make some relaxation were the three wards of Lanarkshire. A deputation from the local branch of the National Farmers' Union was received by the Boards of Health and Agriculture to discuss the byelaws; members of the local authorities concerned attended, and a large number of suggestions were considered. Some of these were agreed to by the local authorities at the suggestion of the Boards, but perhaps the most serious point that emerged was that there were a considerable number of byres in use (most of them probably supplementary byres and not the principal byres in any steading) which had less than 350 cubic feet per cow, and even in some cases less than 30 square feet per cow. Concessions on these points were asked for by the National Farmers' Union. It was eventually arranged that in regard to cubic space the following proviso should be suggested to the local authorities :—

> "In exceptional circumstances, and if they are satisfied that sustained measures are being undertaken to ensure the production of clean milk, the local authority may, if they think fit, and to such an extent as shall appear to them proper, modify the requirements of the first paragraph of this byelaw in regard to air space of existing byres, but in no case shall any byre contain less air space than 300 cubic feet per cow."

In regard to floor space, it was decided not to recommend the local authorities to reduce the figure of 30 square feet per cow.

Model byelaw 11 specifies also the minimum width of passage and grips. The figures which have been used as a suitable basis are :—

Minimum width of passage and two grips in an existing double-headed byre ... ... 7 feet.
Minimum width of passage and two grips in a new double-headed byre ... ... 8 feet.
Minimum width of passage and grip in an existing single-headed byre ... ... 5 feet.
Minimum width of passage and grip in a new single headed byre ... ... 6 feet.

These or any other widths are specified, "except with the express permission of the local authority," because in an existing byre there is little possibility of increasing them, and the byre may be in other respects suitable. The height of walls is usually specified as 8 feet, or 7 feet in existing and 8 in new byres, and in no case is any height over 16 feet to be reckoned in the calculation of cubic space.

Byelaws regarding Methods, &c.—Any useful commentary on the byelaws regarding methods would require a paper to itself. Here it may be sufficient to remark that the byelaws requiring the provision of wash-basins, soap and towels, the thorough washing of hands of milkers, the provision of overalls, the cleansing of udders and teats of every cow before milking, &c., have been almost universally adopted, and it is to be hoped that every effort will be made to enforce them.

Exemption from the Byelaws.—The Act provides for the exemption from registration of those who sell milk to neighbours or persons in their employment only, but confers no exemption on those who sell small quantities of butter and cheese and perhaps sell no milk at all. Shortly after the Act came into operation it became clear that the number of such persons was very great. Shepherds and cottars in outlying districts who have no market for surplus milk, and who keep a cow or two in order to supply themselves and perhaps one or two other workers or their employers with milk, usually make some butter during the flush of milk and dispose of it to the grocer. Many farmers whose principal business is the rearing of stock have some butter for sale during a brief season.

In the case of such dairymen some relaxation of the structural byelaws was called for, and in a circular letter of the Board of Health, dated 9th February 1926, local authorities of districts were recommended to adopt the following form of byelaw :—

> "If a dairyman does not sell milk, or sells milk only in small quantities and for their own consumption to persons in his employment or to neighbours, and he is registered as a dairyman solely by reason of making butter and selling it in small quantities during part of each year, the local authority may, if they think fit, and to such extent as shall appear to them proper, modify the provisions of all or any of the foregoing byelaws, numbered 4 to 17, both inclusive, as regards the premises occupied by such dairyman for the making and keeping of the butter so sold by him."

Many sets of byelaws were submitted without this provision, but the two Boards have succeeded in inducing landward local authorities in nearly every case to adopt it.

Policy of the two Boards.—While byelaws have been scrutinised carefully in order to ensure that proper standards are adopted, the two Boards have omitted no opportunity of calling attention to requirements which in their opinion were excessive. As already recorded, the dairying interests were consulted before the model byelaws were issued, and those interests have been kept in view to a reasonable extent during the consideration of every set of byelaws.

A great deal of information in regard to the administration of the Milk and Dairies Act is contained in the Eighth Annual Report of the Scottish Board of Health, recently published by H.M. Stationery Office, and obtainable at 120 George Street, Edinburgh, or through any bookseller.

SUGAR BEET IN THE NORTH OF SCOTLAND.

W. J. Grant, M.A., B.Sc. (Agr.),

County Organiser for Moray and Nairn.

Although the beet crop has come into prominence only in the last few years, its appearance in Morayshire goes back to pre-war days. Trials of sugar beet were conducted under the supervision of Mr. Alex. Pardy, County Organiser, in 1910, 1911 and 1912. The statistics relating to the first trials are those of sugar content which at four centres were as follows :—

East Pittendreich	15·96 per cent.
Allarburn	15·99 ,,
Kinloss Home Farm...	13·78 ,,
Do.	15·24 ,,

Returns of the 1912 trials were :—

Seed.	Yield per acre.	Sugar Content.	Remarks.
	Tons cwts.	Per cent.	
Sutton's Seed	8 9	11·6	2 per cent. bolted.
Danish Seed	7 16½	14·2	Under 1 per cent. bolted.
Seed saved locally in previous year ...	6 11	11·93	Great many bolted.

In all cases the crops were grown on the ordinary turnip drills, and received no additional treatment to that of the turnip crop either by way of manuring or cultivation. These trials gave evidence that the soil and climate of Moray were suitable for the growing of sugar beet.

Since 1924, when the crop came under the Britsh Sugar (Subsidy) Act, the area under beet has increased beyond the size of experimental plots. The conclusions of the early trials have been verified, and the annual increase on the acreage under beet proves that the crop has been financially successful. In 1926 the acreage in Aberdeenshire was 180, in Moray 114, in Ross 69, while small areas were grown in the counties of Kincardine, Banff, Nairn, Inverness and Caithness.

From observations made when visiting beet growers in Moray in 1926, and from particulars obtained from a questionnaire sent to all growers in the county, the writer has been able to collect facts relating to 94 acres of beet, comprising 24 farms. The measurements in some cases have been verified, but in the majority the farmer's measurement has been taken; the figures relating to yield, tare and sugar content have been taken from the advice notes sent from the factory to the growers. Information has also been received from experimental work carried out by the County Organisers in several of the counties in the North of Scotland College area.

Soil.—The soil most suitable for the beet crop is a free working loam, well drained and deep. Satisfactory results have also been got on lighter soils where the depth is sufficient. This in all cases is a limiting factor. The presence of a hard subsoil or pan at a shallow depth hinders the development of the taproot and the plant is forced to send out other roots in search of food. This gives rise to "forked" roots, which retain much earth and from which the full complement of sugar cannot be extracted at the factory. The underlying pan must be broken up by subsoiling, otherwise beet growing cannot be successful. Subsoiling was done only in one case where the subsoil was heavy and sticky, but not in the form of a pan. The result was satisfactory in that the roots were well shaped. This operation is a benefit to the succeeding crops also, as it brings a large body of soil into activity.

One or two cases in Moray were noted where the soil was a good loam of sufficient depth, but where the beet was comparatively poor. The only explanation was sourness of the soil indicated by an adjoining rig of the turnip crop being badly infected with "finger-and-toe" disease. Similar observations were made in parts of Aberdeenshire where the beet crop was unsuccessful. Beet is very sensitive to sour conditions, and where such exist an application of lime is essential for a successful crop.

A crop grown on peaty soil at Dyke, Forres, gave many forked roots and was also low in sugar content. In this case the presence of too much organic matter interrupted the downward growth, and the natural sourness of the land was also detrimental to the normal growth of the plants. In another case the land was rather stony, and gave a crop of badly shaped roots with a high percentage of tare and a low sugar content. These are the only two types of soil—peaty and stony—which gave unsatisfactory results in the shape of deformed roots. On all the other soils a high proportion of well developed roots was obtained.

Place in Rotation and Cultivations.—Sugar beet is essentially a cleaning crop. In most cases it was grown on the turnip shift after lea oats, and the cultivations were in general similar to those for the root crops. In some cases it followed a root crop, and labour costs were consequently greatly reduced. A case was noted where part followed yaval oats and part potatoes. The latter portion was distinctly better—no doubt due to the better seedbed obtained after potatoes. The land was also much cleaner and there was no check to the crop from the growth of weeds.

Depth and cleanliness are the object of the grower. The plough is the most important implement, and a 10-inch furrow should be turned as early after harvest as possible. Dung must be applied at this time. Subsequent cultivations were deep grubbing, harrowing and removal of weeds. Cross ploughing in spring was done in many cases, but it is not usually necessary nor is it advisable, because it turns down the soil which has been exposed to the weather and brings up raw soil for a seedbed. Tillage by grubber or cultivator is better, as this tends to draw up weeds but does not materially disturb the situation of the soil. Where the land was cloddy or light, rolling was done to break it down in the one case and compact it in the other, in both cases to improve the seed bed.

Seeding.—In all cases in Moray, and in most cases in Aberdeenshire, the crop was sown on shallow drills 21 to 26 inches wide. In 1925 a few growers attempted the continental method of sowing on the flat in rows 18 inches apart. Sowing was done with a corn drill, every third coulter being open and all the others closed, but it was difficult to keep the rows straight, and the space was too narrow for the ordinary farm implements. The crop was less profitable on account of high labour costs for hand cultivation. Where land is cheap and labour dear, the method recommended is to sow in drills not less than 22 inches. The number of plants grown per acre will be less, but the balance of profit is in favour of the drill. It facilitates singling and all the following operations. Sowing can be done by many of the turnip sowers available on the market. Seeding was done from the beginning to the end of May, but no actual records of yields from the different times were kept on any one farm.

In connection with the Rural Science Courses taught in a number of schools in the county of Moray, small plots of beet were sown in 1926 at weekly intervals from the last week in April till the first week in June, and the average of ten trials was as follows:—

	Per acre.
Last week in April	13 tons 4 cwts.
1st ,, May	12 ,, 9 ,,
2nd ,, ,, ...	13 ,, 7 ,,
3rd ,, ,, ...	11 ,, 9 ,,
4th ,, ,, ...	9 ,, 19 ,,
1st ,, June	8 ,, 4 ,,

In view of these results, seeding fairly early in the month of May, provided the soil is in condition, would appear to be most profitable. The amount of seed varied from 8 to 20 lbs. per acre. While the former might be rather low in a year of bad germination, the latter is too high even in bad conditions. The plants were so thick that competition between them set in early and selection at singling time—especially where the operation was delayed—was difficult. With 24 inch drills, 14 lbs. seed per acre is ample, but with 18 inch rows a larger seeding is required.

Rolling was done in a few cases after seeding with good results. The beet seed is rough and the soil does not readily come into close contact with it; as a consequence moisture is not brought to the seed and germination is slow. This is specially true of the lighter classes of soil. Rolling ensures that the soil is in contact with the seed at all points.

Singling.—Singling is an important operation. A run of the drill harrow should precede singling to destroy the early weeds. As soon as the plants have four leaves they are ready for thinning and delay tends to reduce the yield. New growers were apt to judge beet by turnips and wait till the plants were "strong." Careful selection of plants is essential, and a little extra time to ensure this is well repaid. Double plants reduce the crop to a great extent, and even after a blank it is not advisable to leave two beets close to each other as is usually done with turnips. The distance between plants varied from 5½ inches to 8½ inches. The former was too close and gave only small sized roots. About 7½ inches is reckoned a suitable distance.

Summer Cultivations.—Early weeds did most damage, and where cleaning operations were not proceeded with timeously the crop did not successfully recover from the check in the early stages. Second hoeing is no less important than singling. Frequent runs of the drill harrow must be given soon after thinning and until such time as the horse or implement tends to damage the leaves.

A few growers earthed up the crop lightly to cover the crowns and prevent greening, which causes a reduction in sugar content and a consequent loss to grower and manufacturer. Only a light earthing up is necessary; in fact a heavy furrow tends to make the ridges too narrow and to expose the rootlets of the plant to the air to the detriment of the crop.

Manuring.—Dung was generally applied on the surface in autumn and ploughed in, a moderate dressing—about 12 tons per acre—being given. In cases where the beet followed a dunged crop no further application was made. The mixtures of artificials used were widely different, and this no doubt was a factor which influenced the yield. Beet removes considerable plant food from the soil and heavy and complete dressings of artificials are necessary. The majority of growers gave an additional dressing of nitrogen as nitrate of soda at the rate of 1 cwt. per acre after singling.

Experiments on manuring of sugar beet were conducted by the County Organisers at Mains of Esslemont and Milton of Murtle in Aberdeenshire and at East Grange and Surradale in Morayshire, with the following results, which are stated as an

Plot.	Dressing per acre.	Yield per acre. Unwashed. Tons cwts.		Washed.* Tons cwts.		Gross Value of Crop.† £	s.	d.	Cost of Manures. £	s.	d.	Net Value of Crop. £	s.	d.
1.	1 cwt. s./ammonia 3 „ supers. 2 „ mur. of pot. 1 „ nit. soda ...	11	16	10	6·5	27	14	11	2	18	4	24	16	7
2.	Same as plot 1, but 2 cwts. nit. of soda	12	8	10	17	29	3	2	3	13	4	25	9	10
3.	Same as plot 2, but 1 cwt. mur. of potash ...	12	6	10	15	28	18	4	3	3	9	25	14	7
4.	Same as plot 2, but 4 cwts. superphosphate	12	0	10	10	28	4	4	3	16	10	24	7	6

* Tare allowance of 12½ per cent. † Sugar content taken as 17 per cent.

The nitrate of soda in plot 1 was applied after singling, and in plots 2, 3 and 4, 1 cwt. per acre was given before singling and 1 cwt. after singling. The actual yields of washed beet were not obtainable, but an allowance of 12½ per cent. has been made for tare and deducted from the weighed unwashed roots. The sugar content varied not only in the different plots but in each plot, and there was no conclusive evidence to show that the manure had any special value in raising or lowering the sugar. On that account the content has been taken as 17 per cent. for all plots, this figure being the average for Moray. It will be seen that plot 3 has given the highest net value of crop.

Varieties.—Variety trials were carried out over three years and show a preference for Kuhn and Dieppe, as indicated in the following table :—

County District.	English Seed.		Danish Seed.		Vilmorin.		Kuhn.		Dieppe.	
	Tons	cwts.	Tons	cwts.	Tons	cwts.	Tons	cwts.	Tons	cwts.
1923.										
Kincardine	...		...		...		10	2	14	4
West Aberdeen ...	...		...		...		10	7	10	4
1924.										
Kincardine	6	3	10	8	8	8	8	4	8	16
East Aberdeen... ...	4	9	4	14	5	12	6	18	7	12
Moray	8	3	13	2	12	2	13	14	12	2
1925.										
Kincardine	...		...		...		10	0	10	10
Average ...	6	5	9	8	8	14	9	17	10	11

Bolting and Sugar Content.—All crops contained a varying number of plants which ran to seed. The cause could not be definitely stated, as several factors often combine to produce it. Tests were made with different varieties and bolters counted, with the following results :—

County District.	English.	Danish.	Vilmorin.	Kuhn.	Dieppe.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Kincardine	45	15	6	9	12
East Aberdeen... ...	40	10	10	10	10
Morayshire	25	2	1·9	1·3	4
Average ...	36·6	9·0	6·0	6·7	8·6

Two varieties were grown in Moray in 1926—a German seed called Klein Wanzleben, of which there were about 12 acres, and a Dutch seed called Kuhn, which constituted the remainder of the acreage. Only in two cases were both varieties grown side by side, but these gave a marked result in favour of Kuhn as producing fewer bolters. Kuhn itself varied on different farms, even where conditions seemed similar and times of seeding the same.

The time of seeding is also reckoned as a factor which affects bolting, but in the trials carried out in school gardens, already referred to, as well as on the farms there was no difference in this respect between the first and last sowings. This may have been due to the fact that the weather was very suitable for germination after each seeding and the plants got no check after brairding.

All bolters were taken out and fed to stock, as the inclusion of these in a consignment usually gives rise to a low sugar content and a reduced price. Recent investigations have shown that if bolting takes place early in the season the sugar content is greatly reduced, but if late in the season the reduction is so slight as not to warrant the labour of pulling them out. Early bolters become much reduced in size and the root is hard and woody.

Sugar content varied almost with each consignment, which was not easily understood by the average farmer. Where samples were taken from experimental plots, and all roots were analysed individually, the sugar content was different in almost every root. The same thing will inevitably occur in the analysis of crop samples, which comprise 10 beets from each waggon. On taking the average percentage of sugar for the different farms, it indicates generally that the lighter soils give a higher sugar content than the heavy soils. The crop grown on peat gave the lowest sugar yield of all. Manuring did not have any definite effect on the rise or fall in sugar, and consequently it seems wise to advise growers not to attempt increasing sugar by manuring, but to increase the tonnage per acre. The highest analysis for a single waggon from Moray was 19·3 per cent. of sugar, while the greatest variation on any one farm was from 15·0 per cent. to 19·1 per cent.

Lifting. — Considerable labour was required for the harvesting and despatch of the crop. Several types of lifters were used and a number of adaptations—Ransome's plough, Ransome's attachment; The Walking Beet Puller (International Harvester Company), the frame of a drill plough with feathered sock instead of drill sock, a swing plough with mould board and coulter removed and running the land side close up to the beets. The task of pulling the beet after the lifter was easy. The lifter itself has a heavy draught, and for steady work three horses are required. There was a marked variation in the time taken to pull and top an acre. In a few cases where a fairly large acreage was grown the farmers were able to get casual labour to lift by contract. On the average one man was able to pull, shake and top an acre per week, and the price per acre was £1, 15*s*. to £2. Where casual labour can be got it is undoubtedly more economical to employ this, as the horse work on the farm is not thereby interrupted.

Two methods of lifting were seen. In one case the beets of four drills were put into two rows, tail towards each other. This necessitated filling the carts by hand. In the other the beets were thrown into small heaps after being shaken, tails all one way, and when heading, the roots formed one heap and the tops another. This has the double advantage of enabling the beet to be loaded with a fork and of having the tops handy for covering if necessary, or for carting on to the lea or to the steading for stock.

The operation of topping has to be done with some care. All the shaw must be removed along with the crown down to the base of the lowest leaf. The beet does not bleed. Bad topping is harmful in two ways. When an analysis for sugar is being made, the inclusion in the sample of a beet with part of the shaw left on causes a reduction in the percentage. Also when weighing is being done to reckon the tare, any badly topped beets are re-topped and the crown is included with the tare. In quite a number of cases where tare was shown under headings of earth, stones, tops, the tops were responsible for a large proportion of the weight.

Use of Tops. — Most growers used the tops to feed cattle, sheep and pigs, while a few ploughed them down for green manure. In either case they have a considerable value. As a food they are equivalent to marrowstem or thousand headed kale, and an average yield of shaw was 5-6 tons per acre. The manurial constituents amount to—nitrogen, 0·4 per cent.; phosphoric acid, 0·13 per cent.; and potash, 0·70 per cent., and, valuing these according to prices current last spring, gives a price of 7*s*. per ton, or 35*s*. per acre.

Yields from Moray Farms.—The factory returns have been used to obtain averages of washed beet, tare, sugar content and price. The following are the results for 94 acres :—

Total unwashed beet	976 tons 5 cwts.
,, tare	65 ,, 17 ,,
,, washed beet	890 ,, 8 ,,
Average tare	8·79 per cent.
,, yield washed beet per acre ...	9 tons 9·5 cwts.
,, sugar content	17 per cent.
,, price per ton	53*s*. 9*d*.
,, ,, ,, acre	£25, 9*s*. 3*d*.

The highest yield per acre was 13 tons 12¾ cwts. washed beet from a measured area of 1¾ acres at Greeshop, Forres. The highest sugar content for a whole crop was 18·6 per cent. from Garbity. The lowest tare percentage was 3·3.

Cost of Production.—The cost per acre varied from farm to farm, but an endeavour has been made to strike an average. Cultivations vary with the place in rotation and cleanliness of the soil; costs differ with manuring, distance from station, &c. The cost of a man's labour has been worked out at 7*s*. per working day, and a pair of horses at 6*s*. 6*d*. Average distance from the station per acre was 1½ miles. The following are details of costs per acre which will act as a guide to growers :—

Ploughing ...	£0	18	0
Grubbing twice	0	9	6
Harrowing ...	0	1	8
Chaining and removing weeds	0	3	8
Grubbing	0	4	6
Harrowing ...	0	1	8
Chaining and removing weeds	0	3	8
Drilling	0	4	6
Sowing seed	0	1	9
Rolling	0	1	6
Shimming ...	0	2	7
Singling	1	8	0
Second hoeing	0	14	0
Shimming three times	0	7	9
Pulling out bolted beets	0	5	0
Run of beet puller ...	0	4	6
Pulling and heading	2	0	0
Carting to station ...	1	13	9
16 yards dung at 5*s.* 6*d.*	4	8	0
Carting and spreading dung	0	13	9
Artificials—			
1 cwt. S/ammonia	0	13	0
3 ,, superphosphate...	0	10	6
1 ,, muriate of potash	0	9	6
1 ,, nitrate of soda	0	15	0
Sowing artificials, twice ...	0	3	0
Cost of seed, 14 lbs.	0	7	7
Rent	1	10	0
Rates	0	1	6
Implements	0	10	0
	£19	7	10

Deduct half dung	£2	4	0			
,, ,, phosphate	0	5	3			
,, ,, potash ...	0	4	9			
				2	14	0
Cost of production per acre ...				£16	13	10

The average net profit per acre from the beet crop in Moray in 1926 would be about £9.

How Profits may be increased.—A perusal of the foregoing particulars indicates that good results have been got from a crop which is new to many of the growers. It goes without saying that an increased yield can be expected with improvement in methods. This improvement can be made in four ways :—

1. *Cultivation.*—More attention should be given to cleaning and the preparation of a good seed bed. The control of early weeds and the early thinning of the crop should also be attended to.

2. *Varieties.*—Trials of different varieties should be made to find the one which will best suit the district and which will give a good average sugar content.

3. *Manuring.*—Careful attention should be given to the application of well balanced mixtures of artificials, and further manuring trials of different mixtures should be made.

4. *Liming.*—Experiments to show the effect of liming should also be undertaken.

The crops following beet tend to be improved, as a greater body of soil is brought into activity. In quite a few cases in Moray where beet was grown in 1925, the succeeding cereal crops were benefited.

Conclusions. — The soil and climate of considerable parts of the counties of Aberdeen, Kincardine, Banff, Moray, Nairn and Ross and Cromarty are suitable for the growing of sugar beet.

The crop requires rather more attention in the way of cultivation and manuring than the turnip crop, and good workmanship and careful supervision are necessary.

At the present time the crop affords a return for capital and labour which compares favourably with other farm crops.

The growing of beet improves the land and thus benefits the succeeding crops.

A considerable increase in the tonnage of beet per acre is to be looked for from improved methods of management.

THE BIOLOGIST ON THE FARM.—No. XXVI.

Professor J. Arthur Thomson, M.A., LL.D.,
University of Aberdeen.

Hair Worms.—A correspondent has sent us in a box with earth two living hair worms, which were abundant in his garden, some of them 6 inches long and as thin as fine thread. They are not to be confused with horse-hair worms or Gordians, which are rather more substantial, and live when adult in water, and when young as parasites in aquatic insects or in insects that come to the water. Thus one of the best known species of Gordius (*G. tolusanus*) has for its first host the larva of an alder-fly (*Sialis lutaria*) and for its second host a predaceous beetle (*Pterostichus niger*), which devours the other insects and may suffer badly for so doing. But we are wandering from what we wish to call the hair worms, which came in the box. They are true nematodes in the family Mermithidæ, whereas the Gordians are but distantly allied. There is a superficial resemblance, of course, for both are like threads or hairs, and there is a distinct resemblance in the life-history, for the young Mermis is a parasite in insects,—terrestrial insects, however, like grasshoppers. We have often got a brownish Mermis (*M. nigrescens*) that sometimes climbs up cabbage stalks from the damp earth, and we have seen it writhing its head end in the air in a strange way. Is it searching for the male, who is unknown? The female lays her eggs in the ground, where they hatch out, and the larvæ bore into insects. But the one we received the other day was a different species, probably *Mermis albicans* ; but it is very difficult to be quite sure of these worms, for the distinguishing characters are minute and the literature is scattered. Yet many gardeners must be familiar with these long, very delicate, white threads—up to 6 inches or so—that coil themselves up; and zoologists ought to know more about them. They do not seem in any way harmful, except to the insects which serve as their hosts. We should be glad to receive specimens for investigation.

Specificity.—How often we are brought back to this difficult but fundamental fact, that every different kind of creature is itself and no other. It is probable that every well-defined type has a protein peculiar to itself; but even within the type each species is peculiar. The blood crystals from the dried blood of a horse are different from those from a donkey. In the microscopic egg of one species of the deadly parasite Bilharzia there is a sharp spine at one end of the shell, while in another species it projects laterally. One species of rose has fourteen stainable rodlets or chromosomes in the nucleus of each cell of the body, while another has twenty-eight, and so forth. The newness that makes a new species is often detectable in many different parts of the creature. One species differs from another not merely in something striking that makes it worthy of a distinct name, but also in little trivialities which nevertheless breed true. A good example is forthcoming in a recent study by R. P. Wodehouse on the pollen-grains of composite flowers related to the chamomile and artichoke. Many pollen-grains have an ornamented surface, sometimes covered with microscopic spines, and these roughnesses may be of advantage in enabling the pollen-grains to adhere to the hairs of insect-visitors or to the surface of the stigma of the appropriate flower. If that were all, one would think that a few different types of roughness would meet all the needs of the case. But that is not the way nature works. In many cases the roughnesses differ in nearly related species. The individuality or specificity of the species may be expressed in the pattern of the pollen-spines! There is variety in the number of spines and in their arrangement over the surface of the grain. In many cases they are absent altogether.

A Nerve Thrill.—How quickly a horse answers to a flick; how quickly we draw back our hand from a hot cinder; how quickly an earthworm jerks itself into its hole when the earth vibrates under the light tread of an approaching thrush's foot. These are reflex actions, which do not require to be willed or thought about. They are automatic answers-back to stimuli, and many of them are established at birth, as in the case of sucking in mammals, or when the nestling opens its bill at the touch of the food which the mother brings. Automatic as they are nowadays, we need not be dogmatic in answering the question whether the animal never knew at all what it was doing when these reflexes were established in the course of racial evolution. We do not learn to sneeze, it is reflex; but it does not follow that the withdrawal of a limb from something hot or sharp was not once—in distant ancestors—to some extent deliberate. Among trained animals and in ourselves we know of skilful movements which required for a long time much attention and control, yet have now become quite automatic. We do not need to think or will in adjusting our push-bicycle even to a difficult situation. Reflexes may be inborn and perfect from the first, as in the young redshank's squatting and remaining motionless when it hears the parent's danger signal, but they may also be established in the individual lifetime, as in a horse's immediate response to certain touches. Habitation depends on the individual establishment and facilitation of reflexes.

But whatever be the nature of the reflex, it always implies a message passing inwards along a sensory nerve to something in the way of a centre, often in the spinal cord, and a message passing outwards along a motor nerve to a muscle, or, it may be, a gland. News pass from the outer world or from some internal organ to something in the way of a nerve-centre, and commands pass out provoking a muscle to contract or a gland to secrete. In all typical cases, as we said before, there is a chain of four links: (1) the sensory nerve cells, which receive the tidings; (2) the associative nerve-cells, which shunt the impulse; (3) the motor nerve-cells, which pass it on to the (4) effectors or muscle-cells. This is so fundamental that we should be humble enough to think more than once of the comparison that sensory nerve-cells are like Scouts, that associative nerve-cells are like General Headquarters, that motor nerve-cells are like Executive Officers of varied rank, and that the effectors or muscle-cells are like the "men" who do the work.

All this reflex-arc business takes place with great rapidity; thus the average rate of transmission of a nerve impulse in man is 400 feet per second, though in many of the humbler creatures it is much slower. But what is it that travels? This remains one of the most difficult of physiological questions, but some progress is being made. Thus we know that a chemical process occurs, for carbon-dioxide is produced and a very minute quantity of heat. There is also an electric current implicated in at least the beginning of the nerve impulse. If in a long stretch of nerve a part be anæsthetised in some way, this naturally enough delays the passage of the nervous impulse; but if the impulse gets through to the uninjured part it is as strong and rapid as ever. Thus a nerve-thrill is one of the "all or nothing" phenomena. One wishes one understood it better.

The Transpiration Current.—We do not know more than a little about a nerve impulse; we do not fully understand the contraction of a muscle; we are not very fluent when we are asked how the water gets up to the top of that lofty tree in the middle of the field. The common phenomena are often the most baffling, being of course nearest the fundamentals. It is easy enough to see *why* water must get up to the top of the tree, for growing means increase in the amount of living matter and at least 75 per cent. of protoplasm is water. Moreover, the essential process of the green plant is protosynthesis in which carbon-dioxide and water are bound together to make a simple carbohydrate, oxygen being given off as a priceless by-product wherewith animals breathe. Once more, water must be lost—transpired or evaporated—from the great expanse of leafage; therefore more water must ascend.

It is not difficult to understand why soil-water should pass into the delicate absorbent parts of the roots, for if a less dense solution is separated from a more dense solution by a permeable membrane, diffusion must occur from the less dense to the more dense—from the soil-water to the cell-contents—until equilibrium is established. Thus we understand how water must be used up (in three ways) at the top end, and how it must begin to pass into the root-hair region at the lower end. The question is what accounts for the passage from the one end to the other. Now it is well known that every cell of the root-hair region and every cell of the central tissue of the leaf is in close contiguity to a wood-strand, which consists largely of elongated spindle-shaped cells (*tracheids*) and of vessels (*tracheæ*) formed from the end to end fusion of cells. There is no doubt that the wood-cells and wood-vessels form the transport system. But experiments in cutting show that it is only the *young* wood, so-called "sap-wood," that is important in this transport business. Cutting the young wood is at once followed by a wilting of the leaves. It is also possible to inject water containing Chinese Ink into the cut stem, and this marks as its chief path the vessels of the young wood. The pretty experiment has been made of injecting the wood-vessels with melted paraffine or gelatine, which blocks them when it cools, and this is rapidly followed by wilting of the leaves.

But how does the water ascend? There are various theories—the capillarity theory, the root-pressure theory, the atmospheric pressure theory, the "relay-cells" theory, and so on, but the view most in favour nowadays is the "cohesion theory." This may be briefly stated. The essential condition of the ascent of sap is the vaporisation that goes on from the leaf. This affects the osmotic properties of the living cells in the skin and in the active central tissue of the leaf. But beside these central cells there are numerous wood-vessels and wood-cells, branching out from the leaf-veins, and either ending blindly or uniting with one another in recesses of the leaf-tissue. But the wood-vessels and the wood-cells form a connected series from leaf to root, and thus we have to deal with long "water-columns" which, for physical reasons, are very difficult to break. If water is lost by transpiration or otherwise at the top end of the column, it is physically necessary for more water to pass up.

The young wood seems to be a transport system in a wider sense. For while we used to be taught that the sugary or elaborated sap passed down by the tissue outside the wood, namely the bast, the evidence now points to the conclusion that there is a down-current as well as an up-current in the young wood, and that the former transports the organic substances manufactured in the leaves. Materials do pass from the bast into the young wood, but there is more than a suspicion that these materials consist largely of ferments and hormones which keep the wood-vessels in good condition and prevent blockage.

Keeping the Engines clean.—Everyone who has had the good fortune to be received in a friendly way in a Boer farm will remember the embarrassing hospitality—the dining table and the side-boards groaning with viands, each more tempting than another. The difficulty for people with moderate appetites was to get away without mortally offending the "too kind" host and hostess. Even at home the hospitable tradition lingers not merely of having a big spread, but of pressing the visitor to eat too much. Perhaps even within enlightened circles, and in reference to stock as well as ourselves, there has been no complete departure from the old idea that if one portion of food is good, two must be still better. Many people eat as if they were laying up treasure for the future, whereas a little physiology makes it clear that instead of treasure there is an accumulation of ashes, which have to be got rid of, often at the cost of fatigue. It is not the gorging of the food-canal that is so unprofitable, nor even the extra work that is demanded of the digestive organs: what matters most is over-loading the blood with digested materials which are in excess of all possible needs, which have to be eliminated without doing any good and at considerable cost to the liver and the kidneys.

Let us take protein food in particular. It contains the "big four" elements, carbon, hydrogen, oxygen, nitrogen, and may be illustrated by the casein of cheese, the vitellin of yolk of egg, and the gluten of wheat. These nitrogenous food-stuffs have large molecules, and to facilitate diffusion through the wall of the food-canal into the blood, they have to be broken down into smaller molecules, namely those of amino-acids. In other words they have to be digested. Some of these amino-acids are used to repair portions of the living tissues that have suffered from wear and tear, and some are used up as material for growth, if growing is still in progress. But some of the amino-acids have a different fate; they undergo a process known as de-amination. In other words, they are split up into ammonia and some derivative of a fatty or hydrocarbon acid. The latter is burnt up to supply bodily energy; the former, which soon becomes a cell-poison, is changed into a less aggressive substance, such as urea in mammals, amphibians and fishes, or uric acid in birds and reptiles, or even salts of ammonia in some backboneless animals. To effect this change is mainly the work of the liver, while the kidneys have the task of filtering out the waste. What must be understood is that the nitrogenous waste, which has to be got rid of, may arise from the wear and tear of the body, like the minute particles of steel in the lubricating oil of an engine, while the rest is due to the ammonia which is split up in preparing the bodily fuel. The second portion of the waste is comparable to the imperfectly combusted fuel of an oil engine. At all costs the engines have to be kept clean, but it is plain that if more fuel is used than there is any need for, either for repair, growth, or energy requirements, then much profitless work is demanded of the liver and the kidneys. Man habitually over-eats and domestic animals are often over-fed. The result in both cases is an unnecessary clogging and straining of the vital engines. The poet speaks of a certain kind of repentance being "the weight of undigested meals ate yesterday," but the more serious weighting is due to superfluous *digested* food that has passed into the blood. Most wild animals in a lively struggle for existence have to eat sparingly, and this is part of the secret of their vigorous health. And though we may collect instances of gorging, as when the albatross swallows so many fish that it cannot rise, or the stoat runs amok among chickens, killing far more than it can possibly eat, these are rare exceptions, and are to be regarded as illustrations of the momentum of instinctive predispositions, for the animal cannot stop swallowing or killing, though it is long past the promptings of appetite.

But this long story was intended to make three points clear: (1) why the animal engine must have nitrogenous waste, and that for two reasons; (2) how part of this nitrogenous waste is utilised profitably and how the rest is rendered less toxic and then filtered out; and (3) how eating too much is not only profitless but actively prejudicial.

Do Plants excrete?—When the leaves fall from the trees in autumn there must be some elimination of nitrogenous wastage, but apart from this periodic shedding of dead organs do ordinary plants get rid of nitrogenous waste-products? In other words, do they excrete? Until recently it has been usual to answer this question in the negative, and it has been pointed out that plants are not very energetic and will therefore be less likely to be troubled by the accumulation of waste. Moreover if we rule out exceptional cases, such as the interesting insectivorous plants and such as the Leguminosæ which are able by means of partner Bacteria to tap the supply of free nitrogen in the air, we must admit that ordinary green plants are as likely to suffer from nitrogen deficiency as animals, especially carnivores, are likely to suffer from nitrogen excess. The ordinary plants have to find their nitrogen supply in the nitrates and the like, usually somewhat sparsely distributed in the soil.

But a more precise biochemistry has changed the botanist's view. Urea itself has been demonstrated in a number of plants; allied substances like asparagin, glutamin and allantoin are of frequent occurrence; and there are several ferments like urease which act on nitrogenous compounds and liberate ammonia. On general grounds, furthermore, since living is bound up with the metabolism of proteins, and since the breaking down of their components, the amino-acids, involves the formation of ammonia, one would expect plants to have to face the problem of dealing with waste ammonia. They have solved it in a way of their own; they lock up the ammonia in harmless combined form in such substances as asparagin and glutamin. In many a fungus the same rôle—of taking the poisonous edge off ammonia—is discharged by urea itself. But the plant's solution is even better than this, for ferments like urease and asparaginase can re-liberate the ammonia when it is needed for the building up of fresh protein substances. Thus the plant is physiologically more economical than the animal, for it can use its waste products as a nutritive reserve! Not merely beauty for ashes, but food out of ashes! Of course this requires a masterly regulation of the prison-doors, now shutting up ammonia and again setting it free, but the inmost secret of life is regulation.

Motor Cars and Clean Rivers.—Before the middle of the nineteenth century no particular notice was taken of what was emptied into rivers. But since then there has been some commendable legislation which has tended towards keeping the waters clean. Moreover, great progress has been made in the methods of dealing with domestic sewage, so as to reduce its evil influence on life in the waters. Yet there are authorities on the subject who say that the pollution of rivers is worse than ever. In some streams, from source to mouth, it is no longer possible for trout or salmon to live. This is lamentable economically, for salmon is a valuable food, and more is caught in Great Britain and Ireland than in the whole of the rest of Europe. Especially at a time when the nation is none too prosperous, we should be having more and cheaper salmon, whereas it is becoming scarcer and dearer. Moreover the pollution of rivers may mean that farm animals are injured by drinking the poisoned waters, and there are other far-reaching evil effects.

The reasons for this increase in pollution are to be found chiefly in the effluence of new wastes from manufactories, for instance from the new sugar-beet industry. Two substances in the "tailings," called saponine and sapotoxine, are peculiarly fatal to fishes. In many other cases the poisoning operates not on the fishes directly, but on the small molluscs, crustaceans and insect-larvæ on which the fishes depend. There is no cure here except a more rigorous insistence on the pre-sewage treatment of injurious industrial waste, and in some cases it is the will not the way that is lacking. Perhaps the expense is the greatest difficulty, but let the consumer pay.

The other modern danger is due to the washings from tarred roads, for salmon and trout are very susceptible to anything in the coal-tar line. In some places the result of friendly and scientific conference has been the use of some road-making substance like bitumen which gives satisfactory results and yet does not produce poisonous washings. In other cases, we hear, it has been found possible to arrange for natural filtration of the washings from the roads and in many situations this seems feasible. But the general points are two. In the first place, man must be prepared at every turn to face the pains of progress, the taxes on advance; for better roads and sound manufactures of desirable things are as welcome as the destruction of salmon and trout is deplorable. In the second place, knowledge increases by leaps and bounds and it is impossible to believe that man cannot find a way out of turning clean streams into open sewers. But something must be done quickly, for a great authority on the matter, Mr. J. Arthur Hutton of Alderley Edge, a member of a recent deputation to the Privy Council, declared in his evidence that "the situation was becoming worse every day, and if nothing were done it was only a question of time before most of the salmon rivers of this country would be practically destroyed." What a bathos in civilisation that would be.

AGRICULTURAL RESEARCH IN THE BRITISH EMPIRE.[1]

AGRICULTURAL RESEARCH IN INDIA.

Sir David T. Chadwick, C.S.I., C.I.E.

In previous articles attention has been directed to the development of agricultural research and to the improvement of agriculture in the large dominions of the Empire. A certain similarity between the problems engaging the attention of the research workers in those countries has been indicated. These countries are mainly situated in the temperate portions of the globe, and their economic history during the past fifty years is largely that of opening up new areas and bringing new lands, as yet untilled, under cultivation.

In India conditions are widely different. Although the large irrigation works constructed during the last fifty years and those now under construction have turned and are turning hitherto waste lands into rich arable country, yet India has always been a country closely populated, with established social systems peculiar to itself and agricultural methods handed down from father to son through the long ages. The crops that are grown are typical of the tropical and sub-tropical regions of the world and not of the temperate zones. Most of the vast bulk of the crops grown is consumed locally, but it is mainly due to the large volume of her agricultural output that India ranks to-day fifth amongst all the countries in the world in the value of her total overseas trade. In rice, jute, sesamum, rape-seed and ground-nuts she ranks first amongst the producing countries of

[1] This article is one of a series contributed in collaboration with the Director of the Rowett Research Institute.

the world; in regard to cotton, sugar, tea, tobacco, second; and in wheat and barley third.

The old East India Company made some of the earliest attempts to improve local practice by sending consignments of western farming implements, and by inducing a party of cotton growers, from what were then the "American colonies," to settle in Southern India and cultivate cotton from American seed which they had brought with them. Such efforts were not likely to have permanent results, though there is still to-day a type of cotton grown in the Bombay Presidency known on the market as Dharwar-American. Subsequent importations and developments have been more successful. For instance, it was mainly through efforts connected with India that cinchona and rubber were introduced to Asia, and the development of the tea industry furnishes one of the most striking examples of the encouragement of a new crop. The true foundations for recent efforts to develop Indian agriculture are, however, to be found in the increasing attention which was paid in the latter half of the last century by scientists in Great Britain to the fundamental problems of agriculture, and to the economic work which was carried out in India by workers such as Sir David Prain and Sir George Watt. The opening of the Imperial Agricultural Research Station at Pusa and the organisation of the provincial agricultural departments in 1906 marks the beginning of definite, continuous and systematic effort to study scientifically the problems connected with tropical agriculture.

Each of the nine major provinces of India maintains its own agricultural department. They have for the most part their own agricultural colleges for instruction, as well as research stations, experimental farms and trained demonstrators at work throughout the districts. Pusa, which is maintained by the Central Government, is more definitely designed for work on the fundamental problems of agricultural research. It is equipped with botanical, agricultural, mycological, bacteriological, chemical and entomological sections.

The agricultural departments in the various provinces are each organised under its own director responsible to the Government of that province. He has with him as head of the local agricultural college usually a trained agriculturist, as well as trained economic botanists, entomologists, chemists and mycologists. These are engaged partly in tuition in the college, but more on agricultural research problems of practical immediate importance to the province. The province is further divided into a series of divisions, each in charge of a trained agriculturist having control of a small number of experimental stations typical of the different tracts in his division, and a staff of agricultural inspectors and demonstrators whose duty it is to familiarise the farmers with the results attained both by the scientific workers and on the experimental farms. Latterly many of the provinces have also developed work on the improvement of cattle, and especially the improvement of the milk yield.

Much most valuable work has been done by these provincial departments, and on their efforts depend the possibility of introducing improved methods and practice among the community. The object of these articles is, however, to concentrate attention more on the research which has been attempted and is in progress than on the practical methods adopted for interpreting scientific results into regular every day practice.

Under the leadership of Pusa close touch was maintained between scientific men at work in the different provinces and those at work on the cognate science at the Central Research Station of Pusa. Much of this class of work done in the provinces has been published in the various scientific series of memoirs issued from Pusa. Both in the provinces and at Pusa Indians from the universities or agricultural colleges and trained under the officers of the Department are taking an increasing and very large share both in scientific and practical work. At present the annual expenditure on Pusa is nearly £50,000 a year.

It was natural in the circumstances of the time in India that the most tangible economic results have so far arisen from the botanical section. A large number of sub-species varying slightly in economic characteristics were to be found in nearly all the main crops of India as they were then regularly sown. Partly through breeding and partly through selection, pure strains peculiarly suitable to certain localities have been developed whereby the annual receipts of the farmers have already been increased by some millions of pounds. This is notably the case in wheat, in which some of Mr. Albert Howard's pure strains, as for instance Pusa 4 and Pusa 12, have not only spread throughout the Punjab and United Provinces, but have been successfully introduced into Australia and South Africa. The new canes developed at the Cane Breeding Station at Coimbatore, which was started by Dr. Barber, has practically saved sugar cultivation in large tracts of northern India. Superior types of cotton are also being increasingly cultivated each year. The field for further work of this character on the numerous crops of India is almost unlimited.

In entomology and mycology a vast bulk of work has been done in studying the life histories and, in many cases, of devising methods of control of the insects and fungoid pests prevalent among the crops of India.

Whilst, as was inevitably and rightly the case, most attention was paid in the early years of the work of the Department to acquiring knowledge of the peculiarities and features of the economic crops, insects and fungoid pests prevalent in India, and to those problems work on which promised to give the earliest beneficial results to the farmers, efforts have also been continually made to obtain a further understanding of soil life and the process of changes in the soil associated with farming under tropical conditions. Thus, in the chemical and bacteriological sections at Pusa experimental work has been in progress on soil gases, the changes in the soil during the cultivation of rice under deep irrigation, the causes of infertility in soils in relation to bacterial action, the importance and function of the bacterial action in the manufacture of indigo, &c. Some work has also been done on a class of problems of importance in all tropical countries, and of very first importance in India, namely, the changes which take place in the soil as a result of irrigation. In this group come the effect of drainage of rice soils, the water requirements of crops of India and records of drainage in India. A series of experiments, continued over a long period of years, is in progress at Pusa on these problems of drainage, on which the chemical and agricultural sides work in unison. Another class of allied problems arises from those connected with the occurrence of salinity in irrigated lands, a problem which is often a nightmare to the irrigation engineer. Similarly in the mycological and entomological sections particulars have been worked out of the insects and pests which attack many of the crops peculiar to the tropics, for instance, tea, coffee, rice, cocoa-nuts, jute, sugar cane, tobacco, which might at some time be found attacking similar crops in other tropical portions of the world; and in the botanical section, in addition to work on plant breeding and inheritance of characteristics, studies have been made of the root systems of various crops. These will serve as examples of the class of work both in the practical and on the more strictly scientific side which has been undertaken in recent years.

Very many problems of prime economic importance have not yet been touched, and many of them have so far baffled solution. An instance of the last is the control of the water hyacinth, otherwise known figuratively as the "blue devil," which with its beautiful blue flower is gravely threatening to obstruct many of the waterways in parts of India, especially in Bengal.

The demonstration of new methods and the application of scientific results into regular farming practice will always be the task of local officers in close touch with the farming conditions. In that work they are bound by the economic conditions prevalent in the part of the country in which they work, as for instance by the practice of excessive sub-division of land arising from the customary laws of inheritance or from social usages. Those who are engaged in the study of more fundamental facts of agricultural science are freer from such limitations, though it is inevitable that the agricultural directors at work in the districts are constantly urging the scientists near at hand to give their attention to practical problems which appear to the directors of immediate importance in their own division. Much of fundamental scientific research on agricultural problems that has been done in recent years in temperate countries is applicable to and true of tropical conditions, but this is by no means the case with all such work. The tropics present their own problems, in the elucidation of which workers are at present far too few. Also in these countries, owing largely to the distances which separate the scientific workers and to the insistence of purely local needs, it is difficult to attain or develop " team work." The experience and knowledge gained in India should be of much assistance to those who are starting agricultural work in other tropical portions of the Empire, and the work which these may do should be of benefit to India.

With the introduction of the reforms into India in 1912 the provincial departments came more completely under the control of the provincial Governments. This inevitably led for a time to a weakening of the connection between Pusa and the provincial departments, and an increase of the risk of the provincial departments becoming isolated units. As it happened, a very high degree of team work throughout India has been secured in regard to cotton, in which there was already a well organised trade that had taken for many years a close interest in the agricultural problems connected with its raw material. That, however, only touches the fringe of the problem, and the Royal Commission on Agriculture which, under the chairmanship of the Marquis of Linlithgow, is at present conducting an enquiry into "the measures which can be taken for the improvement of agriculture and the promotion of the welfare and prosperity of the rural population," has been also invited to suggest means whereby the activities of the various provincial governments of India may best be co-ordinated and indicate directions in which the Government of India may usefully supplement such activities. This aspect of their enquiry will be of great importance in any proposals or schemes which may be evolved for endeavouring to promote closer association and intercourse between scientists at work on agricultural problems, firstly throughout the tropical parts of the Empire, and still further throughout the whole of the Empire. In such association India should have much to give and more to gain.

SEASONAL VARIATIONS IN THE CARBOHYDRATE CONTENT OF SWEDES.

JOHN CALDWELL, B.Sc.,
Botany Department, University of Glasgow.

THE composition of the Swedish Turnip is a subject which has received comparatively little attention in the past, especially from growers and purchasers, for whom the accurate determination of the real value of the swede crop is a matter of practical importance. Writing in this JOURNAL last year (*S.J.A.*, vol. IX, 1926) Dr. Lauder points out that " it is only within the last few years and in a limited number of cases that anything more than the appearance of a crop has been used as a guide for its excellence." This very general custom of judging swedes mainly by what may be termed " show points " offers a marked contrast to the strictly scientific attitude adopted in the case of sugar-beet, where the value is assessed almost entirely on the percentage content of cane-sugar. The reason for this difference of outlook in the two cases is obvious enough. The grower of sugar-beet is in no doubt as to what is required of his crop in the way of "quality"—a high content of cane-sugar is the main desideratum. Moreover, the sugar content can be determined by comparatively simple means, both for single roots and for bulk samples. In the case of swedes, the desirability of good "quality," i.e. high nutritive value, is generally recognised, though in this country, at any rate, more attention is usually paid to cropping power. The difficulty is that there is available, at present, no reliable information as to what constitutes good quality in a swede, nor is there any satisfactory practical method of determining the relative values of different swedes. The final judgment, as between different varieties or between samples of the same variety grown under different conditions, must be based upon the results of scientifically conducted feeding experiments. The direct method of the feeding experiment is too costly and too elaborate for everyday purposes, but a simple and yet reasonably accurate indirect test has still to be worked out. Among the empirical methods which have been suggested and more or less widely adopted (Fruwirth, *Handb. d. Landw. Pflanzen-züchtung*) are: (*a*) the determination of dry matter content; (*b*) the estimation of sugar content; (*c*) the estimation of "readily soluble matter." None of these has so far been checked by feeding experiments. On the other hand, comparison of the data obtained by these three empirical methods indicates that, on the whole, dry matter content, sugar content and content of "readily soluble matter" run closely parallel, a relation which was to be expected in view of the fact that the dry matter content must be influenced by the amount of sugars, &c. present. The main problem, however, can be solved only by a co-ordinated scheme of research work such as is in progress under the auspices of the Board of Agriculture for Scotland (see Lauder as above). The writer has been investigating some problems of the storage of food material in the swede, and the purpose of the present paper is to draw attention to a point which arose in the investigation, and which appeared to be of more than passing interest and of definite practical importance.

The material on which the analyses were made was supplied to the writer by Dr. M'Arthur of the Chemistry Department at the West of Scotland Agricultural College, who also kindly gave access to data relating to weights and to the dry matter percentages. He had the swedes grown in connection with an investigation into metabolic processes, and had available two sets grown under different conditions which were placed at the writer's disposal.

Conditions of Experiment.—A plot of "Scotia" swedes was set apart for the purposes of the investigation. "Scotia" was selected because this variety shows a fair degree of uniformity; hence the samples taken were reasonably typical of the crop at any given time. The seeds were sown on 18th May in

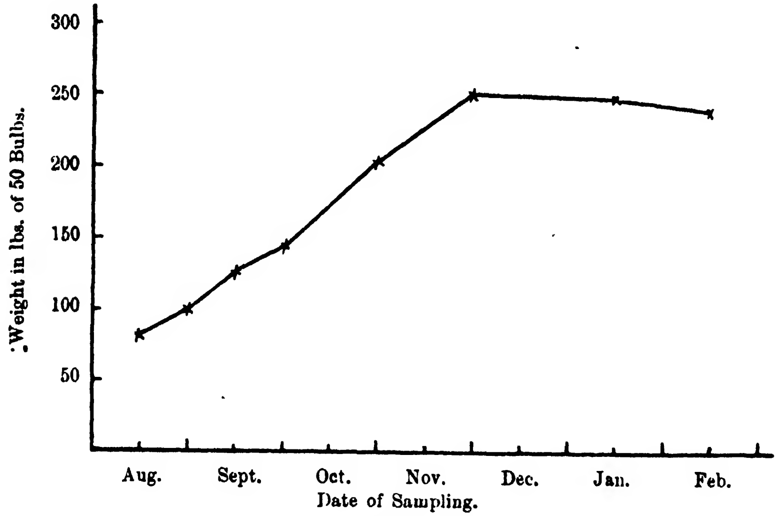
rows 27 inches apart and the young plants were "singled" to 9 inches. Fifty swedes were taken at each sampling. Samples were taken at intervals of a fortnight at first, but subsequently the intervals between two samplings was rather longer. The swedes were washed and allowed to dry, after which the necks and leaves were removed and the "bulbs" weighed. The weights of the samples at different times are shown in Table I.

TABLE I.

Table showing the weight of 50 swede bulbs at various stages in the growth of the crop.

Date.		*Weight of 50 swede bulbs.*
Aug. 17th	... ...	80·5 lbs.
,, 31st	... ...	100·75 ,,
Sept. 14th	... ...	122·5 ,,
,, 28th	... ...	140·25 ,,
Oct. 30th	... ...	206·0 ,,
Dec. 4th	... ...	249·0 ,,
Jan. 15th	... ...	241·0 ,,
Feb. 12th	... ...	235·75 ,,

GRAPH SHOWING WEIGHT OF 50 BULBS AT DIFFERENT DATES. (See Table I.)



It will be seen from Table I—(*a*) that the weight of 50 bulbs increased fairly regularly during August and September; (*b*) that there was a great increase in weight during October, and (*c*) that in December the weight had reached a maximum level, which was substantially maintained during January.

Sampling and Analysis.—After the bulbs had been weighed they were quartered by two radial longitudinal cuts at right angles. Slices were taken from these "quarters" so as to give a uniform and typical sample, care being taken that all the quarters were equally represented. It was borne in mind that there are different amounts of dry matter in different parts of a swede bulb (see Sansome, *Jour. of Agric. Science*, Jan. 1926).

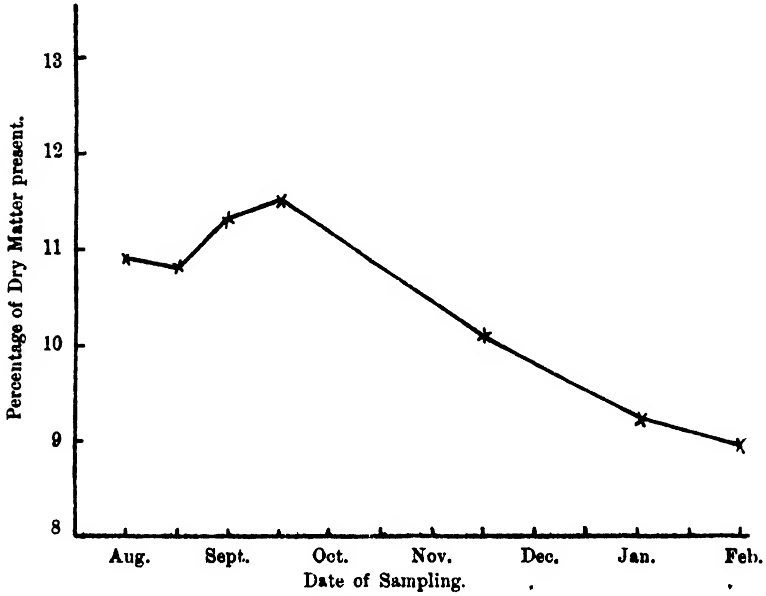
Further, the writer himself has established the fact that carbohydrates are stored in greater quantity in the south-facing portions of the bulb. The slices so obtained were weighed and dried, first at a low temperature for a short time and then at 80° C., until the difference between two successive weighings was slight. The percentage of dry matter present is shown in Table II.

TABLE II.

Table showing the percentage of dry matter present at different dates.

Date.	*Percentage of dry matter.*
Aug. 17th ...	... 10·9 per cent.
,, 31st ...	... 10·7 ,, ,,
Sept. 14th ...	... 11·3 ,, ,,
,, 28th ...	... 11·4 ,, ,,
Oct. 30th ...	... —
Dec. 4th ...	... 10·0 ,, ,,
Jan. 15th ...	... 9·2 ,, ,,
Feb. 12th ...	... 9·0 ,, ,,

GRAPH SHOWING THE PERCENTAGE OF DRY MATTER IN BULBS AT DIFFERENT DATES. (See Table II.)



From the figures in Table II it will be seen that the maximum percentage of dry matter was present during the latter half of September.

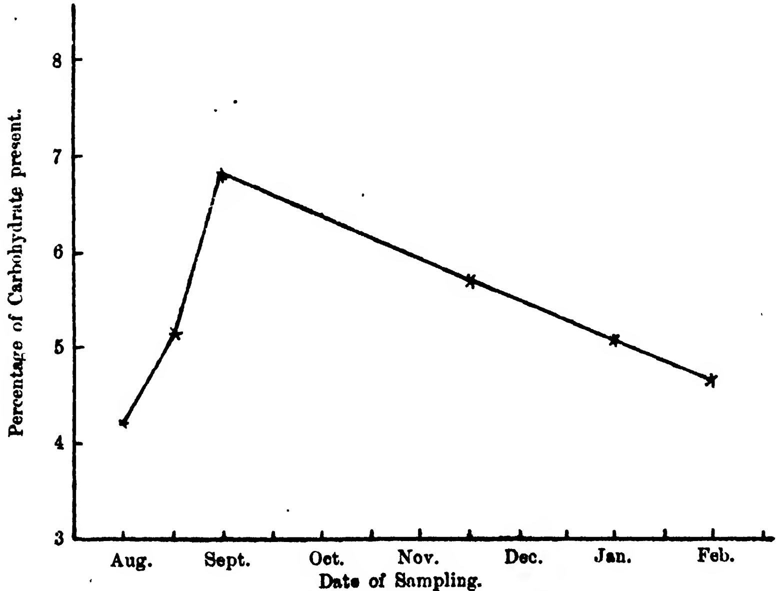
The dried " flesh " was ground to a powder and thoroughly mixed. Small quantities—about 3 grams—of this powder were boiled with 200 c.cs. of 2 per cent. hydrochloric acid. In this process any complex sugars present are hydrolised, i.e. are converted into simple sugars, and hemicelluloses and other readily hydrolisable polysaccharides are also converted into simple sugars. A certain amount of starch was present in the tissues of the bulb during spring and summer and up to the beginning of October. This carbohydrate was, however, practically absent from then onwards. "Carbohydrate" as used hereafter in the present paper must therefore be understood to include not only the simple reducing sugars, but also any Fehling-reducing substances produced as a result of the treatment of the dried pulp with dilute acid. It corresponds to the "readily soluble matter" referred to above. *A priori*, this might be supposed to correspond roughly to the material digestible by herbivorous animals—which includes more than the simple sugars—but this is one of the points which can be settled only by means of feeding experiments combined with detailed chemical analysis. The percentage of carbohydrate present on the various dates is shown in Table III.

TABLE III.

Table showing the percentage of carbohydrate present at different stages in the development of the crop.

Date.	*Percentage of carbohydrate.*
Aug. 17th ...	... 4·2 per cent.
,, 31st ...	... 5·1 ,, ,,
Sept. 14th ...	... 6·8 ,, ,,
,, 28th ...	... 6·6 ,, ,,
Oct. 30th ...	... —
Dec. 4th ...	... 5·9 ,, ,,
Jan. 15th ...	... 5·1 ,, ,,
Feb. 12th ...	... 4·9 ,, ,,

GRAPH SHOWING PERCENTAGE OF CARBOHYDRATE IN THE BULBS AT DIFFERENT DATES. (See Table III.)



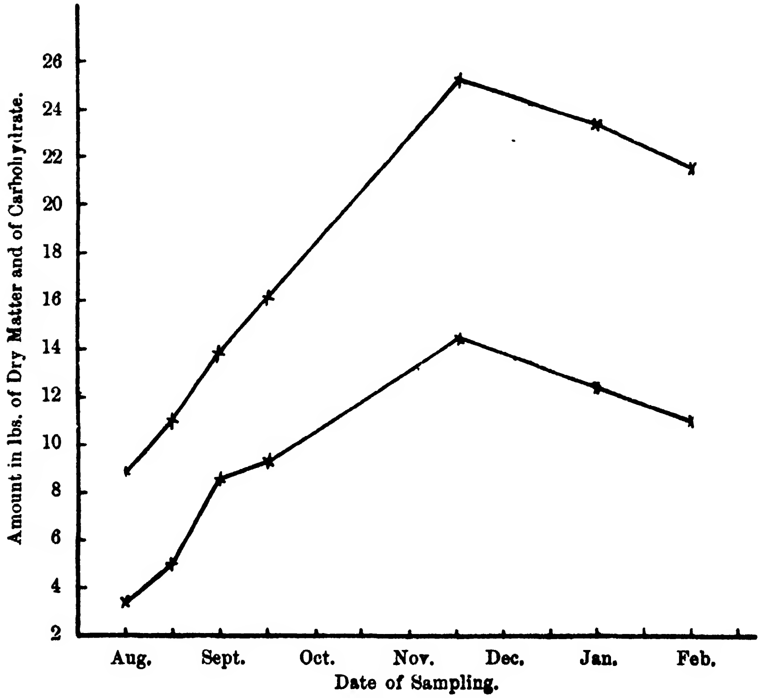
The advantage of not only taking similar samples but also weighing each sample before analysis is that one can calculate the actual amounts of dry matter and of carbohydrate present in the crop at different periods, and can from these figures indicate the relative values of the crop at different times in its growth. Table IV shows the actual amount, in lbs., of dry matter and of carbohydrate respectively present in 50 swedes at different stages in their development.

TABLE IV.

Table showing the actual amounts of dry matter and of carbohydrate present at different times.

Date.	*Amount of dry matter.*	*Amount of carbohydrate.*
Aug 17th	8·8 lbs.	3·4 lbs.
,, 31st	10·8 ,,	5·1 ,,
Sept. 14th	13·8 ,,	8·3 ,,
,, 28th	15·9 ,,	9·2 ,,
Oct. 20th	—	—
Dec. 4th	24·9 ,,	14·6 ,,
Jan. 15th	23·2 ,,	12·3 ,,
Feb. 12th	21·3 ,,	11·5 ,,

GRAPHS SHOWING THE AMOUNTS IN LBS. OF DRY MATTER (UPPER GRAPH) AND OF CARBOHYDRATE (LOWER GRAPH) PRESENT IN 50 BULBS AT DIFFERENT DATES. (See Table IV.)



It will be seen from the figures in Table IV that the actual amounts of dry matter and of carbohydrate present in the swede bulbs are greatest in both cases at the beginning of December, and that they tend to diminish during December and January. This result was borne out by parallel sets of figures obtained for bulbs of the same variety of swede which were grown under slightly different cultural conditions (see p. 327, above).

Conclusions.—A consideration of the figures contained in Table I leads one to the conclusion that as far as the actual weight of the crop is concerned the longer swedes of the "Scotia" type are left in the ground the better, at least up to about the middle of December or so.

A comparison of the figures in Table I with those in Table IV shows that for swedes of this type bulbs of the greatest feeding value—assuming that the feeding value is indicated by the amount of carbohydrate present—would be obtained if the crop were harvested about the beginning of December. If the crop be left in the ground after that time the amounts both of dry matter and of carbohydrate tend to diminish very rapidly. Naturally, these conclusions apply only to swedes of the "Scotia" type; "early" swedes, e.g. of the "Superlative" type, probably contain the greatest amount of carbohydrate and of dry matter at an earlier date. It must also be borne in mind that the results summarised in this paper apply to a particular season and to particular conditions of cultivation.

Another point of considerable practical interest arises out of a consideration of the figures in Tables II and III. From these it will be seen that from the point of view of "quality"—as judged by the percentage either of dry matter or of carbohydrate content—the swedes were of better "quality" at the middle or end of September than they were at the beginning of December. In other words 100 swedes contained approximately 18 lbs. of carbohydrate at the middle of September and 28. lbs of carbohydrate at the beginning of December; 100 lbs. of swede pulp, on the other hand, contained about 6·8 lbs. of carbohydrate at the middle of September but only 5·9 lbs. of carbohydrate at the beginning of December.

Furthermore, it will be seen that there is a definite scientific basis for the practical growers' contention that the "Scotia" type of swede matures relatively late in the year. The weight of the bulbs continued to increase, in this instance, up to the middle of December. The percentage of dry matter, on the other hand, fell steadily from the middle of September onwards, and the percentage of carbohydrate began to diminish a fortnight or so earlier. The final two months of "growth" of the bulbs thus consisted essentially in an active absorption of water.

From the point of view of sampling a consideration of the data set out above emphasises the necessity of establishing, for distinct types of swedes and for definite cultural conditions, the approximate date of the "metabolic turning point," i.e. the point at which the bulb ceases to accumulate organic substance and begins to mobilise its store of reserve material for the development of the shoot. If this be not done there is a chance that samples of two distinct types may be compared when one type is still accumulating food-materials in the bulb while the other type is "living on its capital."

The writer, in conclusion, desires to express his thanks to Dr. M'Arthur for his most substantial help in the work, and to Professor Drummond, whose help and advice have at all times proved invaluable.

Liver Rot of Sheep.

An investigation of the value of certain drugs in the treatment of liver rot of sheep has been conducted by Mr. R. F. Montgomerie, B.Sc., F.R.C.V.S., Veterinary Adviser to the Department of Agriculture, University College of North Wales, Bangor, since the autumn of 1924. Articles published in *The Journal of Comparative Pathology and Therapeutics* give a detailed account of the work done and the results obtained.

Observations have shown that liquid extract of male fern B.P. and *pure* carbon tetrachloride are highly efficient in the destruction of mature and almost mature flukes infesting the livers of sheep.

During the 1924-25 season male fern extract was extensively employed in the treatment of liver rot and good results were obtained. One drachm of male fern given in milk on each of two consecutive mornings was the dosage employed for average Welsh mountain sheep. Later experiments indicated that freshly prepared extract is rather more toxic than old material.

In 1925 pure carbon tetrachloride, a drug new to the treatment of liver rot, was tested. It was found efficient even in very small doses. A single dose of 1 c.c. of that drug in soft gelatine capsule was recommended. It appears advisable to remove the sheep from pasture during the late afternoon of the day previous to that of treatment, but this preparation does not appear to be essential. The sheep may return to pasture immediately after treatment. Welsh mountain sheep, all seriously affected with liver rot, tolerated doses of the drug as large as 50 c.c. without any bad effects. The much lower cost of treatment with carbon tetrachloride, with its apparent safety and equal efficiency, makes it much more suitable than any other drug.

Since this administration, like the others so far employed, kills only flukes which are mature or almost mature, sheep which have recently been on "dangerous" ground must be redosed to clear out all the infesting parasites. It is suggested that a period of one month should elapse between the doses.

Pure carbon tetrachloride may be used with great advantage as a general means of control on farms which regularly or frequently suffer loss. Sheep on such farms should be dosed at monthly intervals during the late autumn, the winter and the early spring. Then as the flukes become mature they will be destroyed. This prevents the distribution of ova in the fæces of the sheep and greatly restricts the spread of the disease.

During the season just closed records relating to the use of carbon tetrachloride in the treatment of some 20,000 sheep have been received. Very generally satisfactory results have been obtained, but four instances in which flocks have suffered loss following the treatment have been reported from the south of England. Each of these flocks showed a remarkably low tolerance of the drug. Further experiments have been conducted and the whole position reviewed. It appears that sheep on free range regularly have a high tolerance towards carbon tetrachloride, while flocks fed on artificial foods or folded on special crops have little or no tolerance. An investigation of the conditions under which the drug is very toxic is proceeding. Until further results have been obtained it is advisable that when dealing with a flock of sheep which is not grazing on ordinary pasture only a few sheep should be dosed at first in order to determine whether the general flock tolerates carbon tetrachloride well. Should some of these sheep show serious symptoms following dosage, carbon tetrachloride should not be used.

Wart Disease—Immunity Tests.

THIS article deals with further trials carried out at the Board's Seed Testing and Registration Station.

In Vol. IX, No. 3, of this JOURNAL (July 1926) an account was given of preliminary experiments which had indicated the possibility of providing a rule-of-thumb method of proving, under laboratory conditions, the immunity of varieties of the potato from wart disease.

The method is to place the tubers, rose end downwards, in a layer of moist sphagnum, which may or may not be impregnated with powdered rotted wart, and to water them with washings of actively growing wart. The receptacles used are circular dishes with sloping sides—6" in diameter at top, 4" in diameter at base, and 2" deep.

In the winter of 1926-27 an experiment on a large scale was planned to test the efficacy of the method when applied to batches of varieties. The number of varieties collected was larger than anticipated, a total of approximately 2,800 seedlings and approximately 380 named varieties being included. The total number of individual tubers tested was 6,036, including 3,531 whose reaction to wart disease was unknown.

Difficulty was experienced at the outset in procuring and maintaining a supply of infective material from which infective washings could be derived; material collected in September in the field was found to be useless for the purpose, as it decayed before tubers assembled for test could be made to sprout.

An attempt was made to commence tests as early as 19th October. The tubers sprouted very irregularly. No infective material (washings) was available until mid-December, and then only in small quantity. By mid-January, however, a fair quantity of actively growing wart had developed on a stock of Sharpe's Express which in early November had been planted in sphagnum impregnated with rotted wart.

The first series of tests was applied to a collection of material (190 tubers) procured from various sources, the senders alone being aware of the identity of the tubers. The infection for this series was composed of rotted wart intimately mixed with sphagnum; later, infective washings were applied when available. Wart became apparent on 4th January. The test was continued until 20th May, on which date wart disease, unnoticed until then, was still appearing. On the identity of the samples being disclosed, it was found that the test had failed to determine wart disease on one Up-to-date, one British Queen, one King Edward, and three seedlings that had developed the disease at Philpstoun or Kilkeel testing grounds, while a pustular form taken to be wart disease had been detected on one tuber of Templar (immune).

In this connection it is necessary to record that proliferations simulating the excrescences of wart disease appeared on the following:—(1) Magdeburger Blaue; (2) a stock believed to be of King George V; (3) two seedlings. These were sent for critical examination to Mrs. N. L. Alcock, Royal Botanic Garden, who reported that the proliferations contained no evidence of the wart disease organism. Wart disease subsequently appeared on one of these two seedlings. Similar proliferations appeared along with wart disease on another seedling sample.

The test, however, proved the susceptibility of eight seedling varieties which had not, in the summer of 1926, become infected under field test at Philpstoun or Kilkeel.

Another test was applied to an assemblage of material comprising all the varieties (380) maintained in 1926 in field tests and demonstrations at East Craigs. This test had for its object the definition of the minimum number of tubers of any variety requisite for a critical test of immunity. The varieties were subjected to an eliminating test, each variety being represented by one tuber, except that several known non-immunes were represented frequently as controls. Infection was supplied by washings only, although the initial washings must have contained winter sporangia and active zoospores escaping from them. The tubers were allowed to sprout previous to infection, which was commenced on 5th January. On 9th February four tubers of each of the varieties remaining unaffected —except 70 known immune varieties which were omitted for considerations of economy in time and space—were subjected to a further test, only infective washings being applied. By 6th April wart disease was evident on 39 additional varieties. Subsequently 12 more varieties in this test contracted wart disease. Seven varieties rotted entirely in both tests, and eight varieties rotted entirely in the second test of four tubers. All the determinations on this series, excluding the discovery of the susceptibility of previously untested named varieties, were in accord with published and unpublished determinations made at Ormskirk and Philpstoun except in respect of the following varieties :—

Raeburn's Gregor Cups.—This variety has previously been regarded as susceptible. The stock which is maintained at East Craigs has, however, remained unaffected in extensive tests in the laboratory.

X 6.—This seedling variety has been grown at Philpstoun annually for five years without wart disease being noted on it there during that period. Its susceptibility was discovered in the laboratory in 1925-26 and confirmed in laboratory tests in 1926-27.

Mr. Bresse.—This variety is on the list of approved immune varieties. Two stocks representing the bulk of the variety as now in commerce proved readily susceptible under laboratory conditions.

Seedling 20 (4) *S.S.R.P.B.*—This seedling did not contract wart disease in its first year's trial at Philpstoun in 1926, but proved susceptible under laboratory conditions.

Blue Gray, Mosaic Rogue, Rogue like Conquest and Tinted-flowered Rogue.—These varieties had been provisionally regarded as immune, having failed to contract wart at Philpstoun during a single year's test; they proved susceptible under laboratory conditions.

Empirical observations during the conduct of the test indicate that failures were due to the following causes :—

1. *Rot.*—Rot is occasioned in the tests by over-watering and by *Phytophthora infestans* (blight). Tubers with even slight traces of blight rot rapidly under the moist conditions employed. Secondary infections occur, occasioning further rot.

It is difficult to prevent over-watering. Tubers are of variable size, and the extent of their immersion individually in the moist sphagnum cannot be made definite.

To test the importance of putrefactive matter as inducing rot, 80 tubers of ten non-immune varieties were tested in a mixture of sphagnum and rotting wart in an advanced condition of decay. Seventy-nine tubers contracted wart disease within two months. Only one tuber rotted.

2. *Low Temperature.*—Wart disease appeared freely in the tests when the temperature of the laboratory was maintained for several hours per day over 20° C. During December, January and February the temperature of the laboratory was rarely above 17° C., and during this period results were unsatisfactory.

3. *Inadequacy of Infection.*—The concentration of the applied infection has a great bearing on the success of the test. A useful concentration is obtained by washing 20 good-sized actively developing warts in one quart of warm

water. The stock of infective material must be maintained in a sweating condition at a temperature of 20° C. (approximately).

The remaining tests were applied to seedling varieties submitted by well-known raisers, and formed the main part of the experiment during the season. Fifty-seven samples, including 40 submitted in ordinary course for the Board's Registration and Immunity Trials, were subjected to a four-tuber test. The susceptibility of 15 of these was proven before 28th May. Five varieties developed wart disease before the planting season.

The following is an analysis of the tests generally :—

Total number of tubers tested	6,036
Total number of tubers affected with wart disease	2,186
Number of tubers of unknown varieties affected ...	1,015
Number of tubers of known non-immune varieties not affected	385
Number of tubers of known non-immune varieties affected	1,171
Total number of tubers rotted within two months	650

Details of important controls :—

King Edward—	Number tested	74
	Number affected with wart disease	51
Arran Chief—	Number tested	175
	Number affected	148
British Queen—	Number tested	274
	Number affected	205
Sharpe's Express—	Number tested	85
	Number affected	71
Up-to-Date—	Number tested	79
	Number affected	36

Notwithstanding the admitted fallibility of the test, it has determined the susceptibility of 905 varieties previously untested. The whole experiment was carried out in an open laboratory as part of the ordinary routine of the Board's Registration Station, without any additions being made to staff and at a capital cost for metal frames and earthenware receptacles of £40.

Acknowledgments are due to the following individuals, firms and institutions for providing material for the purposes of the test :—

Mr. Donald Mackelvie, Lamlash.
The Scottish Society for Research in Plant Breeding.
Mr. W. B. Pollock, Bishopton.
Mr. W. Adams, West Kilbride.
Mr. J. Keay, Blairgowrie.
Messrs. M'Gill & Smith, Ltd., Ayr.

Mr. C. Brown (Messrs. Dobbie & Co., Ltd., Edinburgh).
Mr. A. M'Alister, Dumfries.
Mr. J. Bone, Dollar.
Mr. W. M. Findlay, Marischal College, Aberdeen.
Dr. G. H. Pethybridge, Harpenden.
Mr. G. Young, Ardler.
Mr. D. M'Ewan, Rothesay.
Sir Josslyn Gore-Booth, Ireland.
Mr. D. Cuthbertson (Messrs. Dobbie & Co., Ltd., Edinburgh).

Farm Wages in Scotland.

THE Board have as usual issued with their Monthly Reports for 1st January and 1st July supplements giving the wages of various classes of farm workers as at Martinmas 1926 and Whitsunday 1927. This article summarizes these statements, and gives a comparison with the wages current at Whitsunday 1926, in continuation of the series of articles contributed to this JOURNAL by the late Sir James Wilson, K.C.S.I., the last of which appeared in October 1926. It is thought to be unnecessary to repeat the careful statements made in these articles of the various ways in which farm wages are paid in different parts of Scotland.

The money values of the allowances given in addition to the cash wage, as reckoned at each of the three terms mentioned above, are as follows :—

	Whitsunday, 1926.	Martinmas, 1926.	Whitsunday, 1927.
Meal, per cwt.	17*s*. 6*d*.	16*s*.	16*s*.
Milk, per gallon	1*s*.	1*s*.	1*s*.
Potatoes, per ton	£3	£5	£5
House, per annum	£6	£6	£6
Coal, per ton	£1, 15*s*.	£2, 5*s*.	£1, 15*s*.
Board and lodging for single men, per week	14*s*.	14*s*.	14*s*.
Bothy accommodation, with attendance, per annum	£9	£9	£9
Bothy accommodation, without attendance, per annum	£6	£6	£6
Keep of cow and followers, per cow, per annum	...	£12	£12

The fall of 1*s*. 6*d*. in the estimated value of a hundredweight of oatmeal would mean, for men getting 65 stone per annum, about 3*d*. a week, while the rise in the value of potatoes would mean, for men getting a ton a year, about 2*d*. a week. The rise in the value placed on coal was due to the prolonged stoppage in the coal-mining industry, which affected prices for a considerable time before Martinmas 1926. The last item was introduced at that term. The other items show no change throughout the period.

The arithmetical averages of the Board's figures for the wages of married men are as follows :—

Average Weekly Earnings of Married Men.

	Summer, 1926.						Winter, 1926-27.						Summer, 1927.					
	Cash.		Allowances.		Total.		Cash.		Allowances.		Total.		Cash.		Allowances.		Total.	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Ploughmen ...	30	2	7	10	38	0	30	0	8	5	38	5	30	0	8	2	38	2
Cattlemen ...	29	9	9	0	38	9	31	6	8	8	40	2	31	1	8	6	39	7
Shepherds ...	28	11	9	5	38	4	29	10	10	7	40	5	29	8	10	8	40	4

These averages indicate an increase of 2*s*. a week in shepherds' wages during the past year, and a smaller increase in those of cattlemen, while those of ploughmen are practically unchanged.

The following table gives in round figures the weekly earnings of ordinary married ploughmen in summer 1926 and summer 1927 in 38 out of the total number of 52 counties or parts of counties included in the Board's statement.

County or District.	Summer, 1926.			Summer, 1927.		
	Cash.	Allowances.	Total.	Cash.	Allowances.	Total.
	s.	s.	s.	s.	s.	s.
Wigtown ...	24	14	38	24	14	38
Kirkcudbright ...	34	4	38	34	4	38
Dumfries ...	33	4	37	33	5	38
Selkirk ...	33	5	38	30	6	36
Roxburgh ...	33	5	38	30	6	36
Berwick ...	35	5	40	34	6	40
Peebles ...	35	6	41	34	6	40
East Lothian ...	36	5	41	34	8	42
Midlothian ...	38	5	43	34	7½	41½
West Lothian ...	38	5	43	34	7½	41½
Stirling ...	40	3	43	40	3	43
Dumbarton (Lower Clyde Valley)	40	4	44	39	4	43
Lanark (N.W.) (Lower Clyde Valley)	40	4	44	36	4	40
Renfrew (Lower Clyde Valley)	40	4	44	38	4	42
Ayr (N.) ...	37	5	42	36	5	41
Ayr (S.) ...	35	4	39	35	4	39
Lanark (S.E.) ...	36	4	40	35	4	39
Clackmannan ...	40	1	41	38	1	39
Fife (S.W.) ...	40	1	41	38	1	39
Fife (N.E.) ...	29	11	40	28	12	40
Kinross ...	29	10	39	28½	11	39½
Perth (S.E.) ...	29	10	39	29	10	39
Perth (Central) ...	27	10	37	27	10	37
Forfar (S.W.) ...	31	10	41	31	10	41
Forfar (N.E.) ...	29	10	39	29	10	39
Kincardine ...	30	10	40	30	11	41
Aberdeen (E.) ...	26	10	36	25½	11	36½
Aberdeen (N.E.) ...	24	10	34	24	11	35
Aberdeen (Central) ...	22	10	32	22	10	32
Aberdeen (S.W.) ...	26	10	36	24	10½	34½
Aberdeen (N.W.) ...	23	10	33	24	10½	34½
Banff (N.E.) ...	24	10	34	24	10½	34½
Moray ...	26	9	35	26	9	35
Nairn ...	23	11	34	22	12	34
Inverness (E.) ...	23	11	34	22	12	34
Ross and Cromarty (E.) ...	24	12	36	24	12½	36½
Sutherland (E.) ...	18	12	30	17½	13	30½
Caithness ...	16	15	31	16	15	31

The arithmetical average for this summer for these 38 counties and parts of counties is 38*s*. (cash 29*s*. 10*d*., allowances 8*s*. 2*d*.), while for summer 1926 it was 38*s*. 3*d*. (cash 30*s*. 8*d*., allowances 7*s*. 7*d*.). The average cash wage has fallen by 10*d*., while the value placed on allowances has risen by 7*d*.

About half the districts show decreases in the cash wages, amounting in Mid and West Lothian and North-West Lanark to 4*s*., in Selkirk and Roxburgh to 3*s*., in East Lothian, Renfrew, Clackmannan, South-West Fife and South-West Aberdeen to 2*s*., and in a number of other districts to 1*s*. or less.

Including cash and allowances, the average weekly earnings of a married ploughman in the southern counties are 38*s*.; in the south-eastern counties they range from 36*s*. to 42*s*.; in the Lower Clyde Valley from 40*s*. to 43*s*.; in the rest of the central area from 37*s*. to 41*s*.; and in the north-eastern counties from 32*s*. to 35*s*.

Single Ploughmen.—In the south-eastern counties the average wage is 33*s*., which shows a reduction of about 1*s*. 6*d*. as compared with the figure for summer 1926. In the Lower Clyde Valley and North Ayr the cash wage averages 20*s*. (as compared with 21*s*. in 1926), with board and lodging valued at 14*s*. In Forfar, East Perth and Fife the average cash wage is 30*s*., about the same as last year, with allowances valued at 6*s*. 6*d*. In the north-eastern counties the average cash wage is 21*s*. 6*d*. or 6*d*. less than last year, with board and lodging valued at 14*s*. In Inverness, Sutherland, Caithness, Orkney and Shetland the cash wage ranges from 14*s*. to 20*s*., with board and lodging valued at 14*s*. The single ploughman's earnings average for Scotland as a whole about 33*s*. (cash 23*s*., allowances 10*s*.), compared with 38*s*. for married men; this figure shows a reduction of 1*s*. as compared with that for 1926.

Women workers.—Wages paid by the week range from 20*s*. to 22*s*. 6*d*., and in the case of longer engagements, where, in addition to the cash payments, board and lodging are provided, the total weekly earnings range from about 21*s*. in Caithness to about 31*s*. in South-West Aberdeen. Women paid by the day get from 3*s*. to 4*s*. and occasionally 4*s*. 6*d*.

Boys.—The wages paid to boys vary considerably according to age and experience. On a six-months' engagement, where allowances are given, the total weekly earnings range from 21*s*. 6*d*. to 27*s*. 6*d*.; where the whole wage is paid in cash the rates vary from 15*s*. to 24*s*.

Girls.—Where the whole wage is paid in cash, as in the south-eastern counties, the rate varies from 14*s*. to 18*s*. a week; where board and lodging are provided, the estimated total is somewhat higher. The daily rate ranges from 2*s*. 8*d*. to 4*s*., and the hourly rate from 3*d*. to 4*d*.

Casual workers.—Male casual workers get from 5*s*. 6*d*. to

8s. a day in most districts, or 9d. an hour; with a weekly engagement the wages vary from 30s. to 36s.

Emigration of Scottish Agricultural Workers.

THE emigration of agricultural workers from Scotland during the years 1921 to 1923 was dealt with in a previous article in this JOURNAL (July 1925, p. 307). The publication of the figures for 1926[1] enables a similar survey to be made of the figures for the years 1924 to 1926. Reference is made to the former article for a discussion of the course of emigration in general in earlier years.

The total gross number of emigrants from Scotland in the years 1924 to 1926 was 125,700, as compared with 169,900 in the preceding three years, showing a decrease of 26 per cent. The number of immigrants in the same period was 29,850, so that the net emigration amounted to 95,850. All these figures relate only to British subjects.

The following table gives the numbers for each of the six years:—

TABLE I.

Year.	*Emigrants.*	*Immigrants.*	*Net Emigration.*
1921	41,400	10,600	30,800
1922	39,900	9,000	30,900
1923	88,600	8,500	80,100
1924	39,150	12,250	26,900
1925	37,900	9,600	28,300
1926	48,650	8,000	40,650
Total ...	295,600	57,950	237,650

The net emigration during the six years was equal to that of the ten years between the Censuses of 1911 and 1921 (which, however, included the war years, when emigration was suspended), and was only about 16,000 less than that of the ten years between the Censuses of 1901 and 1911. The four years 1921, 1922, 1924 and 1925 are fairly uniform, while 1923 shows an exceptionally high figure. The increase in 1926 was no doubt due to the prolonged dispute in the coal-mining industry.

Of the gross total of 125,700 for the years 1924 to 1926, emigrants over 18 years of age numbered 89,100, of whom 43,730 were men and 45,370 were women. The number of women thus exceeded that of men by nearly 4 per cent., whereas in the preceding three years the number of men exceeded that of women by 42 per cent.

[1] *Board of Trade Journal*, March 31st, 1927; see also the issues of March 26th and August 27th, 1925, March 11th and 25th, 1926, and March 17th, 1927.

The occupations of the men were as follows :—

TABLE II.

Occupation.	*Number.*	*Per cent.* A.	*Per cent* B.
Agricultural	8,300	19·0	10·5
Commercial, &c.	5,385	12·3	11·1
Professional	1,770	4·0	2·3
Skilled—			
Mining and Quarrying ...	4,500	10·3	11·5
Metal and Engineering ...	7,220	16·5	23·0
Building	945	2·2	4·3
Transport and Communications	2,050	4·7	9·7
Skilled, other than as above ...	5,470	12·5 } 31·0	27·6
Labourers not in Agriculture or Transport	3,440	7·9	
Others	4,650	10·6	
Total ...	43,730	100·0	100·0

The first column gives the actual number, the second the percentage that that number bears to the total, and the third the percentage that the group in question bore to the whole number of "occupied males" at the time of the Census of 1921, so far as the grouping corresponds. A comparison between percentage "A" and percentage "B" shows how far emigration among men of any group was above or below the average. Of the groups for which a comparison can be made, the agricultural, commercial and professional contributed more than their quotas and the other groups less, while the miscellaneous groups, for which no exact comparison can be made, exceeded their collective quota. In the case of agriculture, the exact quota would have been 4,600, and there was what may be called an excess emigration of 3,700. Thus while the actual gross number of agricultural emigrants in the years 1924 to 1926 was less than that in the years 1921 to 1923, viz. 8,300 as compared with 10,550, the proportionate number was considerably greater.

An analysis of the figures relating to England and Wales shows that, as in the earlier period, emigration from these countries was relatively much less than that from Scotland, the total gross numbers of male emigrants over 18 being 117,900, or less than three times the Scottish total, whereas the proportionate number would have been eight times the latter. Out of the English total the agricultural group accounted for 21,900, or 18·6 per cent., and it was again both absolutely and relatively the largest of the groups. Its quota would have been only about 9,500. The proportion on this occasion was slightly less than that in 1921-23, and was also slightly less than the proportion in Scotland in 1924-26, instead of being as on the previous occasion a good deal larger.

The Scottish figures for each year are as follows :—

TABLE III.

Year.		Male Emigrants over 18.	In Agricultural Occupations.	Per cent.
1924	... ...	13,530	2,980	22·0
1925	... ...	12,320	2,065	16·8
1926	... ...	17,880	3,255	18·2
	Total ...	43,730	8,300	19·0

On the previous occasion it was not possible to state the net number of agricultural emigrants, since the published tables of immigration did not show how many came into Scotland, England and Wales and Ireland respectively. On the assumption that the total of 7,500 agricultural immigrants was distributed proportionately to the number of emigrants, Scotland's share would be 1,500, and the net emigration in 1921-23 would be 9,050. On this occasion the figures are given separately, Scotland's agricultural immigrants numbering 1,185. The net number of agricultural immigrants during the three years is thus reduced to 7,115. It will be noted that the proportion of immigrants to emigrants, as estimated for the first period and ascertained for the second, is exactly one-seventh.

An analysis of the destinations of the agricultural emigrants (gross number) shows that 4,050 went to Canada, 1,650 to Australia, 1,120 to New Zealand, 550 to other parts of the Empire, and 930 to foreign countries. The proportion going to Canada was less, and that to Australia and New Zealand greater, than in the years 1921-23.

Of the immigrants, 505 came from Canada, 490 from the rest of the Empire, and 190 from foreign countries.

Scottish agriculture has thus continued to be depleted above the average of all industries, the proportional excess being greater during the years 1924-26 than during 1921-23. It is remarkable that in spite of the continued unemployment in the metal and engineering occupations, the emigration of men engaged in these should have been considerably less both absolutely and relatively during the second period than during the first.

The average annual net emigration of men over 18 in agricultural occupations for the six years 1921-26 was 2,700. Not all of these were employees, but by far the greater proportion would be. The number of male employees over 18 is estimated at nearly 70,000. The annual loss has therefore been about 4 per cent. The following table shows, however, that the numbers have in spite of this loss been well maintained.

TABLE IV.

Year.		Regular Male Workers. Over 21.	Under 21.	Total.
1921	... ...	58,810	23,290	82,100
1922	... ...	58,600	22,920	81,520
1923	... ...	57,560	22,880	80,440
1924	... ...	58,010	22,075	80,085
1925	... ...	59,750	22,900	82,650
1926	... ...	60,800	22,480	83,280

Casual workers show considerable variations from year to year, which are of less significance than the variations in the numbers of regular workers. The number of casual male workers returned on 4th June 1926 was 12,970, of whom about two-thirds were over 21. The number in 1921 was 11,540, while in 1924 it fell to 8,760.

Increasing Productivity of American Live Stock Herds.

THE following extracts are taken from Armour's *Monthly Letter to Animal Husbandmen.* Vol. 8, No. 2, May 1927.—

"Most economists have predicted a declining meat consumption for each American citizen as the years and generations pass. A half century ago the United Sates probably consumed amounts of meat comparable to Australia, and at the same time exported large quantities of beef and pork. To-day the per capita consumption has not only declined, but beef exports have almost vanished, and pork exports are each year lighter than the year preceding. A recent writer points out that while the population of the United States has risen from 76 million to 118 million people since 1900, *or an increase of* 55·3 *per cent.*, the combined number of food animals —cattle, hogs and sheep—has declined from 192 million to 152 million, or a *decrease of approximately* 21 *per cent.* . . .

"As we have gradually evolved from the stage of range production and farm exploitation, rising land values and other agricultural costs have forced so many changes in American systems of farm and live-stock management, that a mere recital of our apparent capital in acreage and herds by no means measures the food supply. Improved methods of crop production and breeding are each year producing larger supplies from unit farms and unit herds. In the case of meat production there has been a gradual improvement in the births of live-stock per thousand. The number of births per thousand animals in cattle, sheep and swine since 1907 was calculated as follows :—

Year.	*Cattle.*	*Sheep.*	*Swine.*
1907	253	332	845
1912	273	411	810
1917	364	319	975
1922	287	413	995
1926	374	422	1,212

"In general it is significant that the efforts at improved methods of live-stock management which have been exercised by the workers in agricultural education have been adopted to a degree sufficiently widespread to increase the yields of breeding herds. . . .

"Statistics of beef consumption show that in 1907 our per capita consumption was 77·5 lbs., and in 1926, 63·4 lbs. This reduction is 18·2 per cent., which is greater than the reduction in cattle slaughter, but the rest of the decrease can readily be accounted for by the reduced weights of carcases. The same is true for sheep. Since 1907 there has been a reduction of 28·6 per cent. in per capita slaughter, but the actual slaughter figures for 1907 and 1926 are almost exactly the same. However, the general trend is slightly downward, the calculated decrease being about 23·5 per cent. As carcase weights are actually lighter on sheep and lambs since 1907, Chicago averages being 83 lbs. in that year and 79 lbs. in 1926, a much higher rate of productivity of flocks is indicated. . . .

"The most favourable situation from the viewpoint of the application of improved methods of live-stock management is seen in the case of swine. The per capita population trend is distinctly downward. In 1907 the per capita swine population was 0·7, while in 1926 the per capita population was 0·45, a drop of 35·7 per cent. In spite of this, swine slaughter has in general been increasing, the trend line showing a rise of about 5 per cent. for the period covered. . . . Increased productivity of herds of swine is thoroughly demonstrated. For swine only has there been any tendency toward increasing average weights. If the four years preceding 1907 are included for an average, the weight was 225 lbs., whereas if the average for the four years preceding 1926 were included, the weight was 238 lbs. . . . This indicates that the productivity of herds of swine has been improved in two directions since 1907, namely, in per capita slaughter and in average weight. . . .

"The competition of vegetable fats seems in no wise to have reduced the consumption of animal fats. Lard, butter and oleomargarine are consumed on a constantly increasing per capita basis, and there seems no evidence to indicate that the development of consumption of vegetable substitutes is anything more than a supplement to the meat and animal products already consumed. . . .

"The important conclusion brought out in the foregoing discussion is that up to the present time the systems of live-stock management have changed enough to establish such productivity in live-stock production as to enable slaughter to remain on a relatively level standard, despite the fact that live-stock population, especially from a per capita standpoint, seems rapidly to be decreasing."

These are some extracts from an extremely interesting paper. Their interest to British stockbreeders lies in the fact that the meat market of this country is governed by circumstances abroad, and the United States, which previously exported a great deal of meat, is now only able to support its own population, and that only by the almost complete alteration of stock-raising methods. The change in method of stock production during the past twenty years is attributed mainly to advances in education and research, a fact which amply justifies the present expenditure in the United States of over £4,000,000 annually upon agricultural research alone.

Quarantine Stations for Export of Live Stock.

Owing to the restrictions imposed by the Dominions and other countries on the importation of British live stock following on outbreaks of foot-and-mouth disease in this country, there has been a serious decline in the export of live stock from Great Britain. It is believed that the establishment of quarantine stations would lead to some modification of these restrictions, and the consequent re-opening of ports at present closed to British live stock. Already considerable progress has been made with the proposal in England, where the Royal Agricultural Society has consented to establish and maintain quarantine stations on condition that a grant is made from public funds to enable them to do so. The present position, it is understood, is that the Empire Marketing Board have indicated their willingness to contribute towards the cost of the establishment and maintenance of two quarantine stations to be situated at London and Liverpool. These stations would be owned and managed by the Royal Agricultural Society under the supervision of the Ministry of Agriculture and Fisheries, who would also be the authority for granting the necessary certificates in respect of stock for export.

The question has arisen whether the establishment of quarantine stations in England would affect the position of Scottish exporters. If English live stock, for export abroad, pass through quarantine stations, the Colonies may insist on similar procedure for Scottish stock, although they may not require it at present. Further, if cattle from Scotland as well as England were required to pass through a quarantine station, the accommodation provided by two stations in England might prove not only inconvenient for Scottish trade but also inadequate.

In order that the whole subject, as it affects Scotland, might be fully discussed, the Board of Agriculture for Scotland convened a meeting on 25th May at which representatives of the Highland and Agricultural Society and the Scottish Breed Societies met representatives of the Ministry of Agriculture and Fisheries, who explained the nature of the scheme that will probably be adopted in England and who gave general advice as to what steps towards a similar end might be taken in Scotland. The meeting unanimously agreed that (1) the establishment of a quarantine station in Glasgow was desirable, and that (2) the Highland and Agricultural Society should be requested to undertake the management of the station.

The Potato Moth.

In view of the discovery of the Potato Moth (*Phthorimæa operculella*) in consignments of potatoes imported into England from the Canary Islands, the Ministry of Agriculture and Fisheries on 2nd May made an Order prohibiting the landing in England of any potatoes grown in the Canary Islands unless they are accompanied by a certificate of health in the terms prescribed by the Destructive Insects and Pests Order of 1922. The Board have made an Order in similar terms applicable to Scotland.

Although the presence of this moth has not been reported on consignments of potatoes landed in Scotland from the Canary Islands, inspectors of the Board discovered this pest in consignments of potatoes from Malta which recently arrived at Glasgow and at Leith. The Board exercised their powers under the Destructive Insects and Pests Act with regard to these potatoes.

The potato moth closely resembles the clothes moth, and lays its eggs in the eyes of the potato. When the caterpillars develop they eat their way into the potato, and in severe cases the whole tuber becomes riddled with tunnels in which the caterpillars can often be found. The flesh of the potato round the holes turns brown and soon decays. While the moth has not so far gained a footing in this country, it is necessary that every possible precaution should be taken to prevent its introduction.

Reviews.

The Countryman. (Quarterly, price 2*s.* 6*d.*)—Mr. J. W. Robertson Scott, the well-known writer on agricultural subjects, has issued the first number of a new quarterly magazine, *The Countryman*, which is described as "an illustrated review and miscellany of rural life, edited in the country and written by countrymen and countrywomen throughout the world." Mr. Scott has enlisted the help of a number of distinguished men, including Lord Ernle, who discusses briefly the outlook for agriculture; Sir A. D. Hall, who asks whether higher wages can be paid to farm workers in England, and thinks that "with more leadership and more thought" they can; and Sir F. Acland, who wishes to see 4,000,000 acres of woodlands in England in fifty years. Other subjects are New Zealand wool sales, electroculture, electricity for village homes, schools in Denmark, empty village churches, subsidies for country cottages, rural industries, the work of County Councils, Rural Community Councils, Women's Institutes, &c. Naturally the atmosphere is mainly that of the English countryside, and the only reference to Scotland is a quotation from Professor Watson's recent comparison of Scottish and English farm workers, but Mr. Scott wishes to make the sphere of his magazine as extensive as possible, and letters from abroad are a feature. Like Mr. Scott's other publications, *The Countryman* is lively, stimulating, and personal in its tone. We may hope that his enterprise will be rewarded by a substantial circulation. The paper and print of the magazine are those of a well-produced book; it contains several fine photographs and drawings, and is bound in an attractive green cover. The price of each number is 2*s.* 6*d.*, and the annual subscription of 10*s.* may be sent to Mr. Scott at Idbury, Kingham, Oxford.

Diagrams of Weed Plants. E. Korsmo, Oslo, 1924.—The treatment of weeds depends on an accurate knowledge of their life-history and structure, hence good illustrations are of great assistance in describing them. Hitherto there has been no great choice in diagrams large enough to be used in teaching work, but recently a fine series of coloured diagrams has been issued by Professor E. Korsmo of the University of Oslo (Christiania), Norway. To enable these to be used in English-speaking countries a booklet of 60 pages of full descriptive notes has been issued in English. The diagrams are about 2 by 2½ feet, and as most sheets illustrate one plant only, and never more than three plants, the illustrations are large and suitable for a fairly large room. The series includes 40 sheets illustrating 65 weeds, and the colouring is effectively done. Each plant is shown as a young seedling and onwards to a full-grown flowering plant with details of flower, fruit and seed, so that the diagrams are also suitable for the general teaching of plant structure. Underground parts are particularly well drawn, and at a glance one sees charlock with the simple root structure of an annual, in strong contrast to the complex underground parts of couch grass and field thistle. These details are of importance when eradication comes under consideration. Some special cases are illustrated such as the renewed growth from a dandelion plant ploughed out and left lying on its side, also renewal of growth in dock, field thistle, &c. Another useful diagram shows side by side the three yellow weeds, charlock, runch and wild turnip, so that their distinctions are evident by direct comparison. The cost of the complete set, at the present rates of exchange, is about £4, but as the sheets are paper only the cost of cloth-backing should be added. (A set is in use in this country at the Edinburgh and East of Scotland College of Agriculture.)

The author, Professor E. Korsmo, has carried out extensive researches on weeds and their control, and his book "Ugress" is one of the best manuals on the subject, but the language, Norwegian, will be a barrier to most readers. It contains a summary of extensive investigations by the author on weeds, quite distinct from descriptions of species of weeds. Special chapters deal with topics such as effect of weeds in reducing crop yields, the methods of dispersal of weeds and experiments on the number of weed seeds and other propagating parts in soil. A comprehensive chapter deals with control, including implements and chemical methods.

The Economics of Small Holdings. Edgar Thomas. Cambridge University Press.—While much has been spoken and written in recent years on the subject of small holdings, the discussion has usually been on general lines and the arguments have been largely of an impressionist character. The present study, based on a survey of small scale farming in Carmarthenshire, is the more welcome as a serious and thoughtful attempt to look at the problem in an open-minded way and to apply to it methods of scientific analysis.

The county of Carmarthen is a peculiarly suitable area for such a study, with its varied surface of mountain, hill, dale and plain, and its three types of farming, mountain sheep-rearing, mixed husbandry of the fields and dales, and dairying on the lowland. Apparently it has always been a district of small farms, and the latest statistics show that in its total area of 587,816 acres there are 5,439 holdings of 50 acres and under. That represents 63·6 per cent. of all the holdings in the county. Farms from 50 to 100 acres account for 23·4 per cent., and only the remaining 13·1 per cent. represents holdings of over 100 acres.

Of the 1 to 50 acre holdings, 44·4 per cent. are held by owner-occupiers, the remainder being rented.

On these holdings the holders who have no other employment represent 54·1 of the total, the others had subsidiary employment to a greater or less degree.

For information on the economic condition of the holders two methods of investigation were adopted—an extensive survey of 262 holdings, taking account of systems of farming, labour, efficiency of equipment, housing conditions, &c., and a more intensive study based on financial accounts kept by 93 holders.

In these ways much interesting knowledge was gained concerning acreage of crops grown, numbers of cattle, working and other horses, sheep, pigs and poultry kept per 100 acres, character of housing and equipment on holdings of different sizes and in different locations; and in respect of financial returns, the allocation of these over the various products of the holdings—cattle, dairy produce, horses, sheep, pigs, poultry, &c., worked out to return per acre on the three groups of farms. Similarly, the expenses were obtained under such heads as rent, rates, labour, manures, feeding stuffs, seeds, live stock purchased, &c. From these data, the net returns per holding, the "family" wages and the wages per unit of labour, i.e. man equivalent, are worked out.

The whole study is a model of careful, accurate and well-planned method, which obviously warrants confidence in the conclusions reached. The amount of arable land is shown to be small and comparatively unimportant throughout. The smaller holdings show greater stock-carrying capacity than the larger. The importance of cattle, pigs and poultry in the economy of the small holding is emphasised, as is also the difficulty of provision of horse labour. The figures prove unquestionably that the smaller farms provide much more employment than the larger farms. The milk-selling holdings show the best financial return.

The small-holder's chief problem is shown to be the relation of his expenses to his total capital and to his possible income, and the net return to his labour is so stated as to be comparable with that of the hired labourer. The study shows that for every type of holding there is a definite limit of size to make an adequate return to the holder's labour.

These conclusions may not appear to be, nor can they well be, novel discoveries, but the merit of the book is that they are documented and vouched.

An appendix gives summaries of comparable studies of similar returns in Denmark, Norway, Sweden and Switzerland.

An interesting preface to the book is contributed by Mr. C. S. Orwin.

Agricultural Conditions.

The weather during the first fortnight of March was generally mild and dry, and excellent progress was made with all outdoor work. During the second half of the month the weather was showery and colder in some districts, with the result that the land became too wet for seeding, and all outdoor work was interrupted. In some other parts of the country, however, the second half of the month was quite as fine and open as the first half, and cultivation and seeding proceeded satisfactorily throughout the whole month. During April the weather conditions varied considerably, the outstanding feature from the meteorological point of view being the wintry spell that occurred in the last week, when frost, sleet and snow were general throughout the country. As a result the wheat braird and young grasses were checked, while outdoor stock, especially hill sheep, suffered considerable hardship. During the month of May the weather was cold and dull, night frosts being general, while the day temperatures were unusually low for the time of the year. In the northern and north-eastern counties rain showers were frequent and seriously interfered with agriculture, but elsewhere the month was mainly dry, and farming operations were carried out satisfactorily. Conditions generally were unfavourable for growth, the crops and pastures being adversely affected by the low temperatures and the comparative absence of sunshine; in south-western areas, however, there were several bright days of genial warmth, and in these districts crops made fair average progress.

The present appearance of the wheat crop is stated to be satisfactory generally. The plants brairded well during the early months of the year, and although growth was slower than usual during April and May, it would seem that the crop is now looking fairly vigorous and healthy in most of the districts where grown. In South-West Forfar, however, the general appearance of the crop is not so satisfactory as usual, while the report received from South-West Fife states that many fields in that district are patchy owing to the ravages of grub; in North-East Fife the crop is healthy in most cases, but some damage has been caused by the maggot of the wheat bulb fly. Estimates of the acreage sown have been furnished by the Board's Crop Reporters, and from these it would appear that the area under wheat is slightly larger than last year. The greatest increase is indicated in Forfar, where the area is estimated to be greater than last year by from 10 to 20 per cent., while in the Lothians and Fife there is a small increase; in some parts of Perthshire, however, there is a small decrease.

At the end of May barley was generally reported to be backward in growth owing to the cold sunless weather, but in most districts the crop was healthy and showed a fairly strong braird. In Kincardine it is stated that the early-sown fields have a good appearance, but, where sown late, the crop is thin on the ground and lacking in vigour; a report received from South-West Forfar indicates that in consequence of the frequent night frosts the present prospects of the crop are not so favourable as usual. In most districts the area under the crop is estimated to be practically the same as in 1926, but reports show a possible decrease of 15 per cent. in Berwick and 10 per cent. in South-West Forfar, Roxburgh and South-West Perth, while in Kincardine, North and East Perth, South-West Fife and the Lothians it is expected that there will be decreases not exceeding 5 per cent.; an increase of about 5 or 10 per cent. as compared with last year is reported from Central Aberdeen and North-East Fife. Taking the country as a whole it is probable that there will be an appreciable diminution in the acreage under barley this year.

The reports on the oat crop are less satisfactory than those on wheat and barley. In south-western areas the crop has a vigorous and healthy appearance but elsewhere growth has been unusually slow, especially in late-sown fields, where the plants are stunted and not of good colour. The reports from a few counties indicate that leather-jacket grubs are prevalent in some fields, but, up to the present, little damage has been done. In North-East Aberdeen, where most of the seed was sown in bad order, the unfavourable weather during the last few weeks has seriously affected the development of the plants, and the present prospects give cause for some anxiety. The area sown is estimated to be less than last year by about 5 per cent. in North-East Banff, East Aberdeen, Kincardine, North and East Perth, Caithness, North-West Lanark, North Ayr, Dumfries and Kirkcudbright, and from 10 to 15 per cent. in Central Aberdeen, North-East Fife, Roxburgh and South-East Lanark; in South-West Forfar and Berwick slight increases are expected, and in Kintyre and Bute it is thought there may be an increase of about 40 per cent.

Beans are generally reported to be looking well, and in parts of Perthshire the plants are unusually healthy and vigorous, but, as in the case of the other crops, growth generally has been slow. Sunshine and warmth are now required for the proper development of the crop. Ryegrass and clover seeds have made very little progress during May in the northern and eastern areas, and in these districts it is expected that the hay crop will generally be below the normal. In most of the western and south-western counties, however, the condition of the crop is more satisfactory, and there is every indication of a good yield.

Potato-planting was completed, or practically completed, in all districts at the end of May, and in most cases the work was carried out under favourable weather conditions. Except in a few districts the braird of main-crop varieties was not showing at the end of the month. Early varieties were more or less severely checked by frost at the beginning of May, especially in the Lothians, but in most cases the crop has recovered and is now looking well; in North Ayr second earlies are well forward. The area sown is estimated to be less by about 5 per cent. in the Lothians, Peebles and Dumbarton, while in South-West Aberdeen, South-West Forfar, Roxburgh, Selkirk and North-West Lanark the area is reported to be greater by about 5 per cent. and in North-East Aberdeen and Ross-shire by about 10 per cent. Elsewhere the acreage planted is not expected to show much variation from that in 1926.

The sowing of turnips and swedes has been later than usual this year. At the end of May most of the swedes had been sown, while in Ayr, Dumfries, Wigtown and Kirkcudbright the seeding of turnips was completed, but in many districts a considerable acreage of yellows had yet to be sown; in Shetland and the western islands little progress had been made with sowing at the end of May. Where early sowing was possible the braird is regular and healthy, but as in the case of all other crops growth has been slow. The sowing of mangolds is completed in Berwick, Roxburgh, Selkirk, Dumbarton and North Ayr, and on most of the farms in these districts the braird was showing at the end of the month. Sugar beet has been sown much more widely than last year, and in most districts the acreage under the crop shows considerable increases, especially in Fife, the Lothians, Berwick, Roxburgh and Selkirk. Where sown early the braird is healthy and vigorous, but in the majority of cases growth was not sufficiently advanced at the end of May to give any idea of the prospects of the crop.

The reports on the prospects of the fruit crop are distinctly disappointing. The frosts and cold winds that prevailed during the greater part of May caused much damage in all districts, and where the blossoms were out early it is feared that there will be little or no fruit. In South-East Lanark the strawberry plants in some fields are said to be badly affected by disease, but orchard trees are more promising than they were at the beginning of the month. In South-East Perth currants, gooseberries and raspberries were damaged by frost and almost all the plum blossom was ruined. In Fife and Kinross, however, the conditions are rather more hopeful and the fruit crop may prove to be about the average.

In all parts of the country, except in the south-western districts, pastures are now unusually bare for the time of the year. Grazing cattle have in consequence made slow progress generally, and in Shetland they are stated to be in exceptionally poor condition; in the southern districts, however, cattle are generally reported to be in fair average condition. Dairy cows have thriven fairly well and the milk yield has been generally maintained, but in several exposed districts hand-feeding has been necessary. Sheep on arable farms are healthy, but in most cases are not so forward in condition as usual; from South-East Perth it is reported that lowland sheep have thriven very satisfactorily but that early lambs are not so well grown as usual. The reports on hill sheep are varied. In the southern and south-western districts both ewes and lambs have thriven well, but in the western areas their condition is not so satisfactory; in many northern and eastern counties the ewes are stated to be rather lean, and as they have not been milking well the lambs are backward. In Roxburgh and Selkirk "louping-ill" is said to be prevalent amongst some flocks on high ground. Full reports on lambing have now been received. So far as flocks on arable farms are concerned the season has undoubtedly been a favourable one; the fall of lambs was rather above the average and the losses have been comparatively small. Among hill flocks the crop of lambs was not quite so satisfactory and in more than one district it is described as disappointing. The snowstorms at the end of April caused less loss than was at one time feared, the estimates of the deaths due to exposure varying generally between 2 and 5 per cent.; in parts of Inverness, however, the death-rate is estimated to be about 12 per cent., while in Ross and Cromarty the loss among the hill flocks is stated to amount to about 20 per cent. In Central Aberdeen some deaths have occurred owing to "woolball," while dysentery has caused considerable losses in Kirkcudbright and Wigtown.

The supply of regular and casual labour is sufficient for requirements, except in Dumbarton, Renfrew, North Ayr and Wigtown, where there is a shortage of experienced dairy workers, both male and female, while in South-East Perth there is a general shortage of agricultural labourers. In view of the hiring fairs that are held in many districts during May, the Board have obtained their usual reports on wages, a summary of which will be issued with the Monthly Agricultural Report for 1st July.

International Institute of Agriculture: Staff.

THE Permanent Committee of the International Institute of Agriculture at Rome is prepared to receive applications for the following appointments:—

1 "Chef de Section" specially qualified in Tropical Agriculture.
1 "Rédacteur" specially qualified in Tropical Agriculture.
1 "Rédacteur" specially qualified in Dairy Science.
1 "Rédacteur" specially qualified in Plant Diseases.
1 "Rédacteur" specially qualified in Rural Economics.
1 "Rédacteur" specially qualified in the Trade in Agricultural Products.

The minimum initial emoluments are :—

For the " Chef de Section " : 35,800 liras per annum.
For the " Rédacteurs " : 22,750 liras per annum.

The travelling expenses (2nd class) of successful candidates will be repaid on taking up their posts. Members of the staff living at a distance of over 1,000 kilometres from Rome have a right to the payment once in three years of their travelling expenses to their native countries.

The appointments will be made as a result of an examination of the qualifications of the candidates, in which account will also be taken of their knowledge of languages.

Applications should be addressed to the Bureau du Personnel, Institut International d'Agriculture, Villa Borghese, Rome, and must be received not later than 31st August 1927.

SCIENCE AND PRACTICE.

The following extracts and summaries are supplied by members of the staffs of Scottish agricultural colleges and scientific institutions or are taken from recent bulletins of the International Institute of Agriculture. Full references to the original publications may be obtained on application to the Secretary, Board of Agriculture, York Buildings, Edinburgh.

CROPS AND SEEDS.

Yield Studies in Oats: The Effect of Pre-Treatment of the Parent Crop upon the Seed produced, its Germination and Subsequent Growth. *By Martin G. Jones, M.Sc., and M. A. H. Tincker. Annals of Applied Biology,* Volume XIII, No. 4. November 1926.—The effect of environmental conditions upon panicle organisation, the growth of samples under various artificial conditions, the growth of selected seed of equal weight from an upland and lowland sample of grain are amongst the subjects discussed. The variety of oats chosen for the experiment was " Record." The type of spikelet produced was to a certain extent controlled by environmental conditions. The relative proportions of single-grained spikelets, the size of the grain, and particularly the number of spikelets per panicle, were amongst the characters of the panicle that were most readily influenced by seasonal and agronomic conditions. It was concluded that the vigour of the crop was closely correlated with the rate of germination. The writers express the opinion that it would seem that seedling vigour influences yield in spring-sown oats grown under Welsh conditions. The beneficial effects of seed grading by weight is emphasised. In spring oats grown under Welsh conditions, stress is laid on the importance of establishment, which can only be roughly gauged by laboratory tests. Heating the seed samples appeared to be a suitable method by which further information could be obtained as to the seed's vigour. An index of yield might be found in this direction, as seed vigour is correlated with yield. Plant to plant variation was so wide between spaced individuals that little indication of the graminaceous plant's capabilities could be discerned in seedling behaviour.

Italian Ryegrass for Winter and early Spring Keep: The Effect of Methods of Grazing on Productivity and Palatability, and on the Chemical and Botanical Composition of the Herbage. *By R. G. Stapledon, M.A., T. W. Fagan, M.A., F.I.C., R. E. Evans, M.Sc., and W. E. J. Milton, N.D.A. Series H, No. 5. Seasons* 1925-26. *University College of Wales, Welsh Plant Breeding Station, Aberystwyth.*—The experiments were designed primarily to ascertain the effects of different methods of grazing during the autumn and winter on the amount, nutritive value, and palatability of the herbage offering at about the end of March; and also with a view to noting the progressive changes in respect of these three important properties of the herbage during the autumn and winter. The writers in summarising the chief results of the trial point out that Italian Ryegrass during the period from the corn harvest to the end of March gave a larger aggregate yield when cut monthly than when cut once, twice or three times. This result was in the opposite direction to that previously obtained with perennial grasses cut during the period March to September. Italian Ryegrass made appreciable growth all through the winter; on each occasion, even between December and March after but one month's rest, over 200 lb. of dry matter per acre was produced. Evidence showed conclusively that sheep preferred the green leaves of Italian Ryegrass to either the stem or burned portions of the leaf of that species, or to bent daisies. Sheep showed a preference for the plots grazed monthly to the plots previously ungrazed. The leaf (the blade only) of Italian Ryegrass had shown itself to be nearly twice as rich in protein as the stem.

One of the practical conclusions drawn from the experiment as a whole is that in so far as maximum nutrients are concerned which synchronise with maximum production of Italian Ryegrass leaf, the highest yield will be obtained at the crucial spring date by grazing off the autumnal growth and then leaving till required.

Sheep as a Grazing Animal and as an Instrument for Estimating the Productivity of Pastures. *By R. G. Stapledon, M.A., and Martin G. Jones, M.Sc. Series H, No. 5. Seasons* 1925-26. *University College of Wales, Welsh Plant Breeding Station, Aberystwyth.*—Trials now in progress at the Welsh Plant Breeding Station with a view to estimating with precision the effect of grazing with sheep upon a number of plots representing different grasses and clovers are described. Methods are described whereby the yield per acre of grazeable herbage from a pasture, and the amount of that herbage actually eaten by sheep, may be estimated. The amount of herbage eaten per day varied from 9·8 lb. to 24·2 lb. when green grass plus extraneous moisture was taken as the unit, and from 2·6 lb. to 3·4 lb. when dry matter was taken as the unit. It was found that sheep preferred the green blades of grass to either the green sheathes or the stem proper. They also preferred green leafage to either burned or drying material or to weeds. They preferred red clover to grasses, and although apparently showing a slight preference for the leaf of clover over the stem, the difference was not nearly so pronounced as in the case of grasses.

Cost of Producing Field Crops in 1923. *Cooper, M. R., and Hawley, C. R., United States Department of Agriculture, Circular No.* 340.—The report gives details of an enquiry into costs of production of maize, wheat, oats, potatoes and cotton during 1923. The study is based on replies to a questionnaire sent to crop and live-stock reporters in all the States.

The reports on wheat showed an average gross cost of \$22·88 per acre allocated as follows: preparation of seed bed, planting, harvesting and marketing, 45 per cent. of cost; fertilisers 11 per cent.; seed 7 per cent.; land rent 26 per cent.; miscellaneous items 11 per cent.

The average sales value per bushel was \$0·99 and the value per acre was \$4·38 less than the cost per acre, hence farmers did not receive sufficient income from the 1923 wheat crop to repay them the cost of production.

This work is to be continued, so that in course of time indices will be available for making comparisons of yearly costs of production of the principal crops.

Proposals of the American Farm Bureau Federation for dealing with Surpluses of Farm Crops. *Wallaces' Farmer, Vol.* 51, *No.* 51, *Des Moines (Iowa).* 17 *December* 1926. *Nebraska Farmer, Vol.* 68, *No.* 51, *Lincoln (Nebraska).* 18 *December* 1926.—At its annual convention, held at Chicago in December 1926, the American Farm Bureau Federation passed a resolution urging the formation of a federal farm board to deal with surpluses of farm crops. The functions of such a board were thus outlined in a speech by the Hon. F. O. Lowden:—"We have suggested a federal farm board. We have proposed that such board should be vested with power of inquiring into certain facts. Those facts are: Is there a surplus of some basic farm product? Does this surplus depress the price below the cost of production with a reasonable profit? Are the growers of that product sufficiently organised co-operatively as to be fairly representative of all the producers of that product? If the board finds that all these questions must be answered 'Yes,' it is then empowered to authorise the co-operatives to take control of the surplus. The only aid from the Government which the co-operative would require would be that the Government should distribute among all the producers of the particular commodity the cost to the co-operative of handling the surplus. Neither the Government nor the board would determine the price. Nor would even the co-operative itself fix the price in any other sense than industry generally determines prices. Like every other industry, it would study all the conditions affecting the particular commodity and from time to time decide upon a price which conditions would seem to warrant. It would simply enjoy the advantages which come from organised selling."

Tests of Sugar Beets. *Down, E. C., Michigan Agricultural College Experiment Station Bulletin No. 66. East Lansing, Mich., 1927.*—The bulletin contains a report on three years' work on 23 samples of sugar beet of different varieties and from various sources. The average yield, sugar percentage, purity co-efficient and total sugar recoverable are given for the strains tested.

The average total sugar recoverable per acre for the leading varieties was: German Elite 2,242 lb., Zapotel Seed 2,138 lb., Czecho-Slovakia 2,106 lb., Canadian 2,090 lb., G.D.Z. 2,074 lb.; Michigan Grown 2,000 lb.

Michigan grown seed from commercially grown foreign seed, without selection, results in a beet with comparatively high tonnage, low sugar and low purity.

A variety of sugar beet should not be grown because of high sugar content alone, but should be tested for tonnage and purity co-efficient.

FERTILISERS.

The Consumption of Artificial Fertilisers in Denmark. *Harald R. Christensen, Statens Planteavls-Laboratorium, Lyngby, Denmark*, 1926.—The consumption of artificial fertilisers has increased very greatly of late as the following summary will show:—

Annual Import of Artificial Fertilisers into Denmark in Million kg.[1]

Period.	Nitrogen fertiliser	Phosphoric acid fertiliser.	Potassium fertiliser.
1871–1880	0·1	15·0	0·0
1881–1890	0·3	17·3	0·1
1891–1900	3·0	33·0	6·1
1901–1910	9·5	76·4	12·4
1910–1920	41·1	144·0	37·8
1921	105·0	80·2	14 6
1922	103·3	201·9	29·9
1923	123·4	231·9	42 4
1924	142·6	261·1	45·5
1925	174·5	288·1	47·5

The import figures correspond very closely to the actual consumption of the country, for apart from the change from raw phosphates to superphosphates, there is no production of artificial fertilisers in Denmark worthy of mention, nor is there any export.

During 1924-25 the import of nitrogen, phosphoric acid and potassium fertilisers was divided between the separate fertilisers as follows:—

I. *Relative consumption of the separate nitrogen fertilisers (per cent. of total import).*

	1924	1925
Sodium nitrate	37·0 per cent.	32·1 per cent.
Calcium nitrate	50·3 ,, ,,	44·7 ,, ,,
Ammonium sulphate	11·3 ,, ,,	22·5 ,, ,,
Calcium cyanamide	1·4 ,, ,,	0·8 ,, ,,

The consumption of ammonium sulphate, which was small until 1923, has since shown a large relative as well as actual increase, while calcium cyanamide, which has never been used in large quantities in Denmark, has now almost disappeared from the market. Sodium nitrate is almost exclusively used in the form of Chile saltpetre.

[1] Figures taken from the report of the Danish Co-operative Fertiliser Co., 1925.

II. *Relative consumption of the separate phosphoric acid fertilisers.*

	1924	1925
Raw phosphates	44·5 per cent.	44·0 per cent.
Super-phosphates (about 18 per cent. P_2O_5)	46·8 „ „	51·1 „ „
Thomas phosphates	8·4 „ „	4·9 „ „
Bone meal	0·3 „ „	0·0 „ „

Imported raw phosphates are not used directly as fertilisers, but exclusively as raw material in the manufacture of superphosphates. The amount of 18 per cent. superphosphates produced is almost double that of the raw phosphate imported from which it is made. We may say that in 1925 about 95 per cent. of the phosphoric acid fertiliser used for agricultural purposes in Denmark was in the form of superphosphates.

III. *Relative consumption of the separate potassium fertilisers.*

	1924	1925
37 per cent potassium fertiliser	92·1 per cent.	95·4 per cent.
Kainit and 20 per cent. potassium fertiliser	7·9 „ „	4·6 „ „

The greatest consumption of potassium fertiliser was of the high percentage salt.

As the following table indicates, the relative prices between cereals and artificial fertilisers have varied during recent years in a direction favourable to agriculture.

Relation between prices of cereals and of artificial fertilisers.
(From the report of "Det Landokonomiske Driftsbureau.")

Year.	Average price of cereal per 100 kg. in crowns.	Price of weight unit artificial fertiliser in relation to price of weight unit cereal.		
		Calcium nitrate.	18 per cent. super-phosphates.	37 per cent. potassium fertiliser.
1909-14	12·83	155	48	93
1920-21	39 29	117	61	86
1921-22	26·31	131	50	87
1922-23	23·59	133	41	76
1923-24	25·39	134	36	67
February 1925[1] ...	37·19	94	26	44

As a result of this development, artificial fertilisers are used on nearly all Danish farms at present. Based on a report of the Danish Co-operative Fertiliser Association, 1924, with statistics from 10,000 farms, we find that this year :—

98 per cent of the Danish farmers used artificial phosphoric acid fertilisers.
94 „ „ „ „ „ „ „ „ nitrogen fertilisers.
64 „ „ „ „ „ „ „ „ potassium fertilisers.

The average consumption per ha. was :—

Superphosphates	115 kg.
Nitrogen fertilisers	52 „
37 per cent. potassium	16 „

We may say that what characterises the consumption of artificial fertilisers at present in Denmark is the very large amount of phosphoric acid fertiliser used in proportion to nitrogen and particularly potassium fertiliser.

Growth Experiments with different Phosphatic Fertilisers. *Keller, Dr. F. Landw. Jahrbuch der Schweiz, Vol. 6. Bern*, 1926.—The author gives an account of the results of the following experiments with phosphatic fertilisers. (1) *Sulphur phosphate.*—Reckoning the benefits derived from Thomas meal as 100, the above mixture, composed mostly of well-ground raw phosphate and sulphur, produced on slightly acid soil, sown with maize, a benefit of 38, and

[1] From "Landbrugsraadets Meddelelser," February 6, 1925.

Algerian phosphate one of 76. The author concludes that the phosphoric acid in sulphur phosphate is not superior to that in superphosphate.

(2) *Colloidal raw phosphate.*—The colloidal raw phosphates (Gafsa, Cierp and a mixture of Algerian and Cierp-phosphate) were practically without effect on alkaline soil sown with oats; on a slightly acid soil they gave a fair result, inferior, however, to that obtained with superphosphate. No or scarcely any benefit accrued from the use of colloidally-ground Gafsa phosphate on these two kinds of soil sown with oats over and above that obtained with Gafsa phosphate of almost equal composition and ground in the ordinary way.

(3) *Bernhard-phosphate.*—The solubility of phosphoric acid in Bernhard-phosphate (probably Belgian raw phosphate) was less in a slightly acid soil sown with oats and red clover than that of Algerian phosphate.

(4) *Electro-phosphate.*—Electro-phosphate, made from Moroccan raw phosphate, is produced by the so-called Cottrell method. The very high degree of fineness of the small particles of the phosphate thus obtained is said to raise the solubility of the raw phosphate. Experiments with red clover and oats made on two different kinds of soil have shown that the electro-phosphate actually gave no better result than the untreated Moroccan raw phosphate.

(5) *Belgian lime-phosphate.*—This soft raw phosphate had a less satisfactory effect with oats and clover on slightly acid soil than Algerian phosphate. With oats the action of the phosphoric acid in both raw phosphates was small and practically the same. With carrots about the same increased return was obtained, both with lime and with Algerian phosphate. On alkaline soil sown with oats neither was of any use.

(6) *Reinforced phosphate* (Reibephosphat).—This name was given to a mixed fertiliser containing raw phosphate and kianite or other potash manures, carefully ground and mixed. The idea was thus to render soluble the insoluble raw phosphate. From the experiments made on oats and red clover on two different kinds of soil the author concludes that reinforced phosphate cannot be considered more effective than soft raw phosphate.

(7) *Natural phosphate.*—On slightly acid soil sown with oats this raw phosphate was not even equivalent to Algerian phosphate.

(8) *Tetra-phosphate.*—On slightly acid soil sown with oats, red clover and carrots, tetra-phosphate gave results comparable with those obtained with Algerian phosphate. No favourable after effects of tetra-phosphate were noticeable on this soil sown with oats.

Nitrogen Losses in Cow Urine. *Dorsey, H., Jnl. of American Society of Agronomy, Vol. XVII, No. 8. Genova, N.Y.*, 1925.—In 1919 Bear and Royston reported that 92 per cent. of the nitrogen in urine was lost in eight weeks if the urine was kept in flasks in a warm building, but that there was almost no loss of nitrogen in the same period when the urine was covered with a layer of kerosene.

The author's experiments were made to ascertain the nitrogen losses of urine stored in larger volume and in a cooler place, approximating to usual storage conditions.

The experiment was started on March 29 and continued until October 13, analyses being made at regular intervals.

Very little loss took place before July 1, and in no case reached 50 per cent. by October. By the third month three-fourths of the nitrogen was converted into ammonia, and by October all nitrogen except 5 to 8 per cent. was in the form of ammonia.

The kerosene layer reduced the loss of nitrogen fully 40 per cent. during the whole period, and was far more effective for the first six months. The addition of a small amount of acid phosphate seemed to increase the loss of nitrogen.

Effects of Phosphatic Manuring on the quality of Hay and Fodders. *Robertson, G. S., Boletin de la Comp. Admistradora del Guano, Vol. I, No. 7, Lima*, 1925.—The most important direct effect of the application of basic slag is the notable improvement in the quality and food value of the fodders. From the writer's experiments it appears that various basic phosphates (mineral phosphates, highly and slightly soluble slags, basic superphosphates) produce the same improvement and in equal measure.

In soils poor in lime superphosphate has an unsatisfactory influence, especially on leguminous plants, inasmuch as it favours grasses.

Mixing it with lime we get basic superphosphate, which is a stimulant for the leguminous plants.

Lime alone in these soils does not exercise any action.

Results of some Fertiliser Trials in 1926. *Joret, G., Les Mercuriales agricoles, Paris, 1926. Vol. X, 3rd series, No. 50.*—The writer comments on 1926 results on cultivated peat lands (" terres d'hortillonnage ") where contrary to accepted theories farmyard manure alone has not given the best results. Thus chloride of potassium in conjunction with nitrate of soda gave a return of 141·7 as against 100 given by farmyard manure alone in a potato trial. Again, also on potatoes, different potassic fertilisers gave the following results:—control plot 100, sylvinite 120·1, sulphate of potash 130·4, chloride of potash 131·2. It is curious that the starch content of potatoes manured with sylvinite was the highest. The writer attributes this to the action of the chloride of sodium, which according to Schneidewind has a favourable influence on carbohydrate migration.

ANIMAL BREEDING.

The Development of the Animal for Meat. *John Hammond, M.A., 1927, Journal of the Bath and West and Southern Counties Society.*—Mr. Hammond is to be congratulated upon his presentation, in this easily understood paper, of aspects of meat production. The angle from which he views his problems is enlightening to the practical stockbreeder. In his introduction he classifies the problems of the meat producer as follows:—

1. Quantity, i.e. those factors which affect the liveweight growth of the animal.
2. Quality, i.e. those factors which affect the proportions of the body or the composition of the growth made.

He points out that it should be the object of meat producers in this country to improve the quality and so place themselves beyond competition from abroad. At the same time the quantity factor must not be altogether ignored. He suggests that the " store " period should be modified if not diminished altogether, and advises farmers to beware of feeding young animals with too much bulky food. Young growing grass made into hay is not bulky and has a feeding value equal to or better than linseed cake, whereas after the grass has flowered the fibre in it increases, and the feeding value is low. The control of bulk in the ration of a fattening animal is of far greater importance when the animal is growing at the same time.

To prove this he points out that the single lambs usually do far better than twins, and that small litters do better than big ones. Unfortunately breeders in drafting their breeding stock and selecting their show stock often fail to take this into account, and in this way, although many flocks of sheep and herds of pigs have been improved for show purposes, they have deteriorated for commercial purposes. The author makes the following statement regarding pedigree breeding:—" Many things are done by the pedigree breeder which are not profitable in commercial production; for him the first essential is to be able to pick out the animal which develops its proportions best at an early age (see below), and to this end he feeds heavily so that the full capabilities of the animal for development are shown up. He also overfattens so that he may more easily pick out and reject those animals which lay on patchy fat and select only those which carry an even layer. Not much progress in selection for either meat or milk can be made without good feeding."

As regards quality the author points out that the " waste " or offal parts should be as small as possible. The animal changes in shape as it grows older. In this connection there are some extremely interesting photographs showing the Suffolk sheep as a two months' embryo, as a newly-born lamb and as an adult ewe and ram, all on the same withers height. It will be noticed that the head (offal part) is relatively very large in the fœtus and becomes proportionally smaller as the animal grows older; the shanks, too, at birth form a considerable proportion of the animal, and these also are relatively reduced when the animal develops to maturity. Another point which is also shown is that the length of the body in proportion to its height increases as the animal grows up; this is important, because it is along the back that the most valuable cuts of the animal lie, and a short animal is liable to be deficient in these cuts. It will be noticed that the male exceeds the female in development in most respects, and it is therefore especially important to select good males in breeding and to see that they have every chance of developing their full proportions.

These results are compared with the original wild sheep, and the writer states that naturally there are also breed differences, and that they are in the main due to differences in size and early maturity.

It is difficult to discriminate between feeding and breeding, nurture and nature. A young animal may be kept as a store for a year at the same weight,

Edinburgh and East of Scotland College of Agriculture.

Winter Session, . . October to March.
Summer Session, . . April to June.

The Day Classes provide a full course of instruction in Agriculture, Horticulture, and Forestry, and qualify for the Degrees of B.Sc. in Agriculture and in Forestry of the University of Edinburgh, the College Diploma in Agriculture, and the College Certificate in Horticulture.

CALENDAR showing Complete Courses in Agriculture, Forestry, Horticulture, and Allied Sciences in Day and Evening Classes; Short Courses for Farmers and Foresters; Syllabus of County Lectures and Experimental Work, and Scheme of Bursaries for Students resident in the College Area, may be had from the Secretary—

THOMAS BLACKBURN, 13 George Square, EDINBURGH.

All inquiries respecting the Advertising Rates of

The Scottish Journal of Agriculture

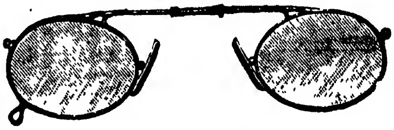
must be made to the Advertisement Controller

FRED. L. SIMONS,

3 Frederick Street,

EDINBURGH.

'Phone—Edinburgh 23866.



GEO. PRESCOTT & CO.

CONSULTING OPTICIANS.

Principal: J. H. MURRAY. **Telephone:** 21478.

—:o:—

All our lens grinding and assembling is done in Edinburgh under the direct supervision of our refractionists—and particular attention is given to the aesthetic value of the glasses prescribed.

—:o:—

98 LOTHIAN ROAD,

EDINBURGH.

yet its bones will grow, but "they do so at the expense first of the fat, and then of the muscles of the body," i.e. however good the hereditary constitution of the animal may have been, it becomes a typical "store." "The loin, the most valuable cut in the animal, is one of the last to develop and suffers more than any other part through bad nutrition, consequently when judging an animal special attention should be paid to this point; looking from behind one should see a well filled straight line of muscle from the hip to the outer side of the shoulder.

"The main object of the breeder of meat animals is to select those which go through the changes in proportion to greatest extent in the shortest time, and it will be readily seen from the above-mentioned experiments that he can do this to best advantage only where they are well fed, so that full growth and development are not hindered. The main way by which meat animals have been improved has been by feeding well, and picking out those which respond best both in actual growth and in proportional development."

It is not possible in this space to give *in extenso* all the various details dealt with, but the following extracts show how useful this paper is to breeders and feeders :—

"In these days of almost universal milk recording it might be better to class dual-purpose animals into three groups on their milk records, giving each a distinctive coloured label before coming into the ring, and, with these in full view, for the judge to select on beef points rather than to try to assess the milking qualities indirectly by points which are of doubtful value when the true value is already known. Many animals with bad milk records have fine shoulders, but so long as these are held to be essential in a high-milking animal and dual-purpose judges select for them instead of for the milk records, they will not attain their object of an animal with a meat conformation which will yield large quantities of milk. . . .

"In conclusion, a few other points which help to determine quality in meat may be mentioned. Of these, perhaps the amount and distribution of the fat is the most important; both for keeping and for roasting purposes there should be an even layer of fat over the whole carcase. This layer gives the smooth rounded outline to a properly finished steer. Some animals put on patchy fat, which is wasteful, as it has to be pared off; while in others, particularly in wild unimproved animals, there is hardly any fat under the skin and covering the carcase, but instead it is deposited in the abdomen as caul or gut fat where it is of relatively small value; this is a defect frequently seen when milk breeds are fattened. . . .

"With bacon pigs an even, not too thick, layer of fat is also required, but here the fault most frequently found is a breeding one consisting of heavy shoulders, a thick mass of fat being deposited in this region before the loin is even moderately covered. If such an animal is fattened until the loin has the correct thickness of fat, then the thickness of fat in the shoulder region is so great that it is valueless for first-class bacon. . . .

"On the other hand the baby beef, which is now being more largely produced than hitherto, often lacks sufficient colour and flavour (for these generally go together) to suit a public accustomed to roast beef of mature age; the colour can be developed, however, not only by breeding for early maturity but by giving exercise and iron-containing foods, as well as by not castrating."

Horses.

Genetics of the White Horses of the Fredreksborg Stud. *Chr. Wriedt. Zeit. f. Tierzucht., v. 1, pp.* 231-242. 1924.—A Danish stud of horses was bred for white colour. The purer became the colour, the lower fell fertility, and soon light-grey stallions had to be used in order to restore fertility. As a result of inbreeding the white line since 1840, 29 males and 29 females were produced, 7 of the latter being white-grey. Four tested mares, in 36 matings with white stallions, produced 11 foals, while in 20 matings with coloured stallions they produced 13 foals. The figures are, however, inconclusive, and the writer makes further deductions which do not appear to be warranted by the facts as presented in the paper. The only conclusion that can be usefully drawn is that a certain form of sterility in horses is hereditary in origin, a fact already known and recognised by all authorities and practical breeders.

Inbreeding in Cattle and Horses. *A. D. Buchanan Smith. Eugenics Review, October* 1926. *Paper from the Animal Breeding Research Department.* —The paper begins with a discussion as to how homozygosity in a breed as a whole may be measured. Inbreeding is only one of three main factors which affect homozygosity. It is the most easily measured. The writer believes

Sewall Wright's co-efficient of inbreeding to be the best measurement of such homozygosity.

Using this co-efficient, a comparison is made between Shorthorn cattle and Clydesdale horses. The former stands at about 26 per cent., the latter at 6 per cent. Nevertheless, the Clydesdale is probably as homozygous as the Shorthorn, due to selection and the greater number of females one stallion can serve. It is also suggested that in the Clydesdale there are a greater number of recessively inherited defects per individual, and this has reduced the amount of inbreeding.

On the Fertility of Stallions. *Sanders, H. G., The Journal of Agricultural Science, Cambridge,* 1926. *Vol. XVI, Part* 3.—Two sets of records, for Light and Heavy Horses respectively, have been analysed statistically with the object of studying some of the factors which affect the percentage of foals left by a stallion in a service season.

It has been found that the stallion himself is one factor, in that each individual's percentage returns, in successive seasons, tend towards a constant figure; although there is every gradation and even considerable variation from year to year, there are definitely good and bad "getters" of foals.

A stallion's fertility varies according to the district of the country in which he stands or travels, being higher in the north and west of England and Wales than in the south and east, and very low in Scotland.

In moderation, frequent use does not impair a stallion's fertility; there is, in fact, some (insignificant) evidence that the more mares he serves, up to about 150 in a season, the greater the proportion of foals he leaves.

There is a slight tendency for a stallion's fertility to rise from the time he is 3 years old till he is 13 years old; it is quite clear that fertility declines after the age of 16 years, and this occurs over the whole range, and is not caused by a certain number becoming absolutely sterile.

Cattle.

Transmitting Ability of 23 Holstein-Friesian Sires. *R. R. Graves. U.S. Dept. Agr. Bul.* 1372, 1926, *p.* 32.—The results are given of a study dealing with the transmitting qualities for milk and fat production of the 23 Holstein-Friesian sires listed in the Advanced Register Year-book up to volume 29 which have six or more daughters with yearly records whose dams also have yearly records. The milk and fat production was calculated to a mature equivalent in all cases where the records were made by cows under five years of age. The individual records of each daughter and dam show that there was considerable variation among the daughters of the same sire and with respect to the relation of the dams' and daughters' production. From these results and a further analysis it seems apparent that the daughters' production is not a simple blend between that of the sire and dam.

The sires were ranked in order according to the average milk yield, butterfat yield, increase of milk, increase of butterfat, and the percentage of daughters that were better than their dams in milk and butterfat yield. This tabulation showed that none of the sires ranked first in all groups, though some had the same relative ranking in several groups.

Some sires were, however, able to increase or decrease the milk yield and percentage of butterfat in milk in most of their daughters as compared with their dams, but most of the sires raised one and lowered the other. The type of breeding by which a sire had been produced did not appear particularly to affect his breeding ability.

It appears that both parents contribute to the milk and butterfat-producing capacity of their daughters, but in certain cases one parent may appear to be more influential because it carries more dominant factors.

A study of the data indicates that the factors for milk yield and butterfat percentage are inherited independently and in the majority of cases were indefinitely correlated, but in some cases a positive correlation was apparent.

Sprouting Oats as a Corrective for Sterility in Cattle. *R. R. Graves and F. W. Miller, United States Dept. of Agriculture, Bureau of Dairy Industry.*—Work has been done at the Government farm at Beltsville, Maryland, which gives some indication that the feeding of sprouted oats counteracts a certain form of sterility in cattle. This is probably due to the presence of vitamin E in the sprouted oats. Sprouted oats also assisted in retaining the fertility of the herd sire to a more advanced age. We are indebted to Dr. Graves for the following details, which should, however, be accepted with some reserve until further experimentation has been carried out.

During the past year, in the Beltsville herd of the Bureau of Dairy Industry, eleven animals that had given trouble in breeding became pregnant after sprouted oats were fed. These animals had not conceived after having been bred a number of times, but upon examination of the genital organs they showed no abnormal condition, pathological or otherwise, that would prevent conception. Only those animals that appeared normal were used in the experiment. Seven of these were cows that had bred without results for periods of six to fourteen months. Three of these seven cows were over eight years of age. The four remaining animals were heifers that had been bred a number of times with no conceptions.

In addition to the eleven animals, seven heifers were fed sprouted oats before being bred. Four of these conceived to first service, and the others required two, three and four services respectively for initial conception, making an average of less than two services per conception. Apparently sprouted oats correct a nutritive deficiency.

The stage of growth at which sprouted oats is most effective has not yet been determined. Experiments are being made with oats having sprouts 2 to 2½ inches long, and also with oats just germinating. Although the experiments with the oats that have barely sprouted have not gone far, it seems that the feeding of these oats will be effective in correcting sterility.

To produce green sprouts 2 to 3 inches long, the desired amount of dry oats should be placed in a sack and soaked for 24 hours in a tub or barrel of water to which a small amount of formalin—one ounce of formalin to 50 gallons of water—has been added for the purpose of preventing mould. The oats should remain in the sack on the floor for 48 hours, after which they should be placed in the pans or trays of an ordinary sprouter, such as is sold by poultry supply houses. The temperature should be maintained at about 75° to 80° F. If long growth is desired, the oats should be left in the pans five days. If less growth is desired, they may be fed sooner. The oats can also be sprouted by placing the dry oats in a perforated drum, soaking them in water for 12 hours, and then placing the drum on a rack for four days. The oats will then be matted together with numerous small white roots, and the sprouts will protrude from the grain sufficiently to be seen. Cattle appear to relish the oats that have just sprouted more than those with the long green sprouts. During the sprouting period the oats must be kept moist, care being taken to prevent too much moisture at one place and drying out at another.

The equivalent of 5 lbs. of dry oats per day is fed, and conception has occurred after a feeding period averaging approximately 60 days. Five lbs. of dry oats is the equivalent of 13 to 15 lbs. of the sprouted oats. The roots, sprout and germ are all fed. It has been the plan at Beltsville to substitute the oats for an equivalent weight of silage in the ration. Most of the animals receiving the oats were on dry feed.

The fact should be emphasised that the feeding of sprouted oats is likely to correct only functional conditions. Before feeding sprouted oats, care should be taken to remove any pathological causes that may prevent conception. For the most part, in the experiments at Beltsville, favourable results from sprouted oats feeding have been secured from animals in which a thorough physical examination has shown no reason for their not conceiving.

This is purely a preliminary note. No official announcement on this subject has as yet been made, and an open mind should be maintained until further particulars are available in a year or so. The Animal Breeding Research Department, Edinburgh, will be glad to communicate with any breeder who is desirous of making a practical experiment along these lines, and will give further particulars.

Udder Capacity and Milk Secretion. *Relation of Conformation and Anatomy of the Dairy Cow to her Milk and Butterfat Producing Capacity. W. W. Swett. U.S. Dept. of Agriculture*, 1927. *Journal of Dairy Science, vol. X, pp.* 1-14—How much milk does the udder of a dairy cow hold? Is most of the milk secreted during milking? Hitherto, the majority of authorities have held that no cow could retain in its udder as much as it gave forth when milked, some even going so far as to say that each quarter could not hold more than half a pint of milk, making two pints in all. This is a view not infrequently held by teachers and professional men, such persons believing that milk is secreted during the process of milking, the rapid acceleration in secretion being the result of a nervous reaction stimulated by the manipulation of the udder and teats.

The present study does not bear out this popular view. Udder capacity, by which is meant storage space inside the secretory system, was determined by injecting formalin through the teats and measuring the quantity retained within the secretory system. Data for five udders was thus secured, and it was found that the quantity of formalin injected was greatly in excess of the amount which it has been generally supposed that the udder would hold. An udder capacity of from three to five gallons was found to be not uncommon, and this would correspond with a potential storage value in the udder of a cow milked twice daily of from six to ten gallons, which is high above the average production.

In order to determine whether the milk in a cow's udder is secreted continuously or chiefly during the few minutes required for the milking process, two cows, which for the past week had been milked once daily at 10 a.m., were killed just before their daily milking was due. The udders were cut out, suspended and milked at 11 a.m. In the case of one cow almost as much milk was obtained as she normally gave, and this with no extra difficulty of milking. In the case of the other cow, only half the amount was obtained in this way, but when the udder was cut into an almost equal amount of milk gushed out. It had evidently been retained by *rigor mortis*.

There was a considerable variation as regards the fat content of the milk before and after death, and the author accounts for this by the fact that butter-fat melts at between 90°-99° F. The post-mortem milk was of lower average than this, being from 90°-93° one hour after death, and decreasing rapidly thereafter. The consistency of the fat would, therefore, change, and a large proportion of it would be retained in the smaller ducts, and thus account for the abnormally low fat content in the post-mortem milkings.

This is a most interesting paper, and its results, although not regarded as conclusive till additional tests at present under way have been carried out, may be summarised as follows :—

1. Milk secretion is to a considerable extent a continuous process.
2. A large proportion of the milk secured at any milking is collected and stored within the gland before the milking process is commenced.
3. The internal capacity of a lactating cow's udder appears to be greater than the volume of the milk secreted. The two udders on which results are here reported were not exceptionally large, yet one of them indicates an internal space sufficient to hold as much as 45 lbs. of milk.
4. The liberation of milk is not entirely dependent either upon a nervous or a mechanical stimulation or upon internal muscular contraction, since the act of milking was in both cases performed after all bodily connections had been severed.
5. The outstanding abnormality in the milk drawn after death is its low fat content. This might be accounted for on the theory that the fat globules were retained within the ducts as a result of the lowered temperature after death of the gland and of the milk contained within it.

Pigs.

Pig Carcases for Wiltshire Bacon. *H. R. Davidson, School of Agriculture, Cambridge, and J. Andreasen, St. Edmundsbury Co-operative Bacon Factory, Ltd.* (1927.) *Jour. Min. Agric., v.* 33, 1095-1102.—" The demands of the consumer must be the standard by which the producer is controlled " forms the thesis of a very useful and timely paper. At the outset, the writers point out that the side of bacon must first of all be capable of being divided into " cuts " of a manageable size, since the greatest demand is for breakfast table bacon, and since it is small rashers or slices that the consumer desires. Then follows a description of the various cuts illustrated by photographs. There is a useful table showing the proportions and values of cuts in a good quality Wiltshire side. This should be studied carefully by every bacon pig breeder in relation to the type of pig he is producing. The gammon is worth 1*s*. 9½*d*. per lb. as compared with the middle at 2*s*. and the fore end at 1*s*.

The writers point out that there is, however, more in pig type production than meets the consumer's eye or taste. There are several factors of great importance in connection with factory management. The farmer must not forget that there are secondary as well as primary offals. " In the case of a 200-lb. live pig the loss from live to dead weight is approximately 25 per cent." This is due to the primary offals. The loss from carcase to cured side is about 20 per cent. of carcase weight, or 15 per cent. of live weight. These secondary offals do not realise more than half per lb. what is paid for bacon, although the farmer has to be paid at the factory for the whole carcase, including these offals.

A carcase of less than 140 lbs. live weight hardly ever gives a streak that is sufficiently thick, while one above 180 lbs. live weight usually has two serious faults—one, the back fat being too thick, and, two, a tendency for the cheap-priced fore end to assume too great a proportion in relation to the middle.

There are also useful notes on sides that are too fat; seedy cut, more properly called black belly when it appears in black pigs, and to which apparently spayed pigs are not so prone; thin streaks, which common fault the authors put down to bad selection in breeding; soft fat, about which little is known, though quite a lot guessed; and heavy fore ends.

The following are the points which the authors believe the pig breeder and feeder should keep before him :—

(i) A carcase weight of from 140 lb. to 170 lb.
(ii) Small proportion of secondary offals, particularly head, feet and coarse bones.
(iii) Light fore end.
(iv) Full, well-shaped gammon, well fleshed down to hock.
(v) Long middle, 36½ in.
(vi) Back fat even; preferably 1½ in. but not over 2 in.
(vii) Thick streak and flank, not less than 1½ in.
(viii) Absence of seedy cut.
(ix) Firm fat.

It is significant to note that while the St. Edmundsbury Co-operative Bacon Factory has given a bonus of 1*s*. per score, amounting to about 8*s*. per pig, on all pigs which conform more or less to the above, this practice has been discontinued because the " home bacon-curing trade is passing through such a difficult time."

This paper provokes much thought, but the chief conclusion to be drawn from it is that there is need for much more knowledge upon the subject, both from the point of view of the type of pig which should be bred, and also the way in which it should be marketed. This emphasises the need which is being increasingly recognised of some system of advanced registry for pigs in connection with type testing stations and pig recording societies.

Poultry.

Inheritance in Poultry at the Connecticut Storrs Station. *Connecticut Storrs Sta. Bul.* 136, 1925.—The results of the following experiments are briefly reported.

Reduction of vigour through close inbreeding of White Leghorns.—The continuation of the inbreeding experiment has mainly confirmed the results previously noted. The most advanced family is in the fifth generation. The various families have been found to differ materially in egg size, egg shape, and bone size.

Crossing restores vigour.—Inbred females mated to their own brothers produced eggs of which 40 per cent. hatched, but when the same females were mated the next year to males of other families, 80 per cent. of the eggs hatched. The outbred chicks also grew more rapidly.

Experiments on Close Inbreeding of Poultry. *Freiin von Schleintz. Deutsche Landwirtschaftl. Geflügelzeitung, No.* 44, 1925.—Six strains were examined for brooding capacity, mortality, growth, egg production, maturity and propagation. The following results were arrived at :—

(1) *Brooding capacity.*—By inbreeding the brooding capacity declined in all six experimental strains. The brooding capacity of the parent stock amounted to 79 per cent.; after three generations of brother-sister inbreeding it was only 22 per cent.

(2) *Mortality.*—Inbreeding probably increases not only the mortality of the young stock but also that of the older stock. The reason is in general the smaller life capacity, partly also the great reversion to ancestral illnesses, and an increase of hens showing the results of recessive inherited factors of specific abnormalities, such as prolapse of the oviduct.

(3) *Growth.*—The rate of growth sank both for the inbred and the control chickens.

(4) *Egg Production.*—Yearly produce of the parent strains, 152. In the first generation of the brother-sister inbreeding there was a decline in productivity in all the six strains, about 57 per cent. of the average of the parent. The winter egg production of the inbred strains sank from 32 eggs in the parent generation to 5·7 in the second. With the control animals the winter egg production remained constant at about 18 eggs.

(5) *Maturity.*—The close inbreeding caused a great decline of fertility in the case of the mated fowls, which does not occur in the same animals in the absence of inbreeding; we here encounter a retardation of the development of the embryonic life.

Investigations regarding Form of Body and Laying Performance. *Weinmiller, Dissertation, Technische Hochschule, München,* 1924.—287 animals of various light breeds were measured and 12 indices drawn up, and these brought into relation with the laying performance. The results were as follows:—

A. With light breeds.

1. Animals with relatively deep and wide breast, and animals, which in comparison with their total size possess long carcases, represent the best layers.
2. Animals with comparatively long breast-bone ridge, and great distance of the end of the breast-bone ridge from the os pubis, are good layers.
3. Great distance of the end of the breast-bone ridge from the os pubis, considered by itself, is no sign of good laying performance.
4. The distance of the two ends of the os pubis from one another should amount to about a third of the width of the carcase of the animal. Animals with a smaller distance are bad layers; the exceeding of this smallest measurement has no connection with an increase of output.
5. The length of the lower part of the leg and ankle has no relation to the output.

B. With heavy breeds correlation between the measurements of the skeleton and the laying performance cannot be recognised.

On the Frequency of Spontaneous Tumours in Poultry. *Schneider, M. The Journal of Experimental Medicine, March* 1926, *Vol. LXIII, No.* 3.—On an experimental farm of about 11,000 birds an autopsy is made on all birds which die. Tumours are more frequent in the second six months of a pullet's life than in the first. It seems that intensive egg production precedes a period in which the proportion of tumours is above normal. The annual proportion of tumours found in birds of 6-18 months varies from 2 to 3 per cent.

The Economical Significance of German Poultry Breeding. *Dr. G. Schönborn. Berliner Tierärztliche Wochenschrift, p.* 159, *No.* 10, *March* 1926. —Until 1900 poultry was not counted in the general census of cattle and was not valued very highly. It is now recognised as of economic importance from the State's point of view, and Germany cannot do better than make use of American experience and adapt it to German conditions. The Americans have shown that continued calculations are the starting point in poultry keeping. In Germany also a tireless energy is being displayed in the economical perfecting of poultry breeding.

The exact knowledge of American working methods introduced after the war, partly by the return home of German-Americans, has had a great influence on poultry keeping. The poultry breeder demands protection for the home egg trade against foreign dumping.

The organisations are mentioned which are devoted to the furtherance of poultry breeding in Germany.

Eggs sold by Weight, Argentina.—In accordance with an announcement made in the South American daily papers, the Argentine home trade in eggs, whether wholesale or retail, will now be carried on by weight. The eggs are grouped in four classes, according as a dozen weigh respectively 500, 600 and 700 grammes or more. Egg producers will thus be encouraged to select good laying breeds, and to pay more attention to feeding and the general health of the birds.

Handling, Packing, Transport, and Storage of Eggs for South African and Overseas Markets. *A. Owen, John. Grootfentein School of Agriculture. Journal of the Department of Agriculture, Pretoria, p.* 261. *March* 1926.— South Africa feels the importance and necessity of producing a first-class egg and marketing it in the very best condition possible.

This article gives many rules conducive to the progress and prosperity of the industry. It contains several drawings and diagrams on how to keep and send eggs in boxes. The standard export egg box for all packs must be of the following dimensions :—

Compartments : 11¾ in. by 11¾ in. square by 13⅛ in. deep.
Length : 26 in. outside including cleats.
Width : 11¾ in. inside; 12¼ in. outside.
Depth : 13⅛ in. inside; 14⅛ in. outside.

In grading the following grades are suggested :—1st grade 24 oz. to the dozen, or 2 oz. per egg; 2nd grade 21 oz. per dozen, or 1¾ oz. per egg.

Grading for colour is not recommended for export overseas, owing to the fact that the coloured are not sufficiently deep in colour to compete with those produced elsewhere, particularly in France and Holland.

The graded eggs must be tested or "candled." It is important that only one grade of egg should be packed in each case.

The best method for cooling is known as "air-cooling." The correct temperature for long storage is 35° F., i.e. for eggs stored for four and a half to six months. When stored for two to three months a temperature of 38° F. is better, and on no condition should eggs be frozen.

Eggs kept in cold storage under proper conditions for five or six months can be of a far higher quality than a "fresh" egg laid under bad conditions.

When eggs are taken out of cold storage they should not suffer an immediate change of temperature from 35°-70°-90° F. This causes "sweating."

The ship's storage rooms are fumigated at the port of loading to avoid the possibility of mildew and are maintained at a uniform temperature of 35° F.

All eggs are exported under government regulations and are inspected in accordance therewith at the port of shipment.

ANIMAL NUTRITION.

The Relation of Sunlight to the Growth and Development of Calves. *Gullickson and Eckles. J. Dairy Sci., X., No. 2, 1927.*—It has been shown that chicks and young pigs are very susceptible to the absence of sunlight, and an experiment was carried out to determine the effect on growth and reproduction of keeping young calves in complete darkness. Two calves from 3-7 days old were kept in darkness for two years, and two, with no restrictions as to the amount of sunlight, were used as controls. The calves were fed on a uniform ration which consisted of whole milk during the first three or four weeks, which was replaced with skim milk until the calves were about six months old. Timothy hay of rather poor quality constituted the only form of roughage. The grain fed consisted of a mixture of three parts by weight of corn meal, and one part each of corn gluten feed, wheat bran and linseed oil meal. The ration was rather low in calcium, which made conditions favourable for positive results if sunlight is a factor in the utilisation of this mineral by cattle. Throughout the whole period of two years all the animals continued normal in all outward respects, and all made gains equal to, or better than, normal. From the beginning almost invariably the two calves raised in the dark made better gains than did the control animals. The calves were bred at about a year old and reproduction was normal except in one calf of the "no sunlight" group, which was found to have malformed reproductive organs. The ration provided an adequate supply of protein and total digestible nutrients but was low in calcium, but the calcium supply was evidently sufficient to enable all four heifers to make better than normal gains in both weight and height. The total amount of phosphorus in the ration invariably exceeded that of calcium, which represents a condition almost the opposite to the optimum recommended by M'Collum.

The Effect of Mineral Deficiency on the Yield and Composition of Cows' Milk. *Becker, Eckles and Palmer. J. Dairy Sci., X., No. 2, 1927.*—Data are presented in connection with an investigation on a deficiency in the rations of dairy cattle common in parts of Minnesota. The symptoms are those of osteomalacia, lack of thrift, low condition of flesh, undersize, abnormal decline in milk production, stiffness in joints, and an abnormal appetite evidenced by persistent chewing of bones, eating wood and dirt. This condition has been shown to be due to a lack of phosphorus in the forage reflected by the small content of phosphorus in the soil. Samples of milk were collected and analysed, after which the ration was supplemented with an inorganic mineral supplement, after which samples of milk were again taken. A supplement of calcium carbonate had no effect on the condition of the animals, but a marked improvement and complete recovery from any visible symptoms of osteomalacia was effected when the ration was supplemented with either mono-basic sodium phosphate or tricalcium phosphate. The data indicate that a shortage of phosphorus in the ration extending over a long period of time may become a limiting factor in milk production, but that under conditions of severe osteomalacia the calcium and phosphorus content of the milk remains normal in amount and in proportion, and there was no indication that the addition of the mineral supplements increased the calcium or phosphorus content of the milk.

The Influence of Animal and Vegetable Proteins on Egg Production. *H. L. Kempster, Univ. of Missouri, Agri. Expt. Stn., Bull. 225, November 1924.*—Ten years of feeding experiments are reported in this bulletin. The report covers 70 separate tests involving four distinct phases of the relationship between protein feeds and egg production, namely, proteins of animal origin, various amounts of such proteins, proteins of vegetable origin, and the correlation between the consumption of meat scrap or tankage and egg production. The conclusions drawn from these experiments are as follows:—The use of meat scrap, tankage, sour skim milk and dried buttermilk resulted in an egg production per hen of 117, 120, 125 and 112 eggs respectively, as compared to 61 eggs in the check pen receiving no animal protein.

Cost is the chief factor to consider in selecting one of the above protein concentrates for feeding for egg production.

Mashes containing 15 per cent. or more of meat scrap or tankage gave uniformly more satisfactory results than when smaller amounts were used.

The addition of cottonseed meal to poultry mashes did not increase production when fed as the only protein concentrate in the mash or in combination with meat scrap or tankage. It is suggested that a mineral deficiency exists in cottonseed meal which may be the cause of the unsatisfactory results.

The optimum amount of meat scrap or tankage for White Leghorn hens is round 6 lbs. per hen per year. White Leghorn hens ate from 67 to 82 lbs. of feed per hen per year. Feeding meat scrap, tankage or milk products reduced by nearly one-half the amount of feed required to produce a pound of eggs.

A Comparison of White and Yellow Corn for growing and fattening Swine and for Brood Sows. *Rice, Mitchell and Laible. Agric. Expt. Stn., Univ. Illinois, Bull.* 281. *December* 1926.—The experiments reported in this bulletin were undertaken to compare the feeding value of white and yellow corn in rations for breeding sows and for weanling and fattening pigs. It was desired also to ascertain how white corn might be supplemented in order to make it as satisfactory as yellow corn for this purpose.

It was found that sows raised on normal rations could be carried through gestation and suckling periods on a ration of white corn, white-corn bran and tankage without evident effect on the number of pigs farrowed or weaned or upon the growth of the pigs during the suckling period. The continued feeding of this ration, however, resulted in serious impairment of the reproductive powers of one sow, her third and fourth litters being farrowed dead. With the addition of 1 per cent. of cod-liver oil to the ration during the fifth gestation this sow farrowed a litter of normal pigs.

Normal weanling pigs which were farrowed by sows carried through their gestation periods on white corn rations were continued on a ration of white corn and tankage. They failed to thrive and ultimately developed pathological symptoms and died. Pigs farrowed by sows not on experiment and raised on normal rations to 60 or 70 lbs. were eventually handicapped by white corn feeding, although they made normal gains for several weeks. At weights of 175 to 200 lbs. they developed characteristic symptoms of white corn feeding and finished poorly.

Small amounts of alfalfa meal (a little more than an ounce a head daily) proved entirely effective in correcting the deficiencies of a ration of white corn and tankage fed pigs while growing and fattening from weights of 60 to 227 lbs.

Apparently it was a lack of vitamin A that caused the unfortunate results when sows and pigs were continued on the white corn ration for too long a time, for when that factor was supplied by adding small amounts of alfalfa meal or cod-liver oil the pigs developed normally and the sows farrowed normal litters. While white corn may be deficient in vitamin D as well as vitamin A, it is considered improbable that such a deficiency could have affected the results, since sunshine apparently removes the necessity for that vitamin in the feed, and all the pigs in these experiments were confined to open dry lots, allowing as great exposure to direct sunlight as the weather would permit.

Utilisation of Cereals in varying stages of preparation for fattening Pigs. *Schlumbohm, R. Journal für Landwirtschaft, Vol. LXXIV, No.* 3. *Berlin,* 1926.—From the numerous analytical data given in this article some of the more important average results may be reproduced here, referring to three sets of animals fed respectively (1) on whole grain; (2) on dry ground grain; (3) on moistened ground grain.

The results show, *inter alia*:—(1) pigs cannot themselves grind up the whole grain so well as is done mechanically; (2) the digestibility of the whole grain is less by 10 per cent. than that of the ground grain (ground to particles of 3 mm.); (3) the energy required to masticate the whole grain involved loss to the animals of 42 gm. of total nutritive substances per every kilogramme of live weight increase; (4) pigs fed with dry ground grain assimilate the food most satisfactorily, i.e. they produce with an equal weight of feed the maximum increase in live weight; on the other hand the moistened ground grain which is softened results in quicker increase of weight. In conclusion, fattening pigs should not be fed on whole grain, and the advantage gained by moistening ground grain is doubtful.

Contribution to the Digestibility of Albumen in Poultry. *Reatz, Arbeiten der Lehr- und Versuchanstalt für Geflügelzucht, Halle a. d. Saale Cröllwitz, Prof. Dr. Römer, Deutsche Landwirtschaftliche Geflügelzeitung, 28th year, No.* 46, 13 *August* 1925.—Kellner established the prime importance of the digestibility of feeding material dealing only with cattle, Lehmann with pigs. Poultry conditions were not much considered. Experiments in food assimilation by poultry did not take place until the end of the last and the beginning of this century, when undertaken by Lehmann, Voltz, Dietrich, and especially Lössl. Figures of digestibility of a few foodstuffs :—

	According to Kellner for large cattle.	According to Lössl for poultry.
Wheat	80 per cent.	26·67 per cent.
Maize	83 ,, ,,	24·10 ,, ,,
Barley	77 ,, ,,	14·92 ,, ,,
Oats	79 ,, ,,	18·64 ,, ,,
Soya Bean	94 ,, ,,	36·05 ,, ,,
Fish-meal	92 ,, ,,	91·90 ,, ,,
Meat meal	97 ,, ,,	82·35 ,, ,,

Experiments on the digestibility of albumen with shredded oats, dry yeast and dry buttermilk with fowls :—

The oats albumen showed	36·12 per cent. digested
The dried yeast albumen	42·68 ,, ,, ,,
The dried buttermilk	74·66 ,, ,, ,,

Dried yeast and dried buttermilk did not prove so digestible for fowls as fish-meal and meat-meal.

DAIRYING.

Experiments with Dairy Cattle at the Pennsylvania Station. *S. I. Bechdel and H. E. Honeywell. Pa. Sta. Bul.* 204. 1926.—Heifer calves raised on a ration deficient in vitamin B have been carried successfully to maturity. Evidently calves do not require vitamin B unless it is elaborated by micro-organisms in the digestive tract. The ration used was not satisfactory for milk production, as the heifers went off feed in one to three weeks after calving and became weak and emaciated. The exact cause of the trouble has not been determined.

The milk from the heifers on a ration deficient in vitamin B was fed to rats receiving a ration otherwise deficient in vitamin B. It was found that this milk was as satisfactory a source of vitamin B as milk from cows on a normal ration. Consequently vitamin B must be elaborated by the cow or by micro-organisms in her digestive system.

Sunflower Silage for Dairy Cows. *Mont. Sta. Rpt.*, 1925.—In a trial with Jersey cows it was found that 100 lbs. of dry matter in oat and pea silage, with hay and grain added, produced 273 lbs. of milk and 12·5 lbs. of butterfat, while an equal amount of dry matter from sunflower silage produced 402 lbs. of milk and 19·23 lbs. of butterfat.

Stabilisation of Prices of Dairy Produce. *The Australian Dairy Stabilisation Plan. Hoard's Dairyman, Vol.* 17, *No.* 22, *Fort Atkinson,* 10 *October* 1926.—*Queensland Producer, Vol.* 8, *No.* 21, *Brisbane,* 24 *November* 1926.—The Australian dairy farmers adopted during 1926 a plan for obtaining higher prices for butter on the home market. The price on the Australian home market is ordinarily ruled by the price obtained on the London market, being less than this price by the cost of transport. The plan adopted was originally propounded by Mr. T. Paterson, Commonwealth Minister of Markets and Migration, who was instrumental in securing its adoption by the dairy factories of five States of Australia, Western Australia, which is still a butter importing State, remaining outside the scheme. The plan was not a legal enactment, but took the form of a voluntary agreement to which almost all the butter factories in Australia subscribed. A levy was imposed for one year from 1st January 1926 on all butter *manufactured* in the Commonwealth. This levy was paid by each factory as agreed to a central agency. The amount of the levy was at first fixed at 1*d.*

per lb.; but was afterwards raised to 1½*d*. From the fund thus formed a bounty of 3*d*. was paid back to the factories on all butter *exported*. The real gain to the factories came from the fact that butter could be sold to the Australian consumer at the same price which the exported butter brought, viz. the London price, less cost of transport, plus the export subsidy. The Australian home market for butter was thus advanced to a higher price level than the London market. However, as a result of this, the New Zealand producers found it advantageous to send their surplus butter to Australia instead of London, the net price received by the New Zealand producer being higher for Australian than for English delivery, and this in spite of the necessity of paying the Australian tariff of 2*d*. per lb. The unexpected competition made it necessary to lower by 1*d*. per lb. the price on the home Australian market.

For the year ending 30th June 1926 the estimated production of butter in the Commonwealth of Australia amounted to 4,900,000 boxes of 56 lbs., and the exports to 2,100,000 boxes. The number of dairy factories in the five States participating in the agreement for 1926 was about 400, only seven factories out of this number refusing to join.

Manufacture and Export of Dairy Produce, &c. *New Zealand*.—An Order in Council of 15th November 1926 regulates the manufacture and export of dairy produce. The Order lays down that " It shall be unlawful for any person to manufacture, receive, or deposit for manufacture, or pack or seal into air-tight packages any dairy produce, or to mix or blend any butter except in accordance with the regulations and in a manufacturing dairy duly registered." The registration of these dairies, the use of milking machines, the care of milk and cream, the grading of cream, and cream grader certificates are fully dealt with. Contaminated or decomposing milk may not be supplied to any manufacturing dairy; if such milk is delivered it shall be coloured with methyl violet. Before being sent to a grading store cheese and butter must be branded or marked. Specific directions are given for the proper grading of butter and cheese, and for the weighing, sampling, testing and recording at manufacturing dairies.

MACHINES AND IMPLEMENTS.

Industrial Tractors. *Wiggins, E. R., Farm Implement News, Chicago*, 1926, *Vol.* 47, *No.* 52.—The writer here calls attention to the advantage of transforming farm into industrial tractors, i.e. tractors capable of road traffic. He describes, with an illustration, an arrangement of interchangeable rubber-tyred wheels which seems to be of considerable practical interest, as it avoids damage to the road as well as to the tractor.

A Motor Mowing Machine. *Die Landmaschine, Berlin*, 1927, *Year VII*, *No.* 1.—An automatic mowing machine manufactured by the firm of Eugen Haag, Schnelldorf-Kempten, in 1926 has undergone a short but successful trial. The government committee of " Technik und Landwirtschaft " has made a grant to the constructor for the further development of the machine.

The cutting apparatus is in front of the chassis instead of as hitherto at the side, thereby ensuring a fuller use of power and rendering any preparatory cutting superfluous.

The light motor of 5 h.p., with which it is equipped, can drive the cutting apparatus or the wheels independently, so as to allow the cutting apparatus alone to be put in gear and the machine to be propelled by hand.

The weight is only 140 kg. The light motor weighing 21 kg. can develop two speeds from 2·5-5·0 km.p.h., and fuel consumption should be 2-2½ litres per morgen (approx. 1 acre).

STATISTICS.

PRICES of AGRICULTURAL PRODUCE, FEEDING STUFFS and FERTILISERS in March, April and May 1927.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	March.			April.			May.		
	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	p-r cwt. l.w. s. d.	per cwt. l.w. s. d.
Aberdeen-Angus ...	59 8	54 2	41 7	60 8	55 3	42 0	59 11	54 1	41 5
Cross-bred (Shorthorn)	55 10	49 2	35 7	56 5	50 4	36 5	56 2	49 8	35 5
Galloway	56 0	51 5	...	55 5	50 3	...	55 8	50 5	...
Ayrshire	58 3	51 6	36 0	56 9	51 3	35 6	54 9	49 0	35 0
Blue Grey	...	...	...	...	...	...	59 0	...	...
Highland	...	...	...	...	...	...	...	...	...
	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
VEAL CALVES	16½	9	5½	15½	8¾	5	15¾	9	5¾
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot	13½	12	10½	14	12½	11	14½	13	11¼
Half-bred	13	12½	8¾	13¼	13	9¼	13¾	13¼	9¼
Blackface	13¼	13	10	13¾	13¼	10¾	13¾	13½	11¼
Greyface	13½	12¼	9¼	14	12¾	10¼	14¼	13¼	10¼
Down Cross	13½	12½	8	14	13	8¼	14¼	13½	8¼
PIGS—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs	14 1	13 2	...	13 11	13 1	...	13 10	12 10	.
Porkers	14 6	13 8	...	14 5	13 7	...	14 3	13 4	...

Average Prices of Live Stock in Scotland—*continued.*

Description.	March.			April.			May.		
	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality
STORE STOCK :—									
CATTLE—	Per head.	Per head.	Per head	Per head.	Per head.	Per head.	Per head.	Per head	Per head
Aberdeen-Angus :	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Yearlings	17 14	14 7	12 12	19 15	16 2	13 2	18 11	15 3	12 14
Two-year-olds ...	23 8	18 17	...	24 5	20 8	17 5	23 8	19 3	16 3
Cross-bred (Shorthorn):									
Yearlings	16 13	13 14	12 3	18 1	14 15	12 6	17 1	14 9	12 3
Two-year-olds ...	21 17	17 13	14 0	23 0	18 16	16 18	22 15	17 19	15 8
Galloway :									
Yearlings	16 17	...	...	17 14	15 10	...	17 16	...	...
Two-year-olds ...	22 0	...	...	22 7	...	...	26 13	20 0	...
Ayrshire :									
Yearlings	...	...	...	11 15	...	...	12 5	...	...
Two-year-olds ...	...	...	...	...	...	...	20 5	17 10	..
Blue Grey :									
Yearlings	...	...	.	...	..	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	25 0	...	...
Highland :									
Yearlings	...	...	...	...	...	...	12 0	11 10	...
Two-year-olds ...	...	..	...	16 18	14 3	...	17 3	15 0	12 15
Three-year-olds ..	18 5	17 3	...	23 0	20 0	17 10	22 10	19 0	17 10
DAIRY COWS—									
Ayrshire :									
In Milk	28 6	21 16	12 0	29 4	22 0	12 5	29 10	22 15	12 0
Calvers	28 16	22 4	14 6	28 13	22 0	14 10	28 5	22 9	14 18
Shorthorn Cross :									
In Milk	31 13	24 0	17 18	32 3	23 16	..	32 0	24 4	...
Calvers	29 11	21 18	15 18	28 16	21 5	15 5	29 5	21 3	15 14
SHEEP—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Cheviot Hoggs ...	48 1	37 7	32 0	50 10	40 10	27 8	49 2	37 5	27 0
Half-bred Hoggs ...	61 7	48 2	39 11	62 0	50 9	46 1	66 7	61 5	51 0
Blackface Hoggs ...	33 2	27 6	21 0	38 6	30 3	23 11	39 6	32 7	25 11
Greyface Hoggs ...	48 5	38 3	36 2	50 0	41 0	36 0	53 4	42 0	34 6
Down Cross Hoggs	59 6	49 6	...	51 9	49 6	...	...	50 0	...
PIGS—									
(6 to 10 weeks old)	50 6	33 7	...	50 0	34 3	...	47 8	33 1	...

Average Prices of Dead Meat at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	March. Dundee.	March. Edinburgh.	March. Glasgow.	April. Dundee.	April. Edinburgh.	April. Glasgow.	May. Dundee.	May. Edinburgh.	May. Glasgow.
		per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
Beef :—										
Home-fed—										
Bullock or Heifer ...	1	8⅝	8⅝	10½	8¼	8⅝	10⅝	8¼	8¾	9⅞
	2	8	...	10	7⅞	8	9⅞	7¾	8⅛	9⅜
Bull	1	6⅝	7¼	7	6½	7¼	7½	6½	7⅜	7⅜
	2	6	6⅜	6½	6	6½	7	6	6⅜	6⅞
Cow	1	5½	5¼	6½	5½	5⅝	6½	5½	5½	6½
	2	5	...	5½	5	...	5½	5	5	5½
Irish—										
Bullock or Heifer ...	1	...	...	8	...	...	8¼	...	...	...
	2	...	...	7½	...	...	7¾	...	...	...
Bull	1	...	...	5⅞	...	...	6¼	...	...	...
	2	...	...	5⅜	...	...	5¾	...	...	...
United States & Canadian—										
Killed at Birkenhead ...	1	...	...	...	..	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	...
Killed at Glasgow ...	1	...	...	8	...	...	8	...	...	...
	2	...	...	7½	...	...	7½	...	...	...
Argentine Frozen—										
Hind Quarters ...	1	4¾	4¾	...	4⅞	5¼	...	5¼	5⅜	...
	2	4½	4⅜	...	...	5	...	...	4⅞	...
Fore ,, ...	1	3¾	3¾	...	3½	3⅝	...	3½	3½	..
	2	...	3½	...	3¼	3⅜	...	3¼	3¼	...
Argentine Chilled—										
Hind Quarters ...	1	5½	5⅛	5⅛	6	5¾	5¾	6½	6⅛	6⅛
	2	...	4¾	4⅝	...	5¼	5¼	...	5⅞	5⅝
Fore ,, ...	1	3⅝	3⅜	3⅜	3½	3⅛	3¼	3⅜	3	3⅛
	2	..	3⅛	3⅛	3¼	2⅞	3	3¼	3	2⅞
New Zealand Frozen—										
Hind Quarters ...	1	...	...	4½	...	...	4½	...	...	4⅝
Fore ,, ...	1	...	...	3½	...	...	3½	...	...	3⅜
Mutton :—										
Hoggs, Blackface ...	under 60 lb.	11¼	11	11¼	11⅝	12	12⅛	11½	12¼	12½
	60 lb. & over	11	10¼	10¾	11	11	11⅝	11	..,	12
,, Cross	under 60 lb.	11¼	11	11	11⅝	12	11⅞	11½	12¼	12¼
	60 lb. & over	11	10¼	10½	11	11	11⅜	11	...	11¾
Ewes, Cheviot	1	9	8¼	9⅛	9⅝	8⅞	10½	9½	8¼	10¼
	2	8¼	...	8⅝	9	8½	10	9	...	9¾
,, Blackface ...	1	9	8¼	9⅛	9⅝	8⅞	10½	9½	8¼	10¼
	2	8¼	...	8⅝	9	8½	10	9	...	9¾
,, Cross	1	6¼	8¼	6¾	6¾	8¾	7⅞	7	8¼	7⅝
	2	6	...	6¼	6	...	7⅜	6	...	7⅛
Argentine Frozen ...	1	...	...	5½	..	...	5½	...	...	5¼
	2	...	...	4½	...	...	4½	...	...	4⅜
Australian ,, ...	1	...	5⅛	...	...	5¼	...	...	5½	...
	2	...	4⅜	...	...	4⅜	...	...	4¾	...
Lamb :—										
Home-fed	1	...	...	...	...	18	23¾	16	16¼	18½
	2	...	...	...	...	...	21¾	...	...	16½
New Zealand Frozen ...	1	...	10	...	...	10¼	9¼	...	10	9¼
	2	...	9¼	...	...	9½	...	...	9½	...

Average Wholesale Prices of Provisions at Glasgow.

(Compiled from Reports received from the Board's Market Reporter.)

Description.		Quality.	March. s. d.	April. s. d.	May. s. d.
Butter:					
Irish Creamery	per cwt.	1	...	...	159 4
Argentine (Unsalted) ...	,,	1	170 0	167 0	162 6
Australian	,,	1	162 5	159 6	159 6
Danish	,,	1	185 10	184 6	165 9
,, (Unsalted) ...	,,	1	191 2	189 6	170 9
New Zealand	,,	1	163 2	159 6	164 9
,, (Unsalted) ...	,,	1	169 7	163 6	169 6
Swedish	,,	1	174 5	174 6	161 0
Cheese:					
Cheddar	,,	1	114 0	112 0	112 0
		2	96 0	94 0	92 6
Cheddar Loaf	,,	1	112 10	110 0	111 0
Dunlop	,,	1	109 2	110 0	108 6
		2	98 5	101 0	104 0
Canadian...	,,	1	101 0	100 0	...
New Zealand (Coloured)	,,	1	90 10	82 9	85 6
,, (White)	,,	1	90 10	82 9	85 6
Bacon:					
Ayrshire (Rolled) ...	,,	1	154 0	154 0	153 6
Irish (Green)	,,	1	143 7	146 0	148 3
,, (Dried or Smoked)	,,	1	150 10	152 0	154 3
,, (Long Clear) ...	,,	1	136 5	133 9	140 6
Wiltshire (Green) ...	,,	1	146 5	147 0	147 0
,, (Dried or Smoked)	,,	1	154 5	155 0	155 0
American, Long Clear Middles (Green)	,,	1	93 5	95 6	104 6
,, Short Clear Backs...	,,	1	104 5	104 0	100 0
Canadian Sides	,,	1	95 0	93 6	91 6
Danish Sides	,,	1	101 2	101 0	106 0
Dutch, Wiltshire Style (Green)	,,	1	91 10	90 6	94 9

Description.		Quality.	March. s. d.	April. s. d.	May. s. d.
Hams:					
Irish (Smoked)	per cwt.	1	195 0	197 0	207 0
		2	181 2	178 6	191 0
American, Long Cut (Green)	,,	1	110 5	114 3	115 0
American, Short Cut ...	,,	1	112 0	115 3	115 0
Eggs:					
Country	per doz.	1	1 10	1 8	1 8
		2	1 8	1 6	1 6
Irish	per 120.	1	12 11	13 2	13 5
		2	12 2	12 2	12 4
,, (Duck)	,,	1	14 8	12 5	12 2
Belgian (Fresh)	,,	1	12 11	...	...
Danish	,,	1	13 10	13 9	14 5
		2	12 7	12 3	13 2
Dutch	,,	1	12 6	...	...
,, (Duck)	,,	1	13 7	...	11 5
Polish	,,	1	10 2	9 2	9 2
		2	...	8 1	7 11
Russian	,,	1	...	...	9 6
Swedish	,,	1	13 8	13 6	14 5
		2	12 4	12 6	13 2

Average Wholesale Prices of First Quality Fruit and Vegetables at Glasgow.

(Compiled from Reports received from the Board's Market Reporter.)

Description.	March.	April.	May.
Fruit :—			
Apples—	s. d.	s. d.	s. d.
British ... per barrel.*	26 0	22 9	25 0
Imported : American ... ... per case.†	13 7	11 3	11 3
Vegetables :—			
Asparagus ... ... per bunch.	...	2 0	2 0
Beet ... ... per cwt.	5 2	5 0	4 9
Brussels Sprouts ... ... ,,	16 0	...	...
Cabbage, Coleworts ... per doz.	1 0	1 0	1 0
,, Savoy ... ... ,,	2 0	...	...
,, Red ... ... ,,	2 0	..	...
Carrots ... ... per cwt.	4 11	5 0	4 11
Cauliflowers—			
Broccoli, *Cornish* ... per doz.	3 6	4 0	5 4
,, *Other British* ,,	...	4 0	5 9
,, *French* ... ,,	3 10	3 0	...
Celery ... ... per bunch.	1 4	...	...
Cucumbers ... ... per doz.	...	9 0	5 9
Greens ... ... ,,	1 0	1 0	...
Leeks ... ... per doz. bunches.	2 6	2 2	1 11
Lettuce, Cabbage ... per doz.	...	1 5	1 4
Onions—			
Spring ... ... per bunch.	0 6	0 5¼	0 5
Dutch ... ... per bag.‡	5 7	...	...
Egyptian ... ... ,, §	..	12 11	11 11
Valencia ... ... per case.*	9 10	9 0	...
Parsley ... ... per cwt.	24 10	16 0	15 0
Parsnips ... . ,,	7 4	6 6	6 0
Radishes ... ... per doz. bunches.	...	...	1 0
Rhubarb ... ... per cwt.	34 0	11 6	6 3
Tomatoes, *British* ... per lb.	...	3 9	1 0
,, *Channel Islands* ,,	0 5	0 6¼	1 3
,, *Canary* ,,	0 5¾	0 5½	0 8
Turnips ... ... per cwt.	1 11	2 0	2 8

* 9 stone (approx.). † 40 lb. (approx.). ‡ 7½ stone (approx.). § 8 stone (approx.).

Average Wholesale Prices of Potatoes at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Market.		Quality.	Late Varieties. Red Soils. Langworthy and Golden Wonder.	Red Soils. Other.	Other Soils. Langworthy and Golden Wonder.	Other Soils. Other.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.
March.						
Dundee	per ton.	1	...	...	...	4 14 0
Edinburgh	,,	1	...	...	...	5 9 0
Glasgow	,,	1	10 4 0	7 3 0	8 12 0	5 7 0
April.						
Dundee	per ton.	1	...	...	...	5 1 0
Edinburgh	,,	1	...	...	...	5 15 0
Glasgow	,,	1	10 3 0	6 19 0	8 11 0	5 18 0
May.						
Dundee	per ton.	1	...	...	...	7 0 0
Edinburgh	,,	1	...	...	..	7 9 0
Glasgow	,,	1	11 5 0	9 5 0	10 0 0	7 9 0

Average Prices of Roots, Hay, Straw, and Moss Litter at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Market.	Quality.	Roots. Carrots.	Roots. Yellow Turnips.	Roots. Swedes.	Hay. Rye Grass and Clover.	Hay. Timothy.	Straw. Wheat.	Straw. Barley.	Straw. Oat.	Moss Litter.
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
March.										
† Dundee ... per ton.	1	...	...	14 7	105 0 (a) 90 0 (b)	...	65 0	65 0	60 0	51 2
‡ Edinburgh ,,	1	...	...	...	97 0 (a) 92 0 (b)	...	49 0	44 0	49 0	45 0
‖ Glasgow ,,	1	...	...	...	73 0	77 6	43 0	...	41 6	31 6
April.										
† Dundee ... ,,	1	...	...	15 0	101 3 (a) 88 9 (b)	...	60 0	60 0	60 0	51 6
‡ Edinburgh ,,	1	...	...	...	90 0 (a) 90 0 (b)	...	47 6	42 6	47 6	45 0
‖ Glasgow ,,	1	...	...	...	75 0	77 6	40 0	...	40 0	32 6
May.										
† Dundee ... ,,	1	...	...	24 6	100 0 (a) 90 0 (b)	100 0	60 0	...	60 0	51 6
‡ Edinburgh ,,	1	...	...	...	90 0 (a) 90 0 (b)	...	46 3	41 3	46 3	45 0
‖ Glasgow ,,	1	...	...	...	75 0	77 6	40 0	...	40 0	32 5

Quotations for Straw, baled and delivered. (a) Baled and delivered.
,, ,, delivered loose in town. (b) Delivered loose.
‖ ,, for baled Hay and Straw f.o.r.

Average Prices of Feeding Stuffs at Glasgow and Leith.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	March.		April.		May.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Linseed Cake—						
Home	12 1 0	11 11 0	11 13 9	10 16 3	11 10 0	10 16 3
Foreign	11 13 0	11 6 6	11 10 8	10 12 6	11 10 0	10 12 6
Decorticated Cotton Cake	10 2 6	...	10 6 3	...	10 9 5	...
Undecorticated Cotton Cake—						
Bombay (Home-manufactured)...	...	6 7 0	...	6 3 9	...	6 11 3
Egyptian (do.)	6 16 0	6 9 0	6 10 8	6 6 3	6 16 3	6 16 3
Palmnut Kernel Cake	9 10 0	...	9 15 0	...	10 0 0	...
Coconut Cake ...	...	...	10 18 9	...	11 0 0	...
Groundnut Cake, Undecorticated—						
37 per cent. Oil and Albuminoids	8 2 6	...	7 16 8	...	...	...
40 per cent. do.	8 9 0	7 10 0	8 3 2	7 10 0	8 10 0	...
Maize Germ Cake—						
Home	10 15 0	...	10 7 6	...	10 10 0	...
Foreign	...	...	...	...	10 9 2	...
Maize Germ Cake Meal	10 5 0	...	10 5 0	...	...	...
Barley Meal ...	10 5 0	...	10 10 0	...	11 2 6	...
Bean Meal	11 19 0	12 5 0	11 16 3	12 5 0	12 1 11	12 5 0
Maize Meal—						
Home Manufactured	8 17 6	8 12 6	8 16 11	8 8 9	9 3 2	8 8 9
South African (Yellow)	9 0 0	...	...	...	9 0 0	...
Rice Meal	7 0 0	...	7 4 5	...	7 5 0	...
Locust Bean Meal ..	9 10 0	8 10 0	9 3 2	8 10 0	9 5 0	8 10 0
Locust Beans (Kibbled and Stoned)	...	7 15 0	...	7 15 0	...	7 15 0
Maize Gluten Feed (Paisley) ...	8 5 0	...	8 5 0	...	8 5 0	...
Maize—Plate ...	7 15 0	8 0 0	7 17 6	7 14 5	8 3 2	8 1 3
Oats—Home ...	8 6 6	7 12 0	8 16 3	8 0 0	10 2 6	9 2 6
,, Plate ...	8 9 0	...	8 11 8	..	9 12 6	...
Barley—Feeding ...	9 19 0	9 2 0	9 16 3	9 0 0	...	9 5 0
,, Bran ...	9 10 0	...	9 0 0	...	9 15 0	...
Malt Culms... ...	7 1 0	...	7 1 3	...	7 0 8	...
Distillery Mixed Grains Dried	7 19 6	8 7 6	7 13 9	8 5 7	7 10 0	8 0 0
Brewers' Grains— Dried	8 0 0	7 1 6	7 10 8	7 3 9	7 7 6	7 0 0
Distillery Malt Grains —Dried ...	7 19 0	...	7 10 10	...	7 10 0	...
Wheat—						
Middlings (Fine Thirds or Parings)	10 8 6	8 10 0	9 15 8	8 13 9	10 1 3	8 15 0
Sharps (Common Thirds) ...	8 4 6	7 10 0	8 0 8	7 13 9	8 4 5	7 17 6
Bran (Medium) ...	8 4 5	7 18 6	8 5 8	8 0 0	8 6 3	8 0 0
,, (Broad) ...	8 9 6	8 14 0	8 10 0	8 15 0	8 11 3	8 15 0
Feeding (Home)...	12 14 0	12 0 0	12 12 6	12 0 0	13 11 3	12 7 6
Feeding Treacle ..	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0
Crushed Linseed ...	21 15 0	...	21 5 0	...	21 5 0	...
Fish Meal	22 0 0	21 0 0	22 0 0	21 0 0	22 1 3	21 0 0
Beans—English ...	11 11 6	...	11 9 5	...	11 18 9	...
China	10 18 0	...	11 0 0	...	11 5 0	...
American (White)	...	...	8 10 0	...	8 10 0	...
Rangoon (White)	9 5 0	...	9 6 8	...	9 5 0	...
Pease—China (White)	13 0 0	...	13 2 6	...	13 0 0	...

Average Prices of Fertilisers at Glasgow and Leith.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Guaranteed Analysis.	March.		April.		May.	
		Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
		per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
	%	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Nitrate of Soda ...	N. 15½	13 13 6	13 0 0	13 15 0	13 2 6	13 15 0	13 10 0
Nitrate of Lime ...	N. 13	11 12 0	11 0 0	11 0 0	11 0 0	11 0 0	11 0 0
Sulphate of Ammonia (Neutral and Granular) ...	N. 20·6	12 5 5	12 6 0	12 6 0	12 6 0	12 6 0	12 6 0
Calcium Cyanamide	N. 19	9 14 0	9 14 0	9 16 0	9 14 6	9 16 0	9 16 0
Superphosphate ...	S.P. 30	2 16 0	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0
"	S.P. 35	3 1 0	3 0 0	3 0 0	3 0 0	3 0 0	3 0 0
"	S.P. 38	3 6 0	3 5 0	3 5 0	3 5 0	3 5 0	3 5 0
Bone Meal—Home	N. 5 I.P. 40	8 15 0	8 0 0	8 15 0	8 0 0	8 15 0	8 0 0
" " —Indian	N. 3¾ I.P. 45	9 14 0	8 0 0	9 10 0	8 0 0	9 10 0	8 0 0
Steamed Bone Flour	N. 1 I.P. 60	6 10 0	6 0 0	7 0 0	6 10 0	7 0 0	8 0 0
‡Ground Mineral Phosphate ...	I.P. 65	...	3 5 0	...	3 3 9	...	3 0 0
‡ " "	I.P. 58/60	2 15 0	...	...	...	...	...
Basic Slag	T.P. 24	*2 7 6	..	*2 7 6	...	*2 7 6	...
" "	" 26	*2 11 6	**2 12 0	*2 11 6	**2 12 0	*2 11 6	**2 12 0
" "	" 28	*2 15 0	...	*2 15 0	...	*2 15 0	...
" "	" 30	*3 0 0	...	*3 0 0	...	*3 0 0	...
" "	" 40	..	†3 5 0	...	†3 5 0	...	†3 5 0
Sulphate of Potash (on basis of 90 per cent. purity)	Potash 48·6	10 2 6	10 0 0	10 2 6	10 0 0	10 2 6	10 0 0
Muriate of Potash... (on basis of 80 per cent. purity)	" 50	8 5 6	8 0 0	8 5 6	8 0 0	8 5 6	8 0 0
Potash Salts ...	" 20	3 2 6	3 1 0	3 2 6	3 1 0	3 2 6	3 1 0
" " ...	" 30	4 8 0	4 8 0	4 8 0	4 8 0	4 8 0	4 8 0
Kainit—In bags ...	" 14	2 15 6	2 14 0	2 15 6	2 14 0	2 15 6	2 14 0

Abbreviations:—N. = nitrogen; S.P. = soluble phosphate; I.P. = insoluble phosphate; T.P. = total phosphate.

* Carriage paid (4-ton lots) to Ayrshire and Renfrewshire; quotations for delivery in Lanarkshire and Stirlingshire 2*s.* per ton higher. † At Leith.

‡ Fine grist: 80 per cent. through standard 100 mesh sieve: price through 120 mesh sieve 2*s.* 6*d.* per ton higher.

** Carriage paid (4-ton lots) to Lothians.

Printed under the authority of His Majesty's Stationery Office
By J. Skinner & Co., Ltd., Thistle Street, Edinburgh.

(6664.) Wt. 16701/848. 1625+48 pp. 361-376. 7.27. J.S.&Co.,Ltd. G.18.

The Scottish
Journal of Agriculture.

Vol. X.—No. 4.] OCTOBER 1927. Price 1s. Net.

PARTNERSHIP FARMING.

Christopher Turnor.

This is a system of "tenure" which is little resorted to in Great Britain. Quite often a father and son, or two or more brothers, may rent a farm as partners, but it is not "partnership farming" in the sense that I use the term.

In partnership farming one partner is the active manager and the other more or less a sleeping partner; to give a concrete example—a landowner has a farm in hand, and instead of putting in a bailiff at a wage of say £200 a year, he selects a highly educated and trained young agriculturist, equips the farm for him, and enters into an agreement with him as "partner manager."

Under this agreement the partner is allowed a small fixed wage, say 30*s*. to 40*s*. per week, which is included in the ordinary wage bill of the farm; the rent, and 5 per cent. interest on the working capital, rank as first charges upon the undertaking. After these items and all operating expenses are paid, the excess of receipts (if there be any!) is profit, and is either divided equally between the two partners or in whatever other proportions that have been agreed to.

The first point that emerges is the importance of careful book-keeping. A chartered accountant must prepare the balance sheet, and a professional valuer should make the valuation. Should the annual "operating" account show a profit of say £800 for the year, but the capital account a depreciation of £200, then the divisible profit would be £600. Account keeping for a corn and dairy farm is somewhat simpler than in the case of a farm which specialises largely in buying in and selling out live stock. The object is to effect the division of the annual cash surplus between the partners without allowing any decrease in the working capital. My partner and I started with £10 per acre working capital, and I have never been called upon to add to this amount. Any real and permanent increase in the working capital is divided equally between the partners when the partnership is wound up and the assets realised; otherwise no notice is taken of the increase.

The second point in regard to partnership farming is that the (partner) manager is paid by results. His fixed wage is so small that he has every incentive to make the farm pay; unless he does he gets no income! A period of acute agricultural depression is not particularly favourable for starting a partnership venture, but from the landowner's point of view it is better to face a difficult period with a skilled and highly trained man than with the ordinary type of English bailiff.

And this brings me to my third point, the benefit that accrues to both parties to the agreement. The advantage to the landowner lies in having as managing partner a young, highly skilled and energetic man who will use his best endeavours to make the venture a success; the advantage to the managing partner is that he has been enabled to start in an independent position and to earn a considerable salary, in short, to be in a position it would otherwise have taken years to work up to.

I started partnership farming in 1910, and from that date to the present I am understating the case when I say that in addition to the rent and 5 per cent. interest on the working capital I put into the farm, I have received as my share of the profits a sum equivalent to a second rental. Or to put it in another way, I have received not only my rental and interest but a share in the farming profits as well. During the prosperous years my partner on several occasions made more than £1,000 a year; this on a farm of 550 acres of third rate land, 80 per cent. arable, and carrying a dairy herd of 90 cows.

Farming 1,000 acres, or even 500 acres, is a large business, and should be treated as such. It is clearly unwise to entrust the management of the enterprise to a man who gets £200 or £250 a year as his sole reward; it is always worth paying for brains.

As in everything else success or failure will depend upon the capacity of the manager, so that the greatest care is necessary in selecting your partner, but just the same applies to the choosing of a bailiff. There is, however, this difference in England, that there is a definite race of bailiffs, and there is no race of managing partners to choose from. In Denmark, on the other hand, it is a common practice for capable young agriculturists to go in for these well-paid managerships either as a stepping-stone to a farm of their own or as a career.

When I started partnership farming I resorted to Denmark for my managing partner, not only because the right type of man existed there, but because I was anxious to try Danish arable dairying in Lincolnshire.

The business of farming is so much wider than just the tilling of the soil and the tending of live stock, that the poorly educated man stands little chance. It would be necessary to take definite measures to train future managers. In the first place it would be advisable to get over a few Danes to act as trainers. I am certain we have plenty of good material, especially amongst the younger sons of good Scottish farmers. These young men very often have a good general education which is the best foundation for future training, and they often have a great aptitude for management. The importance of a good general education cannot be too strongly insisted upon.

Then again our agricultural colleges might do useful work in this direction if they would make a special branch of training really capable farm managers, but to succeed in this would entail certain changes in their present methods. To-day a man may take a three of four years' course at an agricultural college and leave knowing very little of the practical side of farming, and less still of the business side; the reason for this is that a sufficiently long period of practical work on the farm is not regarded as a *sine qua non* to admission to the agricultural college. Our shorter agricultural courses as a rule are not sufficiently intensive or "wide" to be good training for the future farm manager, and on the other hand the long courses are too long for their purpose, three years being too much to give up to the theoretical side, which is effectively dealt with in a nine months' course in a Danish college. Let me illustrate by outlining the usual procedure in Denmark.

In Denmark and other continental countries, far more than with us, agricultural education is built up on the foundation of years of practical work in husbandry. To begin with, the general education of the Danes is very good (they have had a system of compulsory education for 300 years), the greater portion of the rising generation is surrounded by agriculture, and after 14 years are probably helping on their father's farm; then at about the age of 16 those going in for an agricultural career go to work for some noted farmer as pupil labourers and are paid for their work. This is a better system than that of our premium-paying pupils, since though the farmer may make easy money, it is not good from the training point of view. At the end of a year they generally go to another farm to get a wider range of experience. By the time they are 19 or 20 years of age they take a nine months' course at an agricultural college; perhaps this course may err through being somewhat too intensive and involving an over-amount of class-room work for men who are used to being out of doors all day. After passing through the college the next step is to work as under-bailiff to some noted farm manager, or it may be to a large farmer, and it is here that the business side is acquired in the best possible way by working with the manager of a successful and paying enterprise. After several years in this position the young man is ready to become a manager, or a managing partner, or to take a farm of his own. The training is a long one but the results are strikingly satisfactory, and it must be remembered that with the exception of the time in college the trainee is earning his keep and sometimes a good deal more.

Under the partnership system the landowner is, even if vicariously, more directly interested in the financial results of the enterprise than is the case in our present landlord and tenant system, where the landowner is often only a rent receiver and repairer of farm buildings, and not dependent upon the farming operations for his income. It is true that the landowner is a sleeping partner and cannot, or should not, interfere in the management, but the partners meet frequently and discuss policy, and should further capital be needed for the enterprise it is a question for mutual agreement.

In the case of the partnership farm anything that complicates the accounts should be avoided. It is certainly better not to expect it to do any work for the estate, and if it supplies the mansion with produce it must be at full market rates. This seems an obvious point, and yet it is one that often causes difficulties. The farm must be run on strictly commercial lines.

It seems probable that landowners will be obliged to farm more land than they have done in the immediate past. As a result of the great depression of the eighties owners were obliged to take much land in hand, and there is little reason to suppose that the present depression will differ in this respect. If this proves to be the case, partnership farming should be of much assistance to the landowner; since the war the average agricultural estate has brought in little or no income to the owner, the outgoings equalling or exceeding the receipts, so that it is imperative for the owner to find some method which will again make his estate a source of some profit, and I submit that the one way for doing this is for owners of land to receive some share of the actual farming profits, as is the case with nearly all continental owners.

It may at the present moment seem absurd to talk of farming profits, but I believe the present crisis to be temporary; one must believe that, or else that British agriculture is finally doomed, and that a nation of town dwellers has decided that our agriculture is not worth maintaining, and that our countryside can be better utilised as a vast picnic ground!

And even in the present position, bad as it is, the fact remains that the price the *consumer* pays for agricultural produce carries in it a fair profit for the *producer*, if only he could get it. There is only one way in which the producer can at all control the prices he receives, and that is by organising his industry and developing co-operation. Heretofore co-operation in agriculture has never been widely successful, but it has never been on a sufficiently large scale to make any impression upon the market. In countries where co-operation in disposing of farm produce has succeeded, the bulk of the produce has been handled co-operatively. We talk much about co-operation but fail to take effective action. We have a world-wide example of its practical results and not an example confined to exporting countries only, as is suggested by opponents to the movement. In Czecho-Slovakia, for instance, practically every farmer belongs to a co-operative society and all the produce is handled co-operatively; that country is just the size of England and Wales, and there is a network of some 10,000 co-operative societies. The small local societies are affiliated to the county association, and the county associations in their turn are affiliated to the National Federation.

Very often the home farm, or other farms in hand, farmed in the old way, are models of neat and clean farming, but they are also demonstrations of how much can be lost per acre. Under partnership farming the manager is out to make an income for himself and he will not be a party to any uneconomic expenditure; his whole aim will be to see that every shilling spent brings back a shilling and something more, but the farm bailiff on a fixed wage, no matter how good a man, has not this incentive.

I believe that the day of the tenancy system, as it has existed from the Napoleonic Wars up to the Great War, is over, and that it is bound to be modified (*a*) by a great increase in occupying ownership, and (*b*) by the larger landowners farming a greater proportion of the land that remains to them. It is here that partnership farming would come in.

It would, as I have said, give the landowner a more direct interest in farming; it would help the landowner to see that the land he was directly interested in was farmed on commercial lines, a thing that is very difficult for the landowner to do under ordinary circumstances, since so often the bailiff and employees do not believe the landowner really wishes to make money out of his farm; in fact they regard it as almost improper that he should make money. I speak feelingly, since for some years before I adopted the partnership system I farmed nearly 4,000 acres with bailiffs in the ordinary way. But if changes are inevitable, at all events let them be devised by agriculturists and not by politicians, and I believe that it is not too late for landowners and farmers working together and interesting the labourers in the movement to industrialise agriculture as it has been industrialised in continental countries

In my view, agriculture is an industry in which, unlike urban industries, it is impossible to develop a mechanical specialisation. and in which success must ever depend upon individual effort and enterprise, the qualities most easily killed by imposed control. In short, I believe in a free industry in which the members work out their own salvation, and through the medium of organisation provide themselves with the needed degree of control.

I have said that partnership farming is resorted to but little in this country. There are countries, however, in which it is the main form of tenure, as in Italy for instance and in parts of France. The " Metayer " system is simply one form of partnership farming. Under it the " tenant " is given a farm, he pays no rent as such, and the landowner derives his revenue by taking one half of the proceeds from everything that is sold off the farm. This is not a good system. In the first place the farmers as a rule do not hold large areas, and are not men capable of accurate book-keeping, and the owner's agent has to spend most of his time in estimating the yields to ascertain what really has been sold, and in trying, if he can, to prevent surreptitious sales.

In some of the eastern states of America there is also a good deal of partnership farming. City men who are interested in agriculture generally resort to partnership, putting in as a rule some newly arrived Scottish farmer. Accurate accounts are kept and the profits are evenly divided between the partners. This works very well for both parties.

Within the last decade or so there has been a considerable development of partnership farming all over the United States; quite often, when the owning farmer has made enough money to retire from farming, he takes his family to live in a town and puts a partner in charge of the farm on a profit-sharing basis. This practice has been misunderstood in certain quarters in this country and has been described as a movement from occupying ownership towards tenancy, but it is not, since it is in no way similar to what we understand as tenancy. Another variation, which is also satisfactory, is to be found in our Dominions, especially in Australia, and is chiefly confined to dairy farming. The procedure is for the landowner to select a qualified and capable man and provide him with a small farm and a herd of 20 or 30 cows. Since only one commodity—milk—is sold, and it probably goes to some co-operative creamery, it is easy to keep an accurate check upon the sales. The net profits on the milk are shared between the partners.

But of these various methods of partnership farming, the type I have described is, I think, best suited to this country. I can only say that I have had nearly 20 years' experience of it without having had any difficulties or friction. Difficulties there would be if the accounts were not kept accurately.

AGRICULTURAL RESEARCH IN THE BRITISH EMPIRE.

VI.—AGRICULTURAL RESEARCH IN THE COLONIES AND DEPENDENCIES.

J. S. Thomson, M.A., B.Sc.,

The Rowett Research Institute.

Up to the present time agricultural research in our Colonies has not received the attention and support it deserves, in view of the vast potentialities of the Colonies for the production of tropical agricultural products. We, in Britain, are dependent to a very large extent on our tropical possessions for a great part of our supplies of household commodities such as tea, cocoa and sugar, and also for our supplies of agricultural raw products like cotton, rubber, &c. The development of the resources of the tropics, therefore, should be one of our primary considerations, and in any such development science must play an important part.

In this respect we are far behind some of our self-governing Dominions and India. The research work being carried out at the Dominion Experimental Farms in Canada and at Pusa in Bengal, for example, is well known. Again, we have nothing to compare with the intensive scientific efforts of the Dutch in the Island of Java.

Hitherto various difficulties have been in the way of the successful development of the agricultural resources of our Colonies. Large sums of money are required for the building and maintenance of scientific research institutes, and the difficulty of finding such sums has been a serious stumbling block to progress. Too frequently has the solution of problems affecting tropical agriculture been left to the care of private individuals.

Another great difficulty has been the lack of sufficient numbers of properly trained and qualified scientific workers who could be sent out to take up research work in our Colonies. Even now the supply is less than the demand. Certain important steps, however, have now been taken to meet this demand. Perhaps the most important of these is the establishment of the Imperial College of Tropical Agriculture at Trinidad. In addition a system of agricultural scholarships has been introduced for post-graduate training in this country and at the Imperial College, Trinidad.

There are signs that an increased interest is now being taken in the agricultural possibilities of our Colonies, and the whole question of the organisation and development of research is under expert review. A report has just been published by a Committee under the Chairmanship of Lord Lovat which, besides giving an excellent account of the general situation as regards research, makes certain recommendations with particular reference to organisation. This report has been adopted in principle at the recent Conference of Colonial Governors, and a committee is now at work producing a scheme in accordance with its recommendations. Broadly speaking these make provision for the establishment of agricultural research on the basis of a series of seven scientific institutions, with interchange of workers, at various centres in the Colonial Empire, in East and West Africa, West Indies, Ceylon, &c. These Institutes would work in close co-operation not only with each other, but with other research institutes in the British Empire, in the solution of problems of common interest.

Colonial Research Institutes.—Should this scheme for the development of a chain of research stations mature, two of the links are already forged : the Imperial College of Tropical Research at Trinidad and the Amani Institute in Tanganyika Territory.

The Imperial College of Tropical Research was opened in 1922. Its object is to provide training in the art and science of tropical agriculture to students intending to become planters or specialists in different branches of agricultural science and technology, and to offer facilities for the study of tropical agriculture to graduates of other colleges and universities. Large sums of money have already been expended on the erection of new buildings, the capital expenditure to date being over £147,000. This sum has been raised partly by special appeal and by contributions from the Imperial Government, the Empire Marketing Board, and the Lancashire Cotton Industry, but by far the largest individual contributor to the funds of the College has been the planting community of Trinidad and Tobago, who provided £50,000 by means of a special export tax.

In addition to teaching, research work has been commenced here on such problems as the breeding of a variety of bananas immune from Panama disease, the problem of Froghopper blight in the sugar cane, Withertip disease in limes, and the study of colloidal soils.

The second of these Institutes, the Amani Institute, was established by the Imperial German Government, and, previous to the war, had already done good work in the study of tropical agriculture. Work at this Institute is now about to be restarted, and this has been made possible by grants from various Governments in Africa and by contributions from the Empire Marketing Board.

The object of the station will be to undertake fundamental problems of research to supplement more particularly the activities of the East African Dependencies, and the work should also throw light on cognate problems, both in West Africa and in other tropical dependencies.

Although the formation of this chain of research stations is in itself of great interest and importance, the co-ordination and correlation of the research work to be carried out at these stations with the work along similar lines in progress at other centres in the British Empire is of even greater importance. The nucleus of an organisation for this purpose is already provided for, particularly with regard to work on Entomology and Mycology, in the Bureau of Entomology at the Natural History Museum in South Kensington and the Bureau of Mycology at Kew. Both these institutions have already done valuable work in correlating the research being done in these particular branches of science throughout the Empire.

Some Colonial Problems.—*Plant Diseases.*—The climate of our tropical and sub-tropical Colonies is very favourable to the outbreak and spreading of disease, both of insect and fungoid origin, among plants. The annual losses from this cause alone must be enormous. It is not surprising, therefore, that much of the research work already done has dealt with the discovery of methods for eradicating or controlling plant diseases. Various methods of control are now under investigation. Biological control, similar to that being tried in New Zealand and Australia, is being examined and successful experiments have been carried out at Hawaii. In addition, control by spraying or steeping the seeds in certain solutions is also being tried, while the possibility of breeding new varieties of plants immune from disease is also receiving attention.

Plant Breeding.—In addition to the problems of disease, there are a number of fundamental problems of very great economic importance in connection with plant breeding and selection for whose solution we are dependent to a very large extent on the expert plant geneticist. This holds good both as regards plantation crops such as tea, coffee, cocoa, &c., and also as regards annual crops like cotton and rice.

In the case of the cocoa tree, for example, it is well known that there are individual trees which are naturally heavy, medium or poor yielders, and that these characteristics are not appreciably affected by manurial treatment or by alteration in the conditions. In the Eastern Province of the Gold Coast, where the cocoa industry has been established longest, a definite falling off in the yield has taken place.

The oil palm problem is very similar. There are extreme variations between varieties of oil palm and between individual palms of the same variety not only in the annual yield of bunches, but also with regard to the oil content of the pericarp and of the kernal. Dutch research has shown that the oil palm reaches its full yield at 11 years and continues at this yield till 30 years, after which there is a very rapid decline.

Research in the Federated Malay States has shown the very wide variation in the yield of cocoanut palms on similar land, and a special cocoanut selection experiment station has been established at Klang to investigate this economic problem.

Camphos is another example of a permanent crop, the study of which is in urgent need of scientific investigation.

The application of genetics is almost equally important for the annual crops, and it is interesting to note that a good deal of work is now going on in our Colonies in the selection and breeding of cotton suitable to different parts of the Empire. Sir R. Biffen has recently visited Kenya and valuable work has been begun there. In Nigeria an attempt is now being made to improve the quality of selected strains of native cotton for growth in areas where American types do not succeed. A new type, "Improved Ishan," has just been introduced, and if successful will mean the saving of millions of pounds a year to Nigeria.

Soils.—One of the main difficulties in connection with the cultivation of the permanent crops, and in particular tea, rubber and oil palms, is the problem of soil erosion. Soil erosion, the effect of the combined action of heavy rain and burning sun, is a universal and fundamental problem in the tropics. It is particularly evident in Jamaica, Ceylon and the Gold Coast. The best method of dealing with soil erosion is the growing of some form of cover crop under and between the trees. This preserves the humus and at the same time acts as a green manure. A good deal of work on this subject has been done in Ceylon to discover the most suitable cover crops which will act as protective agents to the different kinds of permanent crops.

One problem of soil science, which is peculiar to tropical countries, is the so-called salting of soils which has been observed in India, Australia and elsewhere. Large tracts of the British Empire have a rainfall of less than 10 inches per annum, and an artificial supply of water is essential for the growth of crops. In the formation of soil in the tropics the intensity and amount of the rainfall are only sufficient to carry the soluble salts formed by the disintegration of the parent rock a short distance below the surface. These salts are carried upwards to the surface again under the influence of strong evaporation, and an actual deposition of salts may take place about the roots of plants. The presence of these highly concentrated salts is frequently injurious to plant life. In addition to being toxic these salts are responsible for changes in the physical characteristics of the soil, and much once fertile land has gone out of cultivation. Irrigation, the improper use of irrigation water, and deficient drainage all tend to hasten the process of salting and soil deterioration. In this connection, signs are now evident that the once fertile valley of the Nile appears to be showing signs of a much lessened response to irrigation.

The whole problem of the successful cultivation of annual crops in the Colonies is intimately associated with the composition of the soil, both physical and chemical. Soil deterioration takes place much more rapidly in the tropics than in temperate climates, and it is known, for instance, that nitrogen is very easily lost from the soil. No systematic soil survey of our Colonies has yet been attempted. Cereal crops, especially maize and wheat, are dependent on adequate supplies of nitrogen, potash, phosphorus and lime, and it is a matter for investigation whether the soils in the tropical areas are becoming depleted in these elements. An interesting case is on record in a tea estate in Ceylon in which the yield of the same variety varied in different parts of the estate. A chemical analysis of the soil revealed the fact that the yield varied as the phosphorus content of the soil varied. The necessary quantities of superphosphate to balance up the poorest areas were applied with very beneficial effect.

A fundamental study of the soil, not only from a chemical but also from a microbiological point of view, might throw light on some of the problems of plant growth in the tropics. A biological examination, for example, might explain the cause of the growth of laterite in nearly every tropical country, but not in temperate climates.

Mineral Content of Pastures.—Although in many of our Colonies crop production is still the main agricultural pursuit, in others stock-raising is of primary importance, and in recent years considerable difficulty has been experienced in the successful raising of stock in certain of these Colonies. In the Falkland Islands, for instance, the mortality amongst sheep for the past 20 years has been extraordinarily high, although there was an abundance of pasture. The quality of the pasture has been investigated in certain of these areas to see whether the composition of the pasture could be correlated with high mortality and with the incidence of disease, and it has been found that in large areas of the British Empire much of the pasture is deficient in some of the mineral elements necessary for normal health and growth in animals. In our own country much of our hill pasture is deficient in calcium and phosphorus. In parts of South Africa there is a definite deficiency of phosphorus both in the soil and pasture, while in New Zealand certain areas of the North Islands are known to be deficient in iron.

The problem of the mineral content of pastures in relation to animal nutrition is now of Empire importance, and the main work on this subject is being carried out at the Rowett Research Institute.

As regards our Colonies, a chemical examination of the Falkland Island pastures has shown that they are becoming very rapidly impoverished, as far as their mineral content is concerned, through the failure of the farmers to compensate the soil, by manurial treatment, for the mineral matter removed in the form of mutton and wool.

In Kenya Colony a similar problem exists, and an examination of the pastures has revealed a deficiency of phosphorus. Practical feeding experiments are now being carried out in Kenya to test the effect on growth and health of stock of feeding concentrates rich in phosphorus. This investigation is as yet in its infancy and it is too soon to look for results.

From the replies to a questionnaire sent out to the Colonial Governments, it is clear that many of the difficulties in stock-raising are of a similar nature to those of the Falkland Islands and Kenya, and this investigation into the mineral content of pastures in different parts of the Empire, both cultivated and natural, is being actively pursued by means of a grant from the Empire Marketing Board.

Co-operation.—The above are only a few of the many problems awaiting scientific investigation in the Colonies; others equally important, such as the question of dry land farming, could be mentioned. They are sufficient, however, to show the great need for the application of science to problems affecting the welfare of our Colonial Empire, and for an extension of the existing organisation for teaching and research work. Excellent results have already been achieved at the Imperial College in Trinidad on the eradication and control of plant diseases, but there is still a wide field for investigation into problems of plant breeding and problems affecting the soil. The reorganisation of the research work by the establishment of a chain of stations scattered through the Colonial Empire, working as far as possible in co-operation with each other, linked up by the periodic change of workers, and interchange of ideas, and in touch with the older-established research institutes in Britain is likely to be fruitful of results not only to the Colonies themselves but to the British Empire as a whole.

VII.—THE RESEARCH GRANTS OF THE EMPIRE MARKETING BOARD.

Right Honourable W. G. A. Ormsby-Gore, M.P.,
Parliamentary Under-Secretary of State for the Colonies.

The Empire Marketing Board was appointed in the early summer of 1926 upon the recommendation of the Imperial Economic Committee—a body which is responsible to all the Governments of the Empire. Its chairman was to be the Secretary of State for Dominion Affairs. Its membership, though limited for the sake of efficiency, left no part of the Empire unrepresented. The British Government had placed at its chairman's disposal a sum of £500,000 for the remainder of the financial year of its appointment, and had promised £1,000,000 a year for the future. It was not to be called upon to surrender any unexpended balance of its income, and was thus free to plan out over a period the wise employment of its resources. The Parliamentary Vote, from which its funds were derived, indicated only that they were to be devoted to "furthering the marketing of Empire produce in this country." The Imperial Economic Committee, recognising that the Home Country was not less a part of the Empire than the Dominions and Colonies, had announced the unanimous view of both its home and overseas members that the policy of the Board should be to encourage the public to ask first for the produce of their own country and next for the produce of the Empire overseas.

The Imperial Economic Committee, from whose personnel no small part of the Board's membership is drawn, had foreseen that the marketing of Empire produce was not merely a question of publicity. They had recommended that a substantial part of the revenues of the new body should be devoted to scientific research.

Accordingly, the Board has devoted a substantial share of its funds to the financing of various scientific enquiries which it was satisfied should lead, directly or indirectly, to an increase in the supply or to an improvement in the quality of home and oversea Empire primary produce.

But the Board has made no attempt itself to engage directly in scientific research. It has been a patron, not a practitioner, in the fields of research. Its proper part was seen clearly from the outset to be that of fortifying existing scientific institutions in such measure as would enable them to intensify or develop their work, and of making possible the establishment of new institutions to meet new and proven needs. Moreover, in deciding upon the allocation of grants for research, the Board has consistently been guided by the different Government organisations, whether at home or overseas, that were best qualified to advise it. It has itself of set policy acted through a lay Research Committee, thus leaving entirely to the technically qualified bodies the responsibility for providing scientific advice.

The fundamental Empire need for increased research need not be illustrated here. It was authoritatively endorsed both by the Imperial Conference last autumn and by the Colonial Office Conference this spring, and has been emphasised by the Imperial Economic Committee in a series of Reports on the marketing of Empire products. Admittedly the results of even proved agricultural research have as yet found but a very imperfect reflection in the practical agriculture of the Empire. Empire development, and, therefore, Empire marketing, postulate the examination of a wide and diverse range of problems, many of which have not, so far, been subjected to scientific examination at all. Empire expenditure on agricultural scientific research and the dissemination of its results still falls short not merely of Empire requirements, but of the scale attained by at least one other nation with lesser responsibilities. It is plain that the rate at which scientific research can be developed is largely dictated by the number of trained research workers forthcoming. The Board, with the resources of the Empire Marketing Fund at its back, has felt that in the vigorous support of scientific research it has an evident duty and a notable opportunity. In recommending grants it has sought to ensure that the research work to be aided should be of interest, if not to the Empire as a whole, at least to more than one part of it. It has not recommended grants in support of research work which appeared to be the concern of any single Government alone. Scientific institutions in the United Kingdom have received a considerable share of the grants made during the first year's work. There are two reasons for this. Broadly speaking, scientific research work of general interest to the Empire as a whole is at present more fully developed in Great Britain than overseas; while distance had inevitably prevented the oversea authorities from gaining full contact with the Board in the few months during which it has been effectively at work. The Board is, however, getting each month into closer touch with scientific institutions overseas, and hopes much in this respect from the Imperial Agricultural Research Conference.

A full list of the research grants actually approved on the Board's advice up to May 1927 is printed in the first Annual Report of the Board, a copy of which may be obtained on application from the Board's offices by any interested person.

In a number of cases the promise of financial assistance from the Fund has elicited contributions from other Governments or from private sources. The total contributions from other sources upon which grants have been made conditional amount to more than £230,000. The interesting possibilities which the research side of the Board's work opens up can perhaps best be shown here by a brief indication of what some of its individual grants signify.

Tropical and Sub-tropical Research Stations.—The tropical and sub-tropical parts of the world are capable of a production without visible limit, while temperate countries are becoming yearly more dependent upon the food and raw materials which they supply. But the same causes which afford this opportunity for the swift multiplication of crops lead also to the exaggerated increase of the pests and diseases which afflict them. Research into the needs and diseases of animals and plants in the tropics is still largely undeveloped, and for its development the Empire, with its great tropical possessions, has a peculiar responsibility. The Board, impressed with this responsibility, has already recommended substantial grants to two research stations. Assistance has already been given to the Imperial College of Agriculture at Trinidad, and assistance has been definitely promised to the Amani Institute in Tanganyika, towards the restoration of which the Governments of the East African dependencies have undertaken to make a substantial contribution. Moreover, the Board has agreed in principle to recommend a considerable grant towards a research station which the Commonwealth Government of Australia contemplates establishing to deal with tropical and sub-tropical areas for which it is directly or indirectly responsible.

Low Temperature Research.—The successful marketing of Empire produce from overseas depends upon no single factor more than upon the skilful development of cold storage processes; and research into these processes is also of great importance in its bearing upon the keeping qualities of the produce of the home supplier. The Low Temperature Research Station at Cambridge under the auspices of the Department of Scientific and Industrial Research has already made contributions to this development which have been gratefully recognised throughout the Empire, and which point to invaluable opportunities for their extension. The Board has accordingly approved a substantial grant for the extension of this station at Cambridge, and has given provisional approval to a scheme for the erection of a new station at East Malling, Kent, for cold storage experiments on a semi-commercial scale.

Entomology.—Insects, it has been calculated, consume 10 per cent. of the world's crops and destroy probably quite 20 per cent. of the crops grown in the tropics. More and more the commercial value of agricultural entomology is being appreciated by primary producers; and the recent Imperial Conference gave special attention to a report by the Director of the Imperial Bureau of Entomology on the present state of entomology within the Empire. The magnitude of the losses inflicted by insect pests, compared with the relatively small expenditure within the Empire on trained entomologists, has impressed the Empire Marketing Board with the urgent necessity of considering the claims of entomology for financial assistance in education, in research, and in the application of knowledge gained by research.

The Board found a substantial consensus of opinion that Cambridge University afforded the best centre for the additional facilities required for the training of research workers and practical entomologists. A contribution was accordingly approved towards the establishment of a new Institute of Entomology at

Cambridge on condition that the balance required was obtained from other sources.

In the field of applied research grants have been made to the Imperial Bureau of Entomology and to the Cawthorn Institute, New Zealand. Among the most effective means known to science of keeping down insect pests is the enlargement upon them of their natural parasitic enemies. Such a remedy can never be employed until exhaustive precautions have been taken to ensure that the parasite will not in its turn do more damage than the insect it was meant to destroy; but striking results have already been obtained in various parts of the world by the release of "beneficial" parasites. For the development of such work the Empire Marketing Board has approved a grant to the Imperial Bureau of Entomology for the creation of a central laboratory in England for parasite breeding and testing. From this "Parasite Zoo" consignments will be sent wherever they are required to wage war upon insects devouring the Empire's crops.

Animal Husbandry: Pasture Investigation. — Reference has been made in the preceding article to the investigation of mineral deficiencies in pastures. Following pioneer work done in various parts of the Empire—and notably in South Africa—research into this question, the importance of which was brought to the Board's notice at an early stage by the Committee of Civil Research, is already being pursued upon a concerted plan, with funds provided partly from the Empire Marketing Fund and partly from local public or private sources, at the Rowett Institute, Aberdeen, in the highlands of Kenya, in New Zealand and in Australia. No better example could be offered of the value of scientific "team work" throughout the Empire.

Should the enquiries now being prosecuted at all fulfil their initial promise, farmers in some areas of Scotland stand to gain no less than do those of almost every part of the Empire overseas. If the feeding qualities of Empire pasture can be improved, the stock-breeder and the flockmaster will be enabled to carry more animals to the acre, and to improve their output of meat, dairy produce, hides and wool.

Animal Breeding.—The chief centres for research in animal breeding are to be found at Edinburgh and Cambridge Universities. A grant has been made out of the Empire Marketing Fund towards the cost of establishing a Chair of Genetics at Edinburgh University and the development of the Animal Breeding Department. Financial assistance has also been given towards work on the reproduction and growth of animals carried on under the Faculty of Agriculture at Cambridge University.

Economic Botany, Kew. — The Royal Botanic Gardens, Kew, have received a grant from the Empire Marketing Board through the Ministry of Agriculture and Fisheries. The grant has been devoted partly to the employment of an Economic Botanist at Kew, who will be available either to visit the Dominions and Colonies from time to time or to set free a superior officer of the Kew staff to undertake oversea missions. It will also be used in part for sending botanical collectors to various parts of the world to study and bring home plants of economic importance for cultivation at Kew and distribution to the Dominions and Colonies.

Fruit Growing.—The pioneer research work of the East Malling Fruit Research Station on the standardisation of root stocks and the principles underlying the relationship of stock and scion has had a striking influence on the technique of fruit culture in Great Britain. Standardisation of horticultural material is important to the fruit grower when he seeks to plant his orchard with young trees which can be relied upon to grow up true to specification, but it is equally important to the scientific research worker, seeking uniform and reliable material for experiments in methods of culture, storage and transport and for studying problems of resistance to disease. The technique evolved at East Malling should be applicable to many other fruits than those which grow in Great Britain, and the work that is being carried on there is recognised by experts to be of Empire-wide interest. The Board has approved a substantial appropriation in its aid.

The Long Ashton Horticultural Research Station made an application for assistance towards investigations into the keeping quality of fruit and its relation to the nutrition of the tree and to soil conditions. On the recommendation of the appropriate authorities the Board decided to approve a grant for this work in view of its interest to fruit-growers both at home and overseas. A small grant has also been made to the Cheshunt Experimental and Research Station for investigation into the control of certain pests and diseases of particular interest to horticulturists.

The prevalence of Panama disease in the banana-growing areas of the West Indies lends special importance to the grant made to the Imperial College of Tropical Agriculture at Trinidad for the prosecution of research into the production of a variety immune from this disease. Investigations into the transport of bananas under cold storage conditions are also being facilitated by a grant for the erection at the College of an experimental cold storage station.

Dietetics.—There has been a profound change during the last century in the diet of the people of Great Britain. The growth of population at home, the opening up of new territories, increased swiftness of transport and the discoveries of cold storage have brought to the doors of crowded city populations, whose grandfathers were fed from the countryside about them, a great variety of foodstuffs from different parts of the earth.

The effects of this change have yet in the main to be explored and their exploration is bound to be a prolonged and patient process. The achievement of knowledge of this subject cannot but be of profound importance to those engaged in the production and the marketing both of home and oversea Empire supplies.

The Board, in recognising the need for further research in this field, has recognised also its close bearing on Empire marketing. With the advice of the Medical Research Council it has approved a grant for the investigation into the vitamin content of fruits of different varieties and treated in different ways, to be conducted at the Lister Institute in development of fundamental work previously undertaken for the Council. It expects shortly to enable this research to be extended to include a like enquiry into dairy produce. In addition, extensive food tests have been conducted under a joint producers' and consumers' organisation in Scotland to demonstrate the striking advantages of milk for school children. On the recommendation of the Committee of Civil Research the Board is also assisting a piece of work on native dietary in East Africa, which is closely related to the study of mineral deficiencies in the soil referred to above, and is likely to assist that general investigation.

Imperial Co-operation in Agricultural Research. — The Ministry of Agriculture and Fisheries, which had arranged about the time of the Board's appointment to summon for the autumn of 1927 an Imperial Agricultural Research Conference, has invited the Board to be associated with it in the organisation of the Conference. It has been agreed that the expenses of the Conference shall be met from the Empire Marketing Fund, and the Ministry and the Board have collaborated in preparatory work for it.

As part of this latter duty, the Board has arranged for the distribution to oversea Governments of several memoranda upon different subjects of agricultural research, written by the leading experts in Great Britain and designed to afford a starting point for the collection of Empire experience in the different fields which they review.

In the interests of fruit-growers and horticulturists in the Empire, memoranda have been prepared by Mr. R. G. Hatton, Director of the East Malling Horticultural Research Station, and Professor B. T. P. Barker, of Long Aston, dealing respectively with the importance of standardised root stocks and the effect of nutrition on the quality of fruit. To each of these memoranda is attached a questionnaire which, it is hoped, may elicit from scientific workers in different parts of the Empire information which will enlarge the common stock of Empire knowledge on the subject, and contribute to the development of co-operative research into a set of problems of great practical importance.

With the same object in view a memorandum and questionnaire on irrigation problems of Empire interest has been prepared by Dr. B. A. Keen, Assistant Director of the Rothamsted Experimental Station. The application of water to parched land seems so obviously right and simple that it is not always easy to realise that under certain conditions irrigation may produce " salting up " and catastrophe.

Surveys of the present development of research in dairying and in tropical agriculture are being undertaken by Professor R. H. Leitch of the West of Scotland Agricultural College, and Dr. C. A. Barber of the School of Agriculture, Cambridge, and a general survey of veterinary problems and research in the Empire has been completed by Sir Arnold Theiler, late Director of Veterinary Education and Research to the Government of the Union of South Africa, with the assistance of officers of the Ministry of Agriculture and Fisheries.

VARIATIONS IN CARCASE TYPE FOR PORK AND BACON.

H. R. DAVIDSON, M.A., Dip. Agric.,

School of Agriculture, Cambridge.

PIG-KEEPERS in this country are well aware of the fact that the two main outlets for their fat pigs are the markets for bacon and for small fresh pork. While this gives them an advantage over competitors in many other countries such as Denmark, whose only large market is in this country for bacon, and France, where bacon is not appreciated and pork is the only outlet, nevertheless it introduces some uncertainty as to which market they ought to aim at supplying. Since the placing of the Government embargo on fresh carcases from the continent this difficulty has become more prominent, because it has been the means of excluding about forty thousand tons per annum of fresh pork which previously had been sent into this country, principally from Holland. To supply the demand for fresh pork it has been estimated that about one million porkers per year are required which, while the market is still open, might be supplied from this country, though one has only to follow the New Zealand, Australian and Argentine press to realise what strong efforts are being made to develop an export trade in porkers to this country to replace the recent Dutch supplies.

On the other hand, although we import annually some forty million pounds worth of bacon, various committees of enquiry and commissions have reported that factories in this country do not work at much more than half their capacity, from which it is clear that the outlet for bacon is still very large in spite of the number of pigs required by the pork market.

Now, the problem of which market to supply arises from the fact that whereas the bacon factory requires a pig of from 140 to 180 or 190 lbs. dead weight, the highest price for pork is paid for carcases of 80-100 lbs., and even in districts where less importance is laid on the very small pig, good quality pork carcases do not usually average more than 120-140 lbs. A pig which will yield a carcase of 80 lbs. is not much more than a quarter of its mature weight, and it can readily be understood that it is difficult to get an animal which in its relative bodily development corresponds approximately to a child of four, to put on as much meat as is required by the consumer. On the other hand the bacon curers require a pig which, although two or three months older than the porker, must possess a very lean and relatively long carcase. Consequently it has, until recently, been assumed that the type of pig required for pork must be of a different breed from the proper bacon type. Such breeds as the Large White, Large Black, Tamworth, and Saddleback pigs have been described as being suitable for bacon, whereas the breed which one finds most recommended for pork is the Middle White followed very closely by the Berkshire (1, 2 and 3). The two latter breeds appear to contain a great deal of the blood of the Chinese pig, one of the chief characteristics of which is its early maturity and capacity to lay on fat at the earliest stages.

To maintain two herds, however, from which to supply the two markets is in the great majority of cases impracticable, but a much greater trouble which arises from the problem is that an excuse is available for the maintenance of a large number of separate breeds and the societies which exist to guard their interests.

Much is being written at the moment about the harmlessness of the number of breeds which we possess, so long as they all conform to commercial standards; but it must be remembered that a house divided against itself cannot stand, and it is very largely on account of inter-breed jealousy and the misleading propaganda arising from it that a real working agreement has not now been arrived at between breeders, butchers, curers and scientific investigators. If it were possible to concentrate on one or possibly two breeds of pigs which were as suitable as could be obtained for commercial purposes, not only would technical investigation and assistance be greatly facilitated, but the resultant standardisation would provide one of the surest safeguards against the coming competition from Australasia and South America.

Swedish Results.—While turning these possibilities over in his mind the writer last year received the report from the Swedish Pig Testing Station in which, as a result of analysing all the available figures, it was reported that the gilts gave a very much higher proportion of first grade bacon carcases than did the hogs (46·8 per cent. as against 20·3 per cent. on a two years' average). The reason for this classification was that in the case of the gilts the average thickness of the back fat was 1·55 ins. as compared with 1·68 in the hogs, whereas when the average thickness of the belly was examined it was found to be 1·33 ins. for the gilts and only 1·29 ins. for the hogs. While most producers are now well aware of the fact that bacon curers want a very thin layer of back fat and at the same time as great a thickness of belly as possible, it may not be so commonly realised that when all pigs of both sexes are averaged the thickness of these two parts varies directly in proportion to one another. In other words the thicker the streak, the thicker will be the back fat. It is only when separate analyses are made of the two sexes that the superiority of the gilts becomes evident. The reason is not far to seek. The gilts being unspayed have experienced heat, which in return is responsible for a greater growth of tissue in the mammary region than in the case of males. The hog pigs on the other hand have not been disturbed by sexual excitement, and as commonly occurs in most castrated animals, they have put on more fat in proportion to lean than have the females.

Now, if the hogs put on more fat by the time bacon weight is reached, it is reasonable to suppose that they are also slightly fatter than the gilts at the stage which corresponds to small London pork, i.e., at about 100 lbs. live weight. If this should prove to be correct, then the objection that a bacon breed of pig is not properly fleshed at the early age required for small pork will be largely overcome in the case of male castrates and the deduction follows that, given a type of pig which is suitable for the bacon market, it should be possible to run on all the gilts for bacon and to kill the hogs at an earlier stage, when they would be much better suited for pork than the females. The way would then be clear to standardise one type of pig in the country, the bacon type, with the knowledge that by proper management the pork market could still be supplied.

British Observations.—A very similar conclusion has been arrived at by others from general observation and experience. Writing in "The Pig Breeders' Annual" for 1927-28, Sir Daniel Hall says that "while the short, compact, thick-set pig which makes a first-class porker, is quite unsuited for the bacon factory, there is plenty of evidence that a pig of bacon type, when properly fed, will make a useful porker, if not of the superlative excellence that can be obtained with some races of Berkshire and Middle White origin." The Scottish Pig Industry Report (4) suggests much the same thing when it says that "for both the bacon and pork trades, we definitely recommend producers to breed either Pure Large Whites of suitable type, or a first cross between a Large White boar and a Middle White sow of the finer type." The pure Large White is one of the most typical bacon breeds, and the "finer" type of Middle White which is referred to is the longer and leaner bacon type of this breed, of which there are none too many strains at the present time. Yet it is to be noted that these are the two breeds which this very representative Committee recommends for producing pork as well as bacon.

In discussing this question with pork butchers in the Eastern Counties and with leading salesmen on the Smithfield market, the impression has been gathered that however "superlative" may be the "excellence of some races" of Berkshires and Middle Whites, there are many other "races" of these two breeds which, on account of the undue proportion of fat which they produce, are unsuitable even at the early age of four months for the production of lean pork, and it is easy to see from figs. 2 and 3 that any more fat than is present there would be undesirable in a small family joint. It is probably on account of the great increase in early maturity which has taken place in the last 20 years that the typical pork breeds are becoming almost too fat and the bacon breeds are becoming just fat enough to be suitable for pork at an early age. The older teaching would therefore seem to be in need of revision at the present time.

All these considerations, however, are based on foreign figures and on general observation only as regards our own country, and in view of the absence of reliable figures for Great Britain it was decided to commence an investigation of the matter on experimental lines. The material available was very limited, but as the results already obtained are suggestive and will perhaps focus attention on one of the main problems particular to this country, they are given here in some detail.

Experimental Details.—The two objects of the experiment were to determine (i) how far it is possible to use bacon pigs for the production of small pork, and (ii) whether or not hog pigs are better for pork and gilts for bacon. The pigs available were two litters of pedigree Large Whites, born on the same day and sired by the same boar. The litters consisted of seven pigs from a gilt and eight from a sow, and of these fifteen pigs six were gilts and nine were hogs. The plan of the experiment was to feed six hogs and six gilts as they would be fed for pork and to kill three of each sex at 100 lbs. live weight and the remaining three of each at bacon weight, 200 lbs. alive. In feeding bacon pigs it is generally taught that during the earlier stages, say from 4 to 5 months, the albuminoid ratio should be a much narrower one than when feeding for pork. As will be seen from Table II Stewart (2) suggests 1 : 4·0 and 1 : 6·3 respectively at this period, and the general belief is that pigs fed on the wider ratio at this period, i.e., according to pork standards, will as a result be too fat if they are carried right on to bacon weight. On the other hand, as pigs killed for pork at the early age of 4 months have definitely to be fattened as well as fed for growth, then feeding from the beginning must, it is believed, be of a more starchy nature than for pigs which are merely growing a frame. In practice, however, it is not always possible to separate at the beginning those pigs which are intended for the different markets and so in this case all the animals were fed as for pork from the start of the experiment, and it will be observed from Table II that the nutritive ratios of the rations fed are even slightly wider than the pork standard.

In producing the small, quickly-grown pork that is in such great demand on the Smithfield market, every effort is made in practice to prevent any loss of growth or bloom at weaning time, and as the profit is normally a good one, it may pay to leave the piglings on the sow for a week or so longer than usual and to feed a certain amount of milk to assist the weaning process. This was done in the case of the present experiment as will be seen from the details of feeding and management in Tables I and II.

As under the conditions available it was not practicable to separate the twelve pigs under experiment from the remaining three, the original fifteen pigs were run together the whole time. Unfortunately one of the three bacon hogs injured a leg three weeks before the end and had to be slaughtered, with the result that the best of the three remaining gilts was substituted for it in order to get an average figure for live weight and food consumption. A comparison of the live weight is, however, given in Table I at the end of 23 weeks just before this accident occurred.

TABLE I.

Details of Live and Dead Weights and Classification for Quality.

	Age in Weeks.	Six Hogs.	Six Gilts.
Born	0	28th Oct. 1926	28th Oct. 1926
Castrated	7	16th Dec. 1926	...
Weaned	9	30th Dec. 1926	30th Dec. 1926
Average weight at weaning ...	9	42·10 lbs.	42·08 lbs.
		Three Hogs.	Three Gilts.
Average live weight at small pork stage 24th Feb. 1927	17	110·0 lbs.	106·3 lbs.
Average carcase dressing percentage	17	67·1 per cent.	66·2 per cent.
Average carcase weight	17	74·0 lbs.	70·5 lbs.
Order of merit as pork	17	1. 2. 3.	4. 5. 6.
Average live weight on 7th April 1927	23	183·3 lbs.	176·0 lbs.
		Two Hogs.	Four Gilts.
Average live weight at bacon stage 28th April 1927	26	216·5 lbs.	203·8 lbs.
Average carcase dressing percentage	26	76·8 per cent.	76·5 per cent.
Average carcase weight	26	166·0 lbs.	156·0 lbs.
Classification as bacon—			
Grade 1	...	...	2
Grade 2	...	1	1
Grade 3	...	1	1

All the food was weighed out accurately each day and the pigs were allowed as much as they would clear up. Green food was also given up to consumption but was likewise weighed daily. When the proportion of fish meal became very small after the 18th week, a box with compartments for ground limestone, steam bone flour, salt and iron oxide was put into the pen, and the pigs took as much as they desired. Weighing was carried out fortnightly and in the early morning before the first feed. Three feeds per day were given till the age of 19 weeks, and two thereafter. The pigs were fed in a yard half of which was roofed over and the other half open, the covered part of the yard being kept well littered with dry wheat straw. This is a practice widely followed in Suffolk and is much to be preferred to letting pigs run in a yard which is continually kept wet and dirty all over by other stock, and in practice appears to be better than keeping them entirely under cover.

Results.— 1. *Pork.*—When the whole pen had reached an average weight of about 100 lbs. the best three hogs and best three gilts were offered to Messrs. F. Winton Smith, Ltd., who have a very large pork business throughout the Eastern Counties as well as several shops in London. Mr. Winton Smith, the managing director, not only immediately accepted them at the then top London price of 21*s*. per score, but was prepared to take all of the fifteen pigs in the pen at the same price. The six which were killed were weighed and examined with the results shown in Table I.

From this it will be seen that there was a slight advantage in live weight, carcase percentage and particularly in carcase weight in favour of the hogs. As regards quality it was very difficult to find any serious fault, but it was agreed by Mr. Winton Smith and the writer that the three hog carcases were slightly fatter and better fleshed along the back. The poorest of the hogs, which was as nearly as possible representative of the six carcases, was then cut up into the usual retail joints, which were weighed and photographed. The weights of this pig were as follows :—

Live weight	109 lbs.
Carcase weight	73 lbs.
Dressing percentage	66·9 per cent.

Weight of Side—	*lbs.*	*oz.*
Leg	9	0
Loin	6	14
Neck (spare-rib)	8	0
Streak or belly	5	6
Spring (including hand) ...	3	14
Head (half)	3	8
	36	10
	2	
Whole carcase ...	73	4

The photographs of one side and of the more important cuts are shown in figures 1 to 6, and an examination of these shows better than figures or description how suitable they are for domestic purposes. Looking first at the whole side (fig. 1) it will be seen that, but for the fact that the leg might be fuller at the tail and carried rather further down to the hock, the carcase leaves little to be desired from the point of view of pork.

When the photograph was shown to a prominent pork salesman on Smithfield market he stated that he could sell at top prices as many such carcases as he could obtain. While it is true that the greater amount of meat on the leg which is commonly found in such typical pork breeds as, for example, the Middle White and Berkshire would have made the carcase ideal, it must be realised that the general supply of pork carcases is for the present very far from the ideal, and a regular supply of carcases as good as the one illustrated would always meet with a steady demand at top prices. Further, the fact has to be remembered that the very short and fat limb joints are almost invariably associated with a short back, and as can be seen from fig. 2, the loin is one of the most important cuts from the point of view of a roasting joint. The great length of the side in fig. 1 is one of its best points. This photograph also shows the thin and regular layer of fat which covers the back and which even at the thickest part of the shoulder does not exceed 1½ ins. A light head and not too heavy feet and legs are also best seen in this particular photograph.

TABLE II.

Details of Feeding.

Period.		Fed Wet.						Fed Dry.		Nutritive Ratio.		
Experimental.	Standard.	Whole Milk.	Sharps.	Flaked Maize.	Barley Meal.	Fish Meal.	Whole Peas.	1000-Headed Kale.	Free Choice Minerals.	Of ration.	Standard.* Pork.	Standard.* Bacon.
Weeks.	Weeks.	Parts.	Parts.	Parts.	Parts.	Parts.	Parts.					
...	3-12	..	..	...	...	...	...	As cleared up. Approx. ½ lb. to 1 lb. per head per day.	...	...	1 : 3·46	1 : 3·46
9-10	...	40	15	5	...	...	5		...	1 : 4·5	...	...
10-11	...	25	15	5	...	...	5		...	1 : 4·6	...	...
11-14	...	...	15	5	5	1	5		...	1 : 4·4	...	...
...	12-16	...	...	..	...	...	...		...	...	1 : 3·89	1 : 3·89
14-18	...	...	15	5	5	1	...		..	1 : 4·8	...	...
...	16-20	...	...	...	...	...	...		...	...	1 : 6·27	1 : 4·00
18-26	...	...	10	10	20	1	...		*ad lib.*	1 : 6·9	...	...
...	20-24	...	...	...	...	...	...		...	...	...	1 : 4·89
...	24-30	...	...	...	...	...	...		...	...	...	1 : 6·27

		Average Meal consumed per day.†	*Average Meal consumed per 1 lb. live gain.*
Preliminary Pork period ...	8 weeks	3·22 lbs.	3·57 lbs.
Total Period to Bacon Weight	17 ,,	5·43 ,,	4·23 ,,

* Standard based on reference No. 2.

† Based on 10 lbs. milk = 2·24 lbs. best mixed meal (Crowther).

Fig. 2 speaks for itself and it would be difficult to imagine a joint more suited to supply the average small family of to-day. In this class of trade the consumer demands that the skin should be left on in order to produce the "crackling," but this necessarily prevents the removal of any excess fat by the butcher. The photograph shows that just sufficient fat is present to produce

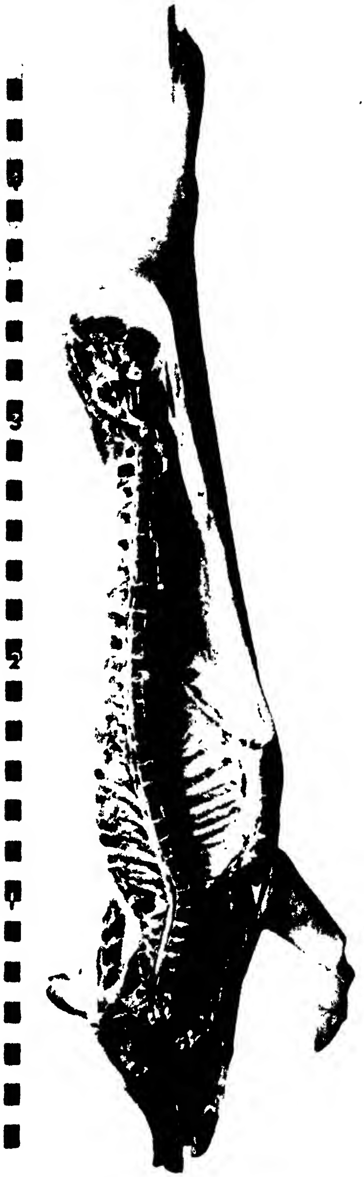


Fig. 1.

Half carcase of London Pork.

Weight of whole carcase, 73 lbs. 1 oz. Age. 17 weeks.

Copyright photo.] [H. R. Davidson.

FIG. 2.

Loin. 6 lbs. 14 oz.

Left—Hind loin through kidney. *Right*—Middle loin.

FIG. 3.

Leg. 9 lbs. 0 oz.

Note the high proportion of lean meat.

Fig. 4.
Spring (including Hand). 3lbs. 14 oz.

Fig. 5.
Neck (Spare-rib). 8 lbs. 0 oz.

Copyright photos.] [H. R. Davidson.

Fig. 6.

Streak or Belly. 5 lbs. 6 oz.

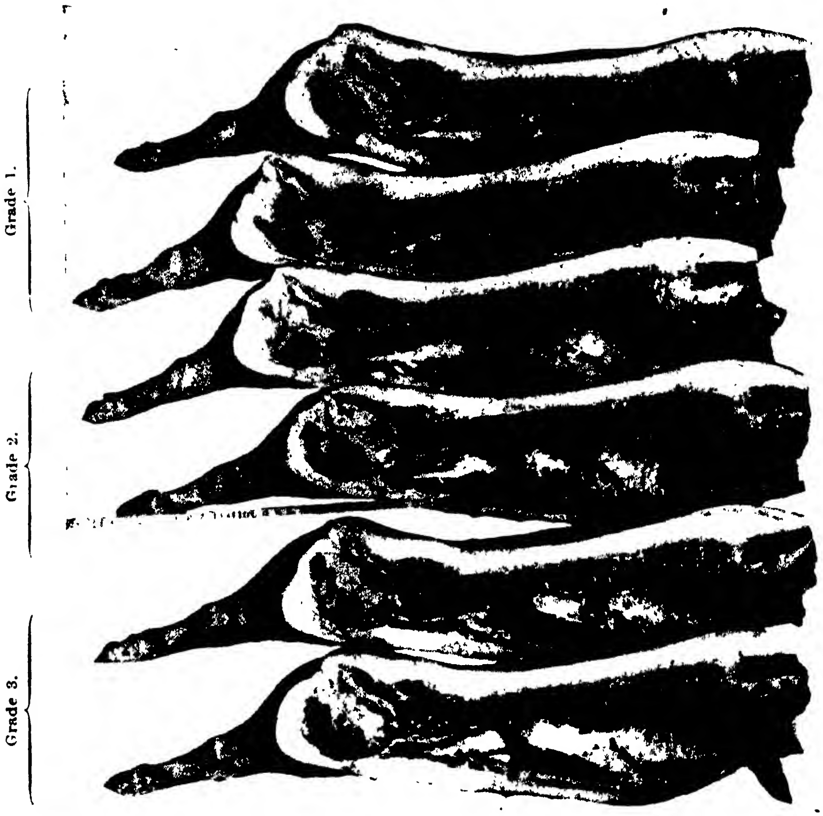


Fig. 7.

Bacon carcases from same pen as pork carcase in Fig. 1.

Note slight excess of back-fat only on the two Grade 3 carcases.

a well proportioned slice when the joint is served. It is particularly in this cut that so many typical pork carcases are unsuitable. In fig. 3 again is seen how full of lean meat is the leg, with just enough fat to make it cook well.

Figs. 4 and 6 show the spring and streak respectively, and just because they are poorer quality cuts it is all the more important that they should appear attractive by containing as large as possible a proportion of lean. The neck, which in fig. 5 has been photographed from a somewhat unorthodox angle, is here represented to show that even at the fattest part of the shoulder the carcase is well proportioned.

2. *Bacon.*—The rapid growth made by the six pork pigs, i.e., 100 lbs. live weight at four months old, led one to suppose that after their removal the average rate of growth of the remainder would be very much reduced; but, as will be seen from Table I, this was not the case, and the excellent result was achieved of getting the remaining six to bacon weight at six months of age. It will be seen that they were killed when exactly 26 weeks old, but it has to be explained that although they were ready to go to the factory at 25 weeks they were retained for a week at the request of the Director of the University Farm in order that students who were just then beginning a new term might have an opportunity of seeing them.

After being weighed as usual in the early morning they were sent direct by road to the factory where they were killed the same forenoon. While the pork pigs only killed about 66 per cent. of their live weight, it is instructive to note that the baconers reached over 76 per cent., which must be considered a very good average figure. Owing to the accidental loss of one hog it is difficult to attempt any comparison between the sexes. Nevertheless the two hogs averaged out considerably heavier than the gilts, and when it came to grading, the gilts gave obviously the better carcases, both of which results are entirely in accord with the Swedish figures already quoted.

From fig. 7 it will be seen that the carcases are all good (compare with reference 5) when it is realised that grade 3 is the grade on which the ordinary market price is paid and grades 1 and 2 normally receive a bonus of 1*s.* and 6*d.* per score respectively. Both the grade 1 carcases were from gilts, whereas the hogs gave only one grade 2 and one grade 3. The most interesting thing to note, however, in this photograph is that in spite of the fattening nature of the feeding practically from the beginning there were only two sides out of six which at bacon weight were too fat to get the extra bonus for high quality, and of these one was a hog's. Had the animals been slaughtered when ready at 25 weeks and approximately one stone lighter, it is not unreasonable to suppose that the hog carcase would have been the only one to fail in this respect.

Conclusion.—The very small scale upon which it was possible to carry out this experiment makes it essential that the results should only be regarded as preliminary and as indicating a direction for further investigation. It is nevertheless true that they are in line with the general considerations discussed earlier, and while the figures relative to the two sexes must for the present be treated with great caution, the fact that a bacon type of pig can produce as good a pork carcase as is necessary is only corroborative of what has been shown by others. It is often argued that such a bacon breed as the Large White is not a very rapid grower, but in practice no one would be disappointed with an average live weight of 200 lbs. at six months old. Nor is there anything to be said against the fecundity of this breed as compared with the popular "blue" (i.e., Large White × Large Black) pig, when the average figures of the University Farm herd as published by the late Mr. Mackenzie are considered. These were 11·66 born and 8·20 weaned twice per year and at a time when experiments were being carried out on all sorts of war rations of very doubtful value, as a result of which several casualties were incurred.

Scottish readers may object that the importance laid on the production of small London pork does not appeal to them, but in that case they should remember that just as a bacon pig can produce a pork carcase whereas a typical porker from a recognised pork breed is unsuited for bacon, so a pig which is suitable for the production of the smallest and finest pork will always provide good pork at any reasonably higher weight, while the converse is not necessarily true. But there is a second and a much more important reason. Since the embargo on fresh carcases from the continent eighteen months ago, the shutting off of the Dutch supplies has opened up to the producers of this country a very large market for small pork. But although full prominence was given to this opening, the information, so far as England, Wales and Scotland are concerned, has not been acted upon. Early in August of this year an important conference was convened in Dublin by the Department of Agriculture of the Irish Free State in connection with the development of the fresh pork industry at which were present representatives of farmers, buyers, bacon and pork firms and factories, Smithfield buyers and salesmen, and railway and shipping companies. At this conference one of the most important meat authorities from the Midlands stated that the English farmers had taken up the question of supplying pork, that they had not done so quite as enthusiastically as the Irish farmers, and that in his opinion there was not going to be as much opposition as Irish farmers thought. It was also stated that the average price for an 80 lbs. (dead) porker in good condition would be about 1*s*. per lb. for the coming winter. It was further stated that the native Irish or "Ulster" pig was not as good for the pork trade as the Large White Yorkshire pig. From this it would seem that if the Irish farmer, with all the difficulties of arranging for transport not only by rail but also by sea and with a native pig certainly no better than that of the Scottish farmer, can supply the London market, there is every indication that the Scotsman is equally well situated.

The main argument therefore of the present article is that, if he should consider such an outlet for his pigs, it need not in any way interfere with his supplying any bacon market to which he has been accustomed to send them.

Summary.—1. The recent embargo on fresh carcases from the continent has made prominent the two markets of bacon and small pork which exist in this country.

2. The large number of breeds and types in this country leads to great difficulties in the way of amalgamation for the purposes of standardisation and investigation, and the reduction of types to a minimum is to be desired.

3. Evidence is produced to confirm the growing belief that a good bacon type of pig is suitable for the production of even the finest type of pork.

4. Some evidence is given, and further reference made to suggestive Swedish figures, that the use of one type both for bacon and for pork could be made more efficient by killing the hog pigs for pork and confining the baconers to gilts, because in this way the risk is obviated of the early fattening rations making the bacon carcases too fat.

5. The opening for British pig breeders to supply the London market with small pork is rapidly being monopolised by farmers in the Irish Free State, and the suggestion is made that by using the correct type of pig, farmers in Scotland could obtain much of this trade without prejudice to any other present outlet for their pigs.

Acknowledgments.—Grateful acknowledgment is made in the first place to Mr. A. Amos, M.A., Director of the Cambridge University Farm, for permission to carry out the experiment on the University Farm pigs. The writer is also indebted to Mr. F. Winton Smith and to the management of the St. Edmundsbury Co-operative Bacon Factory, Ltd., for permission to weigh, measure and photograph the carcases, and to Mr. T. K. W. Fair, B.A., for assistance in mixing and weighing out the rations.

REFERENCES.

1. Sanders Spencer.—" Pigs for Pork," *Journ. Min. of Agr.*, Oct. 1921.

2. Stewart, W. A.—" Pig Keeping," Min. of Agr. Misc. Publ., No. 48 (1925).

3. " Report on the Marketing of Pigs in England and Wales," Min. of Agr. Economic Series, No. 12 (1926).

4. " Report of the Scottish Pig Industry Committee, 1927," Scot. Agr. Org. Society, 5 St. Andrew Square, Edinburgh.

5. Davidson, H. R.—" Pig Carcases for Wiltshire Bacon," *Journ. Min. of Agr.*, Mar. 1927, Vol. XXXIII, p. 1095.

CROP IMPROVEMENT IN CANADA.

George H. Clark,
Canadian Department of Agriculture.

Promoting the welfare of Canadian farmers provides wholesome competition and perhaps a little overlapping of services between federal and provincial agricultural specialists. Plant breeding and experiments with field and garden crops are regarded as necessary to provincial agricultural colleges. They are the main purpose of federal experiment stations in work of crop improvement. Co-ordination of effort among plant breeders in particular was necessary in order to overcome confusion and waste. Canadian seed production and seed trade control are organised with a view to effect in part that co-ordination.

It has been the object of many years of patient work on the part of many people to protect the best product of the plant breeder, to maintain its purity while being multiplied in quantity for commerce, and finally to secure its distribution in its pure state. The results are clearly evident in the relative quality of the general crops of the country.

The Plant Breeders' Committee.—Most, but not all, plant breeders in Canada are employees of federal or provincial experiment stations, of which there are nearly 50. Twenty-one of the most experienced of these plant breeders form a committee of the Canadian Seed Growers' Association, and at the expense of the Federal Government meet annually with that Association. As producers of Elite stock seed they are qualified as members of the Association. The committee of 21 is sub-divided into three sub-committees to deal with cereal crops, forage crops and garden vegetable crops. They devise ways and means of meeting the pressing needs of agriculture and horticulture as expressed by grain growers, vegetable growers and other organisations in the several provinces. By mutual arrangement the committee divides the work of plant breeding to produce new varieties and improved strains of old varieties to meet particular needs, and to purify and maintain supplies of Elite stock seeds of such varieties, among their members and others, according to their geographical location and personal inclination. They recommend varieties that may be designated as "approved" because of their superior merit. If they are adopted by the Seed Growers' Association, these "approved" varieties are thereafter eligible for admission to the pedigree records of the Association, which issues certificates of registration for the inspected seed crops of those "approved" varieties.

The chairman of each sub-committee, in his capacity as a Federal Government plant breeder, is responsible for determining whether newly introduced varieties are distinctive, and therefore entitled to a licence for a new variety name under the provisions of section 6 of the Seeds Act, but in arriving at their decisions these officers are supported by their committees of plant breeders.

The annual cost of convening this committee of plant breeders is about $3,000 per year. The benefits derived from the co-ordination of their own work is obvious. The advantages that accrue from the co-ordination of their work with that of the seed growers is of great importance to crop improvement in general.

The Canadian Seed Growers' Association.—A quarter of a century of active service has wrought material changes in the methods of production and standards of excellence for the registration of seed crops by the Canadian Seed Growers' Association. After three years of educational work this Association was started in 1902 by adopting the principle of mass selection to be practised by farmers who made a specialty of seed growing. For the first few years the work was conducted only with cereal grain crops. After seven years of experience two of the promotors of the work went to Sweden and studied under Dr. Nielsen of Svalof. Since then mass selection has been encouraged among practical seed growers as a means of maintaining purity of variety, but with the high standards now fixed for registered seed crops, comparatively few of the practical seed growers are able to produce seed crops that will pass field inspection when their seed is more than five generations removed from Elite stock seed that is bred from individual plants by the plant breeder. This factor has enormously increased the demand for service from the plant breeder, whose work in crop improvement has come to be important and effective. This incentive, in turn, naturally leads the plant breeder promptly to respond to the demands of the ultimate market, in the moulding of which his own educational influence plays a part.

The annual meetings of the Canadian Seed Growers' Association are held during the month of June, usually at an agricultural college, and alternately in the east and the west of Canada. The last annual meeting at Victoria, B.C., was attended by more than 50 delegates of practical seed growers and 20 plant breeders. The responsibility of the Association does not extend beyond the establishment of the standards of excellence for each kind and variety of crop, the issue of an illustration and description of each variety for the guidance of seed growers and seed crop inspectors, and the final issue of the certificate of registration which is based on the seed crop inspection report; but the Association takes an active interest in general educational propaganda to encourage the more general use of registered seed, which is marketed under the grade designation "Registered," and is sealed in the sack.

The Association headquarters are in Ottawa, in offices provided and furnished by the Department of Agriculture. In addition the Department provides a money grant of $10,000, which is almost sufficient to meet the salaries and the travelling and other expenses of the secretary and his staff.

The Inspection Service for Registered Seed.—The inspection of seed crops and the inspection and grading of seed for commerce is provided by the Department of Agriculture nominally on the basis of service at cost, but actually at a little less than cost. Fifteen cents per acre is collected from the growers for the inspection of seed crops of cereal grains, and the actual average cost last year amounted to almost 18 cents per acre. The inspectors are graduates of agricultural colleges and are specialists in agronomy or horticulture.

For their work the territory is divided into six inspection districts, with office headquarters and a seed laboratory for each district. There are from five to twelve inspectors for each district, some of them being part-time men. The inspection, grading and sealing in the sack of the recleaned seed is done on farmers' premises at 4 cents per bushel or at central cleaning plants at 2 cents per bushel. Three-quarters of the seed grain from registered seed crops is sold in the community where it is produced. Only that part which enters into general commerce is sealed in the sack. The tag certificate behind the seal, giving the prescribed information, is signed by the inspector.

The results of inspection are summarised in the following table :—

1926 SEED CROP.

Crops.	Acreage registered.	Estimated Yield.	Quantity Seed inspected and sealed.
Wheat	19,511	472,589 bushels.	85,791 bushels.
Oats	5,076	257,387 ,,	34,792 ,,
Barley	2,341	94,275 ,,	13,535 ,,
Corn	298	13,595 ,,	170 ,,
Flax	348	3,605 ,,	162 ,,
Peas	55	1,620 ,,	14 ,,
Soy Beans	22	580 ,,	...
Rye	¼	20 ,,	12 ,,
Alfalfa	2,809	259,161 lbs.	212,832 lbs.
Sweet Clover	172	27,150 ,,	687 ,,
Swede Turnips	¾	...	1,260 ,,
Mangels	4½	...	198 ,,

Number of fields inspected and reported 2,205
Number of registration certificates issued 1,599

Inspection Service for Non-Registered Seed.—The service of seed crop inspection is provided to any seed crop grower who applies and is willing to pay for it. Large acreages of kinds, varieties and standards of purity that are not eligible for registration are inspected when the crop is nearly ready for harvest. The seed from such crops may be graded No. 1 or No. 2, or, if for export, not graded at all, and sealed in the sack with a tag certificate signed by the inspector. The statement on the seed inspection tag certificate is a simple statement of fact as to the kind, variety and comparative quality of the seed crop, and the cleaned seed. The inspector is protected in part by affidavits from the seed grower which he is empowered to take.

With such a seed inspection tag certificate the seed growers individually and co-operatively have no difficulty in marketing their crop either for domestic use or for export, and most seed merchants find it quite satisfactory to expose for sale seed supplies, for the quality of which they do not assume responsibility. Under this new system, introduced by the provisions of the Seeds Act, 1923, alfalfa seed, which seven years ago was largely imported into Canada, was exported last season to the extent of 90,000 bushels of the Canadian variegated variety, and Brown Top (*Agrostis tenuis*) seed of the Maritime Provinces has increased in three years from a few hundred to about 70,000 lbs.

So long as this inspection service continues to pay its own way, there may be no limit to its expansion. Confidence on the part of the purchasing public in the inspector's certificate has rendered this new inspection service of marked financial advantage to the seed growers and their co-operatives. It has very materially enlarged the supply of seed of superior quality, but has to some extent lessened the commercial advantage formerly enjoyed by well-established seed houses whose reputations had been the main, if not the only, assurance of quality to the prospective purchaser.

The Seed Merchant.—The Seeds Act, 1923, and regulations thereunder were designed in part by the Canadian Seed Trade Association and its representatives on the Advisory Board under that Act. Experience has shown unforeseen defects in this Act which at times would seem to inflict unnecessary hardships on the seedsmen; these will be corrected in good time. On the whole the Act has amply proved its real worth in protecting the best interests of the seed trade as well as that of agriculture.

All general crop seeds to be marketed in Canada must be graded as to quality in one of the six district inspection offices. In view of the fact that farmers of many nationalities are scattered over a new country of vast extent, it was deemed advisable to adopt a very simple plan for designating quality in seeds. The meaning of Extra No. 1, No. 1, No. 2 and No. 3 could not easily be misunderstood, because throughout North America these terms are applied to express the quality of most staple agricultural commodities.

The demand in Canada was formerly for seed of a medium quality down, the better qualities being exported. Under the grading system the demand has changed to seed ranging from a medium quality up, more than 75 per cent. of the demand being for No. 1 or higher grade. The farmers are quite willing to pay a fair price for the best available quality when they have reasonable assurance of getting the quality they are paying for. Most seed merchants carry stocks of inspected seeds that are graded and sealed in the sack, and do what they can to encourage their more general use among their patrons. Other general crop seeds are sold on control sample certificates clearly marked as such.

The seed merchant draws and submits to the nearest district inspector's office a control sample of each bulk lot of seed, on which he receives a control sample certificate of grade. Each parcel of his seed must, before being sold, be marked with the grade and the certificate number. If the purchaser, whether the retailer or the ultimate purchaser, suspects that the seed is not up to grade, he draws a sample or applies to the nearest inspector to draw a sample to forward to the district inspection office for comparison with the control sample. Thus the system polices itself and soon leads the unscrupulous dealer into difficulties and exposure. Thus the best and most reliable of the seed merchants support, and to a considerable extent direct, the development of an efficient system that protects legitimate trade and confers great benefits on agriculture.

A quarter of a century may not be regarded as too long, even in a new and rapidly growing country, to develop a fine spirit of co-operation between plant breeders, seed growers, seed merchants and the ultimate consumers of seeds. Seed production and seed control in Canada had a small and simple commencement. Its growth has never been in advance of the concensus of opinion of those most interested and affected.

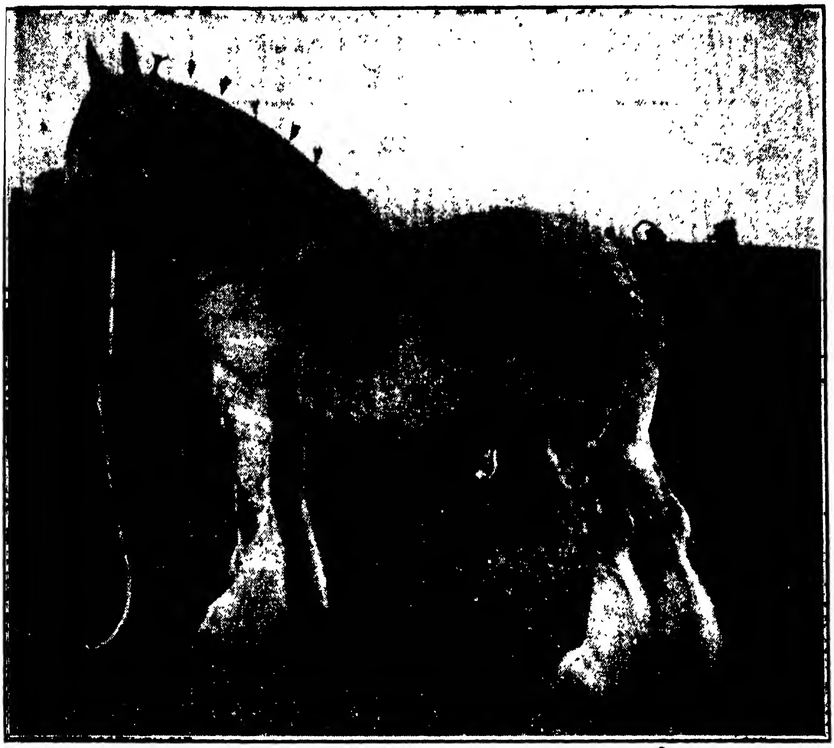
SUGAR IN MILK.

J. F. TOCHER, D.Sc., F.I.C.

Introductory.—The chief constituents of milk from the legal point of view, and consequently from the milk producers' point of view, are butter-fat and solids-not-fat. By solids-not-fat is meant of course all the normal constituents of milk other than butter-fat. As a result of the administration of the Milk Regulations, the attention of local authorities is perhaps unduly concentrated on butter-fat percentages to the disadvantage of other important constituents of milk, except when considered together as a whole. There is evidence, however, of increased attention, particularly on the part of Health Authorities, being paid to the presence of every one of the constituents of milk. This is due to the fact that each constituent has a specific value in animal nutrition—in other words, each constituent has a rôle of its own in supplying heat to the body, in replacing waste or in furnishing bone, muscle and tissue, particularly to the young of every species.

It is a well known fact that the proportions of the various constituents of milk of cows of any one breed vary from cow to cow. It is equally true that the average percentages of the constituents vary in the milks of various breeds. Examples of these variations in the cases of butter-fat and solids-not-fat were given in recent issues of this JOURNAL.[1] A study of the variations of

[1] Vol. X, Nos. 1 and 2.



A penny a week keeps "Show" fitness *all the year round!*

SALTONA keeps your horses always in the pink of condition. Blood disorder, Humour, Eczema and Sluggishness become forgotten troubles—you can get the maximum amount of work out of your stock in winter as well as summer. A dose of SALTONA in food at the week-end—costing only a penny or two-pence—prevents the weakening effects of long confinement in stables and produces vigorous health. Because of the velvety gloss which it imparts to the coat, SALTONA is particularly valuable for Show animals. SALTONA has been proved effective in the finest stables all over the world—including those of H.M. the King. It is perfectly safe for in-foal mares and does not give cold. Also cures all Blood disorders in Cattle, Sheep, Pigs, Poultry, etc.

SALTONA is guaranteed by the name of OSMONDS. *Write for full particulars, prices and users' opinions.* . . . .

OSMOND & SON LTD.

GT GRIMSBY, ENGLAND.

Branches all over the World

Manufacturers of Animal Medicines for over 70 years

the individual constituents of solids-not-fat may be found in the writer's monograph on this subject.[1]

What is Sugar?—The term "sugar" is a general term applied to a group of "carbohydrate" substances. The sugar we use in our tea is one of these and is known as "common sugar" or "cane sugar," the latter term being used because the substance is obtained from the sugar cane. The same substance is, however, obtained from beet, so that "beet sugar" and "cane sugar" are the same chemical substance. The correct chemical term for common sugar is "sucrose." Some people find it hard to believe that sugar from beet and sugar from cane are the same substance chemically. This arises from the fact that certain grades of beet sugar contain very small proportions (much less than 1 per cent.) of mineral substances, and also from the fact that sugar from beet when finally prepared for the market frequently has a different physical appearance from sugar derived from cane. The sugar obtained from milk is, however, different in chemical *constitution* from the sugar obtained from beet and cane, although it does not differ from the latter in chemical *composition*. Let me explain. Both milk sugar and common sugar contain 42·1 per cent. of carbon, 6·4 per cent. of hydrogen and 51·5 per cent. of oxygen, the only chemical elements present in both sugars. Thus they have the same chemical composition. They differ, however, in the way in which these elements are arranged to form a particle, technically a molecule, of the substance. Common sugar, when acted upon by chemical agents, breaks up into two simpler substances known as dextrose (glucose) and lævulose, while milk sugar when similarly treated breaks up into glucose and a substance known as galactose. These substances, galactose, glucose, and lævulose, differ in their physical and other properties because of the different arrangements of the constituent elements. They have, however, the same chemical composition, containing as they do 40 per cent. of carbon, 6·7 per cent. hydrogen and 53·3 per cent. oxygen. The difference in constitution between common and milk sugar also accounts for the fact that common sugar is about four times as sweet as milk sugar. The heat-producing properties of both sugars are the same, as is also their power of dissolving lime in the form of calcium hydrate (slaked lime). Both are unaffected by the presence of citric acid, a substance found in very small proportions in milk. Such substances as pepsin and trypsin, present in the alimentary tract, have no effect on milk sugar, but milk sugar is readily broken up by certain minute organisms normally present in commercial milk into a sour substance known as lactic acid—the chief cause of sourness in milk.

Amount of Sugar and other constituents in the Milk of Mammals.—It may be useful here to show the average percentages of the chief constituents found in the milk of different mammals. The following table (Table I) gives the average values of the constituents for ten mammals.

[1] Variations in the Composition of Milk. H.M. Stationery Office. 1925.

TABLE I.

Mammal.	Butter Fat.	Sugar.	Casein, Albumen, &c.	Mineral Matter.	Water.	TOTAL.
Elephant	19·57	8·84	3·09	0·65	67·85	100
Rabbit	10·45	1·95	15·54	2·56	69·50	100
Ewe	8·63	4·28	5·23	2·42	79·46	100
Sow	4·55	3·13	7·23	1·05	84·04	100
Goat	4·63	4·22	4·35	0·76	86·04	100
Camel	3·07	5·59	4·00	0·77	86·57	100
Cow	3·95	4·64	3·52	0·70	87·19	100
Woman	3·30	6·80	1·50	0·20	88·20	100
Mare	1·17	6·89	1·84	0·30	89·80	100
Ass	1·26	6·50	1·66	0·46	90·12	100

It will be observed that the mammals which give the highest percentages of fat are also the mammals which give the lowest percentages of water. Rabbit's milk contains the lowest percentage of sugar and the highest percentage of protein. Elephant's milk contains the highest percentage of sugar. Human milk differs considerably from cow's milk. Compared with cow's milk, human milk contains on an average about 2 per cent. more sugar, about 2 per cent. less protein, over 0·5 per cent. less fat, and about 0·5 per cent. less mineral matter.

Sugar in Milk from various breeds of Cows.—It is well known that Jersey and Guernsey cows yield milk rich in butter-fat. Ayrshire and Shorthorn cows occupy an intermediate place, while Friesian cows, owing to the fact that they are heavy milkers, give on an average less butter-fat per cent. than the other breeds. If, however, we consider the total amount of butter-fat per week obtained from the milk of Friesians and Ayrshires, it is seen that Friesians give practically the same amount of butter-fat *per week* as Ayrshires do—7·8 lbs. as against 7·7 lbs. With regard to milk sugar, while Friesians and Ayrshires give practically the same percentages of sugar, Friesians give on an average about 10 lbs. of sugar per week compared with 8½ lbs. per week given on an average by Ayrshire cows. It will be seen from the next section of this article that this is due to the larger yield of Friesians when compared with the yields of other breeds.

The following table (Table II) shows the average composition of the milk obtained from cows of various breeds.

TABLE II.

Composition of Milk of different breeds of Cattle.

Breed.	Fat.	Milk Sugar.	Protein, &c.	Ash.	Water.	TOTAL.
Jersey	5·43	4·85	3·96	0·75	85·01	100
Guernsey	5·16	4·80	3·92	0·75	85·37	100
Ayrshire	4·09	4·57	3·27	0·69	87·38	100
Shorthorn... ...	3·91	4·80	3·27	0·73	87·29	100
Friesian	3·63	4·62	3·11	0·71	87·93	100

It will be seen that the average percentage of sugar lies between 4·5 and 4·9 for the various breeds. There is, however, great variation in the percentage of sugar in the milk of individual cows of any one breed. I shall now discuss these variations.

Variations in the proportion of Sugar in Milk.—The proportion of milk sugar in the mixed milk of cows of all breeds varies from 2·1 to 5·7 per cent. The following table (Table III) shows the observed frequencies of the various percentages of milk sugar found from 676 individual cows of all breeds taken at random throughout Scotland. It will be seen that one cow gave as low a percentage of milk sugar as 2·7 and two cows gave as high a percentage as 5·5.

TABLE III.

Milk Sugar per cent. to nearest 0·2.	*Observed frequencies.*
2·7	1
2·9	0
3·1	1
3·3	4
3·5	6
3·7	6
3·9	22
4·1	40
4·3	69
4·5	118
4·7	166
4·9	152
5·1	72
5·3	17
5·5	2
	676

An inspection of Table III reveals the fact that only 6 per cent. of all cows give milk containing less than 4 per cent. sugar; 80 per cent. of all cows give milk containing from 4 to 5 per cent. sugar, and only about 14 per cent. of cows give over 5 per cent. sugar in their milk. The most frequently recurring percentage is 4·8, while the average is 4·6 per cent. About 23 per cent. (nearly a quarter) of all cows give approximately 4·8 per cent. of sugar; over 60 per cent. of all cows give between 4·5 and 4·9 per cent. of sugar in their milk. The accompanying diagram (Diagram I) shows the nature of the distribution of sugar in milk. The theoretical curve is shown by a continuous line, while the observed values are shown by the graph in units of 0·2 per cent.

It is well known that milk sugar is acted upon by organisms known as "lactose fermenters," with the result that milk, on being kept, loses sugar and gains lactic acid. The following diagram (Diagram II) shows on a common scale the milk sugar

DIAGRAM I.

Percentage lactose distribution.

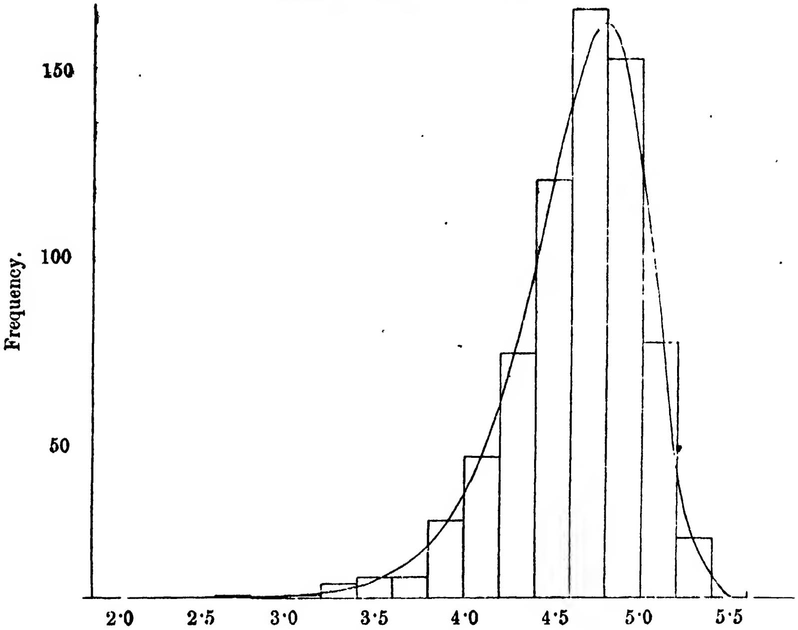
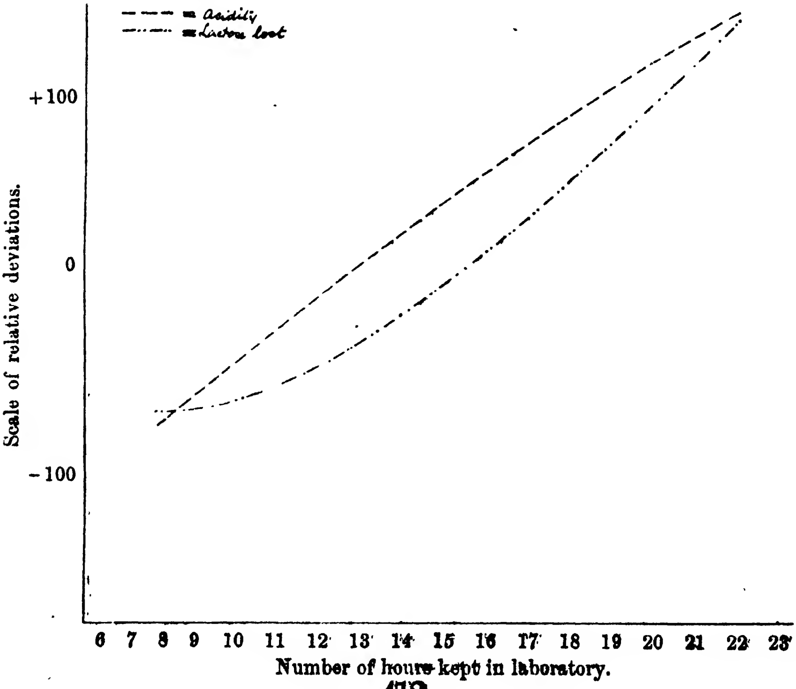


DIAGRAM II.

Diagram showing the increases in acidity and the losses in lactose, both expressed as deviations from their means, relating their respective standard deviations. A deviation as great as the standard deviation is reckoned as 100.

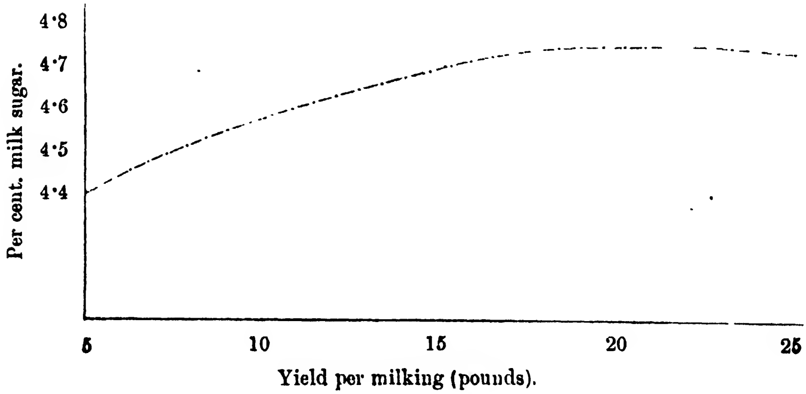


lost with increase of acidity during 24 hours due to the formation of lactic acid. Samples of fresh milk containing relatively low percentages of milk sugar (below the average) are very slightly acid. Samples above the average in milk sugar possess more acidity. Samples very rich in milk sugar have their acidity arrested, due to the inhibitory action of the lactic acid formed by the "lactose fermenters."

One of the most striking facts about milk is the relationship which exists between the amount of milk given by a cow at one milking and the *percentage* of milk sugar present in the milk. The more milk a cow gives, the higher is the percentage of sugar in the milk. If I took 10 gallons of water and dissolved a pound of sugar in it, there would be 1 per cent. of sugar present in the solution. If I added *two* lbs. of sugar to 20 gallons of water the strength of the solution would be still 1 per cent. If, however, I dissolved *four* lbs. of sugar in 20 gallons of water the strength of the solution would be 2 per cent. This is the kind of thing the cow does. If her yield is low the *percentage* of sugar is low—the strength is low. If she has a high yield she increases the strength of her sugar solution—the *percentage* of sugar present in the milk is higher than the *percentage* for low yields. Thus a good milker is a good sugar producer. Since Friesian cows are the best milkers in the sense that they give the highest yields, they are the best sugar producers in the sense that their milk contains on an average the highest percentage of milk sugar. The undernoted diagram (Diagram III) shows the

DIAGRAM III.

Diagram showing the average percentages of sugar associated with various yields per milking.



relationship between yield per milking and percentage of sugar in milk. A probable[1] explanation of the fact that a good milker is also a good sugar producer is that the osmotic pressure of milk tends to correspond to the particular osmotic pressure of the

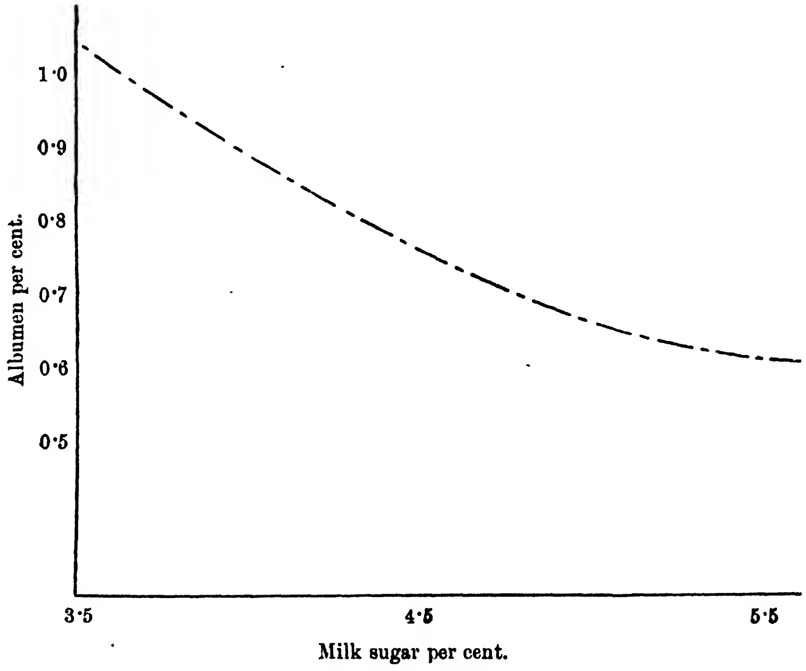
[1] Variations in the Composition of Milk. H.M. Stationery Office, 1925.

blood of the animal at the time the milk is secreted. If this is the case, the particular osmotic pressure of the blood of each cow governs, at the time, the osmotic pressure of the milk.

Another fact of importance relating to sugar in milk is the relationship between sugar and albumen. If the percentage of sugar is high the percentage of albumen is relatively low, and *vice versa*. The actual amount of albumen present in milk is small, on an average about 0·76 per cent., but only 0·6 per cent. albumen, on an average, is found in milk containing 5·5 per cent. sugar, while the average amount of 1·1 per cent. of albumen is present in milk containing 3·5 per cent. sugar. Diagram IV shows graphically this relationship between sugar and albumen.

DIAGRAM IV.

Diagram showing the average percentages of albumen associated with various percentages of sugar in milk.



The amount of mineral matter present in milk is governed to a certain extent by the amount of sugar present. If the percentage of milk sugar is low the percentage of mineral matter is high, and *vice versa*. This can be seen at once from Diagram V, which shows graphically the fall in the percentage of mineral matter expressed as ash with the rise in the percentage of milk sugar. One final point to be noted with regard to sugar in milk is the fact that for any particular cow the percentage of sugar is highest at the beginning of the lactation (5 per cent.), and gradually and uniformly falls during the entire lactation period to about 4·5 per cent. at 44 weeks after calving.

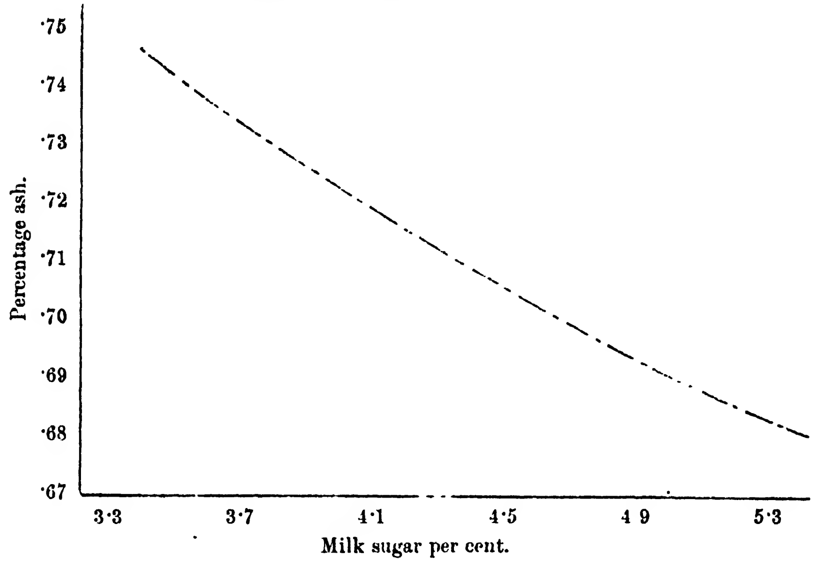
Summary.—(1) Sugar is a general name for a particular group of carbohydrate substances. Common sugar and milk sugar are different substances possessing practically the same heat-producing value, but differing in many physical and other properties. Common sugar is four times sweeter than milk sugar.

(2) The average proportion of sugar in milk varies with the animal secreting the milk. Rabbit's milk contains about 2 per cent. sugar, human milk over 3 per cent., cow's milk about 4 per cent. and elephant's milk about 9 per cent.

(3) The percentage of sugar present in cow's milk depends on (*a*) the breed, (*b*) the stage of lactation period, (*c*) the percentage

DIAGRAM V.

Diagram showing the average percentages of mineral matter associated with particular percentages of sugar in milk.



of mineral matter, (*d*) the percentage of albumen, (*e*) the natural acidity of the milk, (*f*) the yield per milking and number of cows whose milk is bulked. The percentage of sugar falls uniformly from the beginning to the end of the lactation period. Milks with relatively high percentages of sugar have relatively low percentages of ash and albumen, and *vice versa*. Excepting in the cases where milk contains a very high percentage of sugar, the natural acidity of the milk is relatively high when the percentage of sugar is relatively high, and *vice versa*. A good milker is a good sugar producer, and on that account, since Friesians give on an average the highest yields, Friesians are the best sugar producers when the total amount of sugar during a lactation period is considered.

THE BIOLOGIST ON THE FARM.—No. XXVII.

Professor J. ARTHUR THOMSON, M.A., LL.D.,
University of Aberdeen.

Lord Morton's Quagga-Horse Hybrid.—Everyone knows the story of this alleged hybrid, for it has been for more than a century the chief support of the "Telegony" theory, that a dam may be "infected" by the sire of her first-born young in such a specific way that subsequent offspring by a different sire show some characteristics of the first sire. Lord Morton bred from a male quagga and a young chestnut mare of seven-eighths Arabian blood, not previously bred from; and the result was a female hybrid bearing both in her form and colour (bay) very decided indications of her mixed origin. He parted with the mare to Sir Gore Ouseley, who bred from her by a very fine black Arabian horse. When Lord Morton saw their progeny, a two years old filly and a year old colt, half-sister and half-brother of the quagga hybrid, he was struck to find a marked resemblance to the quagga both in their colour and in the hair of their manes. Their colour was bay, marked more or less like the quagga in a darker tint. There were cross stripes on the withers of the colt and the part of the neck next to them. Those on the filly covered nearly the whole of the neck and the back, as far as the flanks. The mane of the filly was short, stiff and upright; that of the colt was long, but so stiff as to arch upwards as in the hybrid. The manes of the Arabian breed hang lank. What impressed Lord Morton so much was "the extraordinary fact of so many striking features, which do not belong to the dam, being in two successive instances, communicated through her to the progeny, not only of another sire, who also has them not, but of a sire belonging probably to another species."

This old story has been subjected to higher criticism by Professor James Wilson, and one's faith is shaken. "If Lord Morton's description of him be correct, Sir Gore Ouseley's stallion was not the sire of the chestnut mare's second and third foals, nor of a fourth which was foaled in 1821; for a chestnut mare cannot have bay foals to a black horse. There are five horse colours: grey, dun (including cream), bay (including brown), black, and chestnut: and, reading from the left, each is dominant to those on its right, reading from the right, recessive to those on its left."

Since black and chestnut are both recessive to bay, a black with a chestnut cannot have bay foals. The stallion's portrait in oil shows a very dark bay. But the expert goes on to ask whether the quagga was really the sire of the chestnut mare's first foal? "Could a chestnut and a quagga have had a bay foal—a foal of a colour dominant to chestnut? The chestnut mare's first foal, had the quagga been its sire, should have been a chestnut. In all probability, only Lord Morton's groom and the leader of some indifferent, light-legged stallion travelling the Lothians in 1814 knew the sire of Lord Morton's hybrid." This seems to us a somewhat dangerous line of criticism, but it is very interesting. Unfortunately it cannot be put to the test of re-experiment, for the quagga is extinct.

Hookworms and Bare Feet.—Hookworm parasites are the cause of one of the heaviest mundane clouds that have ever darkened man's sky. They cause anæmia, wasting, apathy, despair, crippling, death. The minute threadworms, living in moist soil in warm countries, make their way through the skin of bare feet or legs, are carried in the blood-stream to the lungs, and pass thence to the small intestine where they fix themselves to the walls and draw blood. The eggs pass out from the mature worms and hatch in the soil. So the circle re-commences. It is easy by means of carbon tetrachloride or the like to expel the worms from man; but re-infestation is very apt to occur unless the natives will learn to use the latrines provided. In many places the bare-footed children get infected, and this may be prevented by wearing shoes. The larval worms like a loose sandy soil in which they can move about readily and find the indispensable moisture. In close-textured soil, like clay, they cannot thrive. So that there is a correlation with soil as well as with shoes. In Florida the soil and the climate are almost uniformly favourable to hookworms, but the actual amount of infestation varies directly with prosperity; for that means better sanitation and less bare-foot.

Fresh Light on Galls.—Everyone knows the oak-apples, like wooden marbles, on oak trees, and the " brier sponges," like dense tufts of hair, that are common on wild rose bushes. There are scores of common galls in this country, with this in common that they are the answers-back that plants make to the intrusion of some other living creature. The intruder may be a bacterium, as in the root-tubercles of clover and other leguminous plants; or a fungus, as in the immense galls on the root of alders and the witches' brooms on various trees. It may be a Nematode worm, as in the " ear-cockles " of wheat; or it may be a minute mite. But most galls are connected with insects, especially with Hymenoptera; and the most finished galls, like oak-apples, are made by " gall-flies " in the family Cynipidæ. In spite of their name these " gall-flies belong to the order Hymenoptera, and are not far from the " saw-flies " and the " Chalcid flies," which may also make galls. Dr. Werner Magnus has made some very interesting studies on gall-making by Hymenoptera, and some welcome experiments, such as injecting extract of gall-fly eggs into suitable plants and observing the consequences of the provocation.

According to Magnus there are two chapters in gall-making, the general and the special. In the general chapter there is a response, such as increased growth, in the tissue surrounding the intrusion, but nothing new is formed. In the special chapter, there is a development of something specific and distinctly novel, which occasionally seems quite out of keeping with the character of the normal plant. Thus it is possible to find a velvety gall on an oak tree or a prickly gall on a smooth variety of rose! In many a gall of the oak-apple type, the central cavity which contains the white grub is surrounded by plant-tissue rich in protein-reserves, and outside that there is another zone of tissue rich in carbohydrate-reserves; while the outermost layer is hard or sometimes corky, so that the oak-apple with its prisoner may actually be still fresh when the leaves of the plant have withered away. It is a long-standing puzzle why the plant should be so generous, so to speak, to an enemy, but perhaps there may be some advantage in shutting the intruder in a well-stocked prison, for this keeps it from wandering about and doing diffuse damage. It is possible, however, that the plants cannot help themselves. They have to grow in a new way when the ordinary stimuli are disturbed, and the frequent finish of their new growth may simply mean that the plants cannot react to the provocation except in an orderly way.

(1.) In saw-fly galls the first chapter follows from the wound made by the mother insect in inserting an egg. There may be a secretion accompanying the puncture, which provokes stronger development of the adjacent plant tissue; but the growth has been shown to be independent of the presence of the egg.

(2.) In Chalcid-fly galls the first chapter is induced either by the puncture on the mother's part, or by wounds made by the newly hatched grub. In exceptional cases it may be an exudation from the egg that induces a stronger growth of surrounding undifferentiated tissue.

(3.) In ordinary "gall-flies" (Cynipids) there may be a mechanical wounding due to the mother insect or to the larva, but in the main the wounding is chemical. It is produced by a poison or toxin that exudes from the opened egg or from the newly hatched larva. This poison is not readily diffusible, but it brings about a solution of the immediate adjacent tissue, and the larva sinks into a soft cradle. This is not surprising, for it is well known in other connections that the introduction of a strange protein may have a disintegrative or dissolving effect on the victim. This is familiar in the case of snake poison. So far we have been dealing with chapter one.

In all Hymenopterous galls, the second chapter—the specific growth of the gall— is due to the persisting influence of the living and developing larva. The gall is not the result of a virus introduced once and for all into the plant; it is the outcome of a continued series of stimuli emanating from the intruder, including the salivary juice, but more besides. Magnus compares the influence of the grub to the influence of the fertilised mammalian ovum when it effects fixation in the wall of the womb. It activates a succession of growth-changes and tissue-changes that would not occur if it were not there. In all growing there is a play of stimulations and regulations, and we may think of the gall-larva just as if it were a peculiar part of the plant. It intrudes on the physiological stage and the normal routine of the play is altered.

A few galls may be reckoned as beneficial, if we include the root-tubercles caused by certain bacteria on leguminous plants, which make the capture of atmospheric nitrogen possible. Some galls are positively injurious, like the "ear-cockles" of wheat and the "ergot" of rye. Most galls are indifferent, and their structure, often finely finished, is, we think, to be interpreted simply as an orderly response to a quite unusual set of stimuli due to an intruder.

Are Pigs immune to Snake Bite?—If a hedgehog is bitten by an adder, or a mongoose by a cobra, nothing happens. There is a something—called an anti-toxin or anti-body—in the blood of the hedgehog or the mongoose which neutralises or counteracts the snake's venom. We say that the hedgehog is *immune* to the toxin of the adder, and the mongoose to the toxin of the cobra. There are some other instances, but not very many, of this natural immunity to particular poisons. It is comparable to the immunity which Algerian sheep enjoy to anthrax bacilli (except in enormous artificially injected doses), and to the immunity which some black races enjoy to yellow fever.

If the amount of adder poison that will immediately kill a rabbit be injected into a hedgehog, no evil effects follow. If the amount of adder poison that will kill a rabbit be mixed with the serum or fluid of the hedgehog's blood and then injected into a rabbit, there is no fatal result. Therefore we are justified in saying that there is a "something" in the hedgehog's blood that blunts the effect of the poison. What the something is or how it works we do not clearly know. The "something," whether it is substance or quality, is real; but it has not been isolated.

When a pig is bitten by an adder nothing serious happens, and an injection of snake poison under the pig's skin is not followed by evil effects. It might therefore be inferred that the pig is immune in the same way as the hedgehog or mongoose. Yet Calmette showed that if an amount of snake poison, known to be a fatal dose for a rabbit, be mingled with the serum of pig's blood, and then injected into a rabbit, the result is fatal. Therefore it must be concluded that the pig's blood does *not* contain an anti-toxin like that which saves the life of a hedgehog or the mongoose. Why then does the pig remain insusceptible to the adder's bite or to the subcutaneous injection of venom? The answer seems to be that the familiar layer of fat below the pig's skin, a layer with very little in the way of blood-vessels, serves as a sort of sponge that absorbs the poison, and does not allow it to pass into the general circulation. One wishes that all the puzzles of immunity were as easily solved as this one!

Monograph on Leaf-Miners.—Everyone has noticed, on various kinds of leaves, curious markings, sometimes in a spiral, sometimes like a slug's trail, sometimes like a bent bow, and so on. If the leaf be held against the light one may be fortunate enough to see that the skin is intact on both surfaces. One is looking at the tunnel of a leaf-miner, and it is interesting to watch for them, for there are many different species, each making its own kind of mark on the foliage. They eat out the green middle tissue of the leaf, often so skilfully that they do not puncture the epidermis except where they make their entrance and take their departure. What are these leaf-miners? Most of them are the caterpillars of small moths; not a few are the maggots of small flies; a few are grubs of beetles and larvæ of saw-flies; and all of them have the habit of spending most of their youth as miners inside particular kinds of leaves, for they are very rarely indiscriminate in their feeding. They form the subject of a fine recent monograph by Dr. Martin Hering, who has many an interesting story to tell.

In a great many cases the mother-moth lays an egg on a leaf, and it is probable that she always chooses the kind of plant that will suit the future miner. The egg develops and a very minute caterpillar is hatched out. It immediately hurries inside the leaf, and it is sometimes in such a hurry that it begins to tunnel before its hind end is free from the egg-shell. The result is that when it gets inside the leaf, the empty shell closes the door behind it. The miners feed on the protein substances of the leaf, not utilising the carbohydrates. The debris of their food—the familiar " frass " of caterpillars—is very fine in the grain—the mastication being very thorough, and thus it dries up quickly and does not interfere with the sanitary condition of the burrow. Sometimes it is collected in one corner of the mine, and this looks like a hygienic precaution. Gardeners do not welcome leaf-miners, which blemish the leaves of chrysanthemums and the like. On the farm they are relatively unimportant, yet well worthy of study.

An Apology for Wasps.—A correspondent from a fruit-growing county in the south of England reproaches us for saying a good word for wasps, which he regards as an unmitigated pest. But we must look at these questions of pro and con in a broad way, and without too much attention to particular interests and circumstances. Wasps are often very destructive to fruit, but against that must be weighed the good they do in destroying injurious insects, such as aphides, flies, and even caterpillars. The grubs are fed on chewed insects. It must be admitted, however, that our common wasps also devour useful insects, such as hover-flies. The difficulty is to *measure* the pro and the con. Wasps become very numerous in the fruiting time, and may, we admit, become a plague. Yet in scientific fairness we must carefully inquire into the behaviour of the queen wasps in the earlier months, when the fruit is in blossom. And we must think not of British wasps only, but of the tribe of wasps as a whole.

Farmers to the Rescue.—Since the time of Malthus, which was about the time of the French Revolution, the population of the world has doubled, which indicates plainly enough that his wise warnings did not produce much practical impression. The population of the earth was about 850 millions in 1800; it is about 1,750 millions to-day; and it is increasing in its absolute total by about twelve millions every year. If, and it is a big "if," the present rate of total increase continues—in spite of the declining birth-rate in most civilised countries—then the population will soon become too large for the earth. Those who have made a careful study of these matters tell us that it is a question of a few centuries, perhaps of one century. The date of the saturation point is not very important; but it seems very unlikely that the earth can feed more than about five thousand millions. The surface of the earth, including polar regions, offers about 33,000 million acres—a vast allowance for subsistence. But only about 40 per cent. of this is cultivable in the ordinary sense, so that the total shrinks to 13,000 million acres. Now it seems that the minimum with which each of us can be doing is two and a half acres, not including a cow. If this is so, then the earth cannot feed much more than 5,000 millions. But the practical question seems to us to be how far the food supply can be increased to support a population much larger than that of to-day, so as to avert an internecine struggle for subsistence too awful to contemplate. For various reasons, such as man's love of comfort, it is very unlikely that the saturation point for the earth will ever be reached. In separate countries, at the end of a cycle of rapid increase of population, with a curve like that of the increase of yeast-cells in the vat or of fruit-flies amid a plethora of bananas, there has come a rapid check—usually of a very disagreeable kind, such as famine and pestilence and war. It is probable that the same checking will occur in the world population; but it seems wise to look forward so as to avert the debacle that will ensue if the stationariness of the population is not reached long before the limits of subsistence are in sight. The probability is that the debacle will be averted by the further decline of the birth-rate, but it is interesting to inquire what can be done to increase the food supply if the demands of the population come too near the limits of comfortable satisfaction, as they often do locally in small communities, where only the blind can fail to see that the struggle for existence is inhumanly keen.

Three suggestions have been made, all worthy of serious consideration. The first is that man may greatly increase the supply of edible fishes, which depend in the long run on the vast floating sea-meadows of simple marine plants. The second is that some bio-chemical discovery, such as the artificial building-up of sugar believed to have been already effected by the action of light on carbon dioxide and water, may change the whole nutritive problem. The third is that an intenser agriculture—intenser than we have yet scientifically imagined—will enable a family to live not on three acres, but on a cabbage-patch. We wonder, however, to what degree this intensification of agriculture in the wide sense is practicable, and here we find the experts in disagreement. Similarly, it is doubtful whether the resources of the sea can be exploited to the extent of allowing mankind much more rein for multiplying. And as to biochemistry, we should be slow to set limits, especially when we think of the modern fixation of atmospheric nitrogen, but it is difficult to believe that man will be able to effect photosynthesis of carbon compounds more economically than the green plant. It looks as if the line of safety was a further decline of the birth-rate!

THE PALATABILITY OF CERTAIN SEEDS TO CHICKS.

H. F. NEWBIGIN,

Edinburgh and East of Scotland College of Agriculture; and

R. G. LINTON, M.R.C.V.S.,

Dept. of Hygiene, Royal (Dick) Veterinary College, Edinburgh.

It is a commonly expressed opinion concerning commercial chicken grain mixtures that they sometimes contain seeds of doubtful nutritive value to chickens, and that many of the seeds owing to their unpalatable nature are not eaten and thus wasted. Furthermore, it has been suggested from time to time that some of the seeds, particularly millet and canary seeds, are unsuitable for young chickens owing to the hardness of their seed-coats. One of us had previously made an examination of commercial chicken grain mixtures,[1] and concluded that, as a rule, sellers of these mixtures do not compound them with any definite method. Owing to the great variety of seeds used in the mixtures it was thought that an experiment to test their palatability would not be without interest, and the result of the test might possibly help to guide chicken feeders and manufacturers of chicken foods in the selection of grains most suitable for the purpose of rearing chickens. The following eleven foods were chosen for the experiment:—wheat, maize, lentils, peas, pinhead oatmeal (groats), millet (*Panicum miliaceum*), canary seed. dari, hemp, linseed and rice.

In June 1926 a preliminary experiment was made with 30 Ancona and Brown Leghorn chicks. The eleven foods were mixed in equal proportions and placed in a box to which the chicks had access all day, thus enabling them to make their own selection of food from the eleven different grains.

At the end of each day the residue was collected from the box and subsequently examined in the laboratory, where it was weighed, and then, after a thorough mixing, the individual seeds were separated from a representative portion. Thus it was possible to calculate the percentage of each kind of grain consumed by the chicks. This preliminary trial clearly indicated that young chicks, even when only a few days old, show some

[1] "The Composition of Poultry Mixed Grains," R. G. Linton, *The Scottish Journal of Agriculture,* Vol. VIII, No. 4, October 1925.

preference for certain seeds, while others are of secondary choice. During this trial the chicks consumed millet, rice, canary seed and dari in preference to the other grains; hemp and linseed were very unpopular, in fact 80 per cent. of the residue was composed of these two grains. Maize, peas and lentils were also neglected, but not to such an extent as the hemp and linseed. This preliminary trial was conducted for 24 days, the chickens being first given the grain when they were 48 hours old.

As this preliminary trial indicated that chicks do prefer some of the seeds included in the grain mixtures to others, it was decided to repeat the experiment under more exacting conditions. Thirty-six Wyandotte chicks were hatched on December 15th and placed in a brooder house with a Hover. They were weighed on hatching and afterwards every five days. In addition to the seed mixture the chicks were supplied with oyster shell grit, green stuff and milk. The milk was gradually discontinued up to January 14th, after which date water only was given. There was one death due to an accident during the last week of the experiment. The chickens remained in good health during the 7½ weeks the experiment lasted, except that at the sixth week some of the birds showed signs of "leg weakness," and were therefore put on to small quantities of cod-liver oil mixed with bran. All the birds recovered except three, which never regained the full use of their legs, though they ate and throve well. For winter-hatched birds their growth could be regarded as normal and their feathering was good. At the close of the experiment the birds were all put on dry and wet mash. The cockerels were marketed at the age of 14 weeks, when they weighed from 3½ to 4 lbs. Two of the pullets laid their first eggs when exactly five months old.

This second experiment was conducted as follows. A definite quantity of each of the eleven foods was weighed out separately each day in order to ensure accuracy, then mixed together and placed in a large box. To avoid loss of seeds the chickens were lifted into this box every two hours for about ten minutes at a time. After the first few days the birds learnt to jump in and out of the box by themselves. As the size of the chicks and therefore their appetites increased, the quantity of food put into the box was also increased with the intention that there should always be a plentiful supply of each ingredient of the mixture. At the beginning of the trial, when the chicks were only two days old, 10 grammes of each food, or 110 grammes in all, were given; but at the end of the trial this had been increased to 130 grammes of each food, or 1,430 grammes of the total mixture. The amount of residue left for examination ranged from 44 grammes on the first day up to 366 grammes on the last day. But notwithstanding the large quantity of food left over it was found, when examination of the residues was subsequently made, that on many days all the seeds of some varieties of grain had been consumed. Therefore it seems certain that had the total bulk been greater, the consumption of the unfavoured grains would have been still less.

In this experiment the actual weight of each food that was consumed per day per chick (the average of 36 chicks) was determined, and the percentage eaten of that given in the mixture calculated from day to day. During the first day the chicks did not show any marked partiality or distaste for particular foods, except that they consumed all the dari and only 20 per cent. of the linseed, and it is interesting to note that the average consumption of linseed for the whole period, 46 days, was practically the same as that of the first day, namely, 24 per cent. The partiality or the reverse for certain seeds remained fairly constant, and the result of the trial confirms the finding of the preliminary test, namely, that chicks do show a marked preference for some foods over others. It also confirms the results of the first experiments (with one notable exception, namely, hemp) in respect of the foods selected and the foods neglected. The following table shows the *percentage eaten of that given* for each food, and is the average for the 46 days.

TABLE I.

Amount of each food eaten by the chicks per 100 *grammes of that given.*

Food.	*Per cent. eaten.*
Millet	97
Canary seed	95·7
Dari	88
Hemp	86·6
Rice	79
Groats	76
Wheat	63·3
Lentils	56·7
Maize	51·2
Peas	49·4
Linseed	24·4

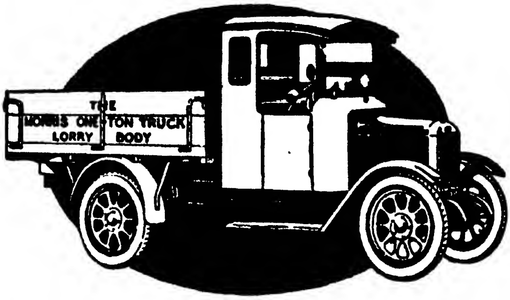
The extent to which some foods were chosen in preference to others is more clearly seen in Fig. I, where the selective capacity of the chicks is shown in graphic form.

That young chicks show a marked preference for some foods to others is certain; and some of the factors that may possibly influence them in making their selection may here be considered.

Colour.—Of the eleven foods, three possess striking and distinctive colours, namely, split red lentils, kibbled yellow maize and split green peas. That these bright and conspicuous colours do not make the grains more attractive to chicks is clearly shown by the fact that in each of the two trials the brightly-coloured foods were the least popular. Linseed, of a definite brown colour, and a very distinctive appearance owing to its size and shape, was the least favoured of any of the foods in the mixture. Colour, therefore, has clearly no influence upon selection, unless

THE MORRIS ONE-TON TRUCK

With LORRY BODY.



Price complete with Lucas Lighting Set, Full Chassis Equipment, and Detachable-sided Body as Illustrated

£225.

Standard Van, £235.

This is a General Service Vehicle, capable of withstanding the roughest usage, and it does its work at the lowest practical cost. Petrol consumption is over 20 miles per gallon.

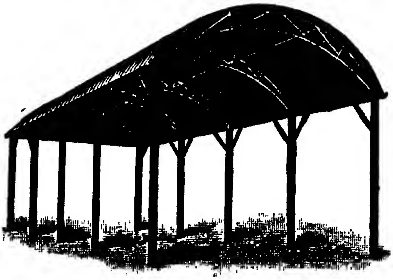
For Fuller Particulars Consult:—

WESTFIELD AUTOCAR Co., Ltd.,

WESTFIELD AVENUE, GORGIE, EDINBURGH.

Phone: No. 61181. Telegrams: MORSERVICE, EDINBURGH.

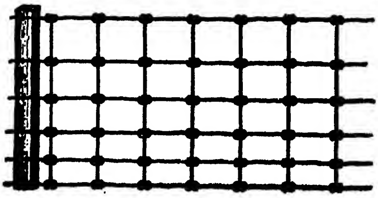
HAY AND GRAIN SHEDS.



Complete catalogue on application.

"RYLOCK" FIELD FENCING

Made in Great Britain.



PERFECTLY GALVANIZED.

Complete descriptive priced catalogue from—

A. & J. MAIN & Coy., Ltd.,

Possilpark, GLASGOW.

THE "SCOTT" SILO

— OF —

Reinforced Concrete

Over 100 SCOTT SILOS in the Country.

Best and cheapest Ensilage Storehouse yet offered.

Requires no maintenance.

Proof against fire, storm and vermin.

We are Agents for the wonderful

"PAPEC" SILO FILLER.

Low upkeep; efficient worker; will not choke.

Prices from £70 including blow-pipes, distributing pipes and bends; mounted on wheels, built up ready to haul into position; delivered nearest Railway Station; no extras.

Full particulars from

JAMES SCOTT & SON

(ABERDEEN), LIMITED,

483-485 Union St., ABERDEEN.

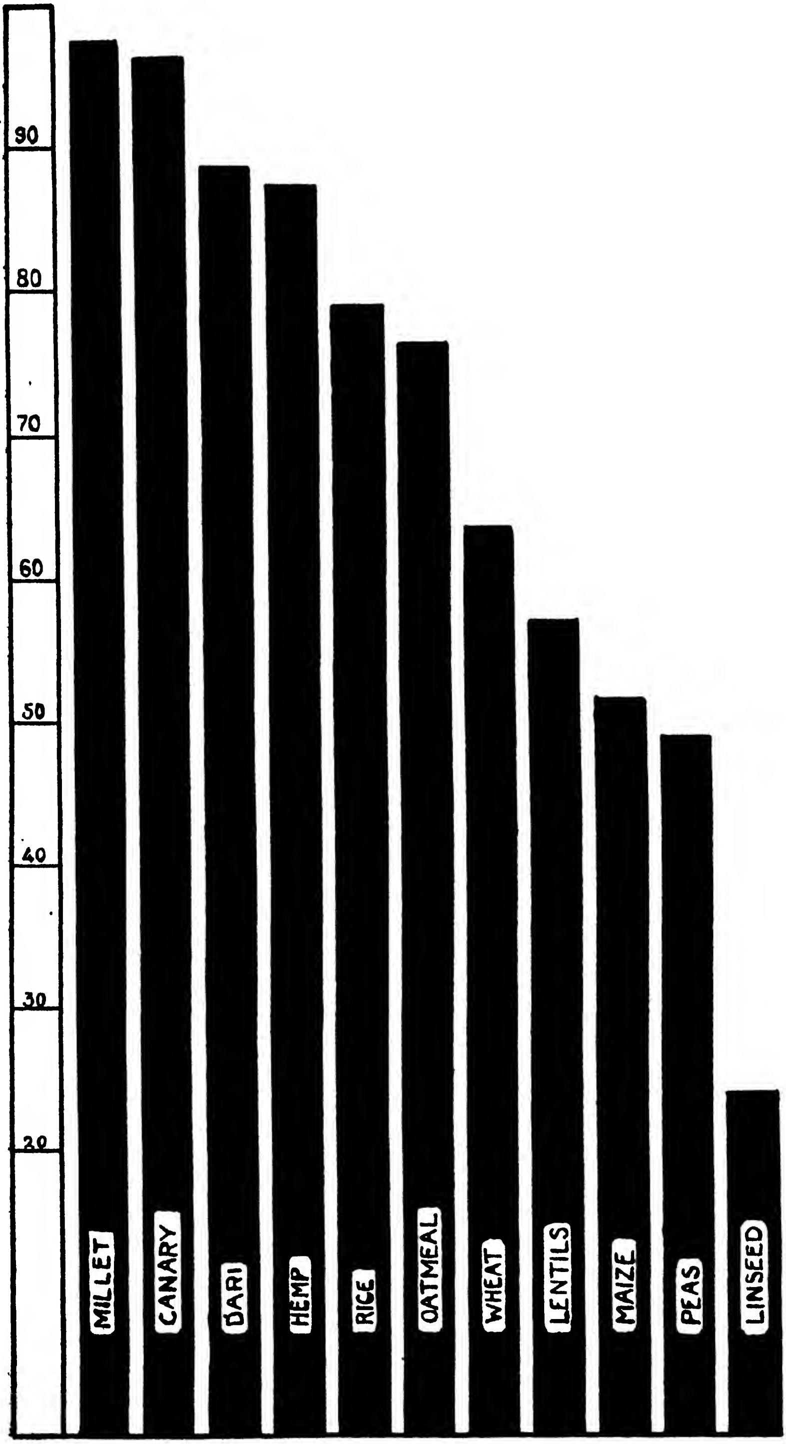


FIG. I.
Percentage of each food offered eaten by the chicks.

it be that the bright colours, being suggestive of toxic seeds, are actually repellent.

Size of Grain.—This does not appear to influence the chicks in any way. The millet, rice and groats used in the test were approximately of the same size, and were the smallest particles of food; canary seed, though much bigger, is almost as much favoured as millet; while dari, the largest seed in the mixture (about the same size as hemp), is more fancied by the chicks than rice, groats or other grains that are much smaller when kibbled, as they were in this mixture.

Shiny appearance.—Millet, canary seed and linseed were the only foods in the mixture that had bright and shiny seed-coats, that of linseed being less bright than that of the other two. Millet and canary are the two most favoured foods, but dari and hemp are almost as popular; as these two latter seeds have a dull drab appearance, the shininess or dullness of the seed-coat obviously does not influence selection.

The chemical composition.—A study of the following table of analyses of the foods (Table II) will reveal that the chemical composition of the various grains has no bearing on their palatability. The fibre content might be thought to have an influence in selection, but foods are picked out by the chicks irrespective of its percentage. Foods rich in protein as well as those containing relatively little were selected with equal freedom. It is clear, from both trials, that linseed is discarded by chicks. It is well known that no other animal can digest this grain unless it is previously softened by boiling or steeping in water, or unless it is crushed, and that if consumed in large quantity the oil is nauseating. It may therefore be that the chicks declined to eat it for either or both of these reasons, and it is interesting to note that the reluctance on the part of the chicks to eat linseed was consistent throughout the whole period of both trials and was not a distaste acquired as the chicks grew older.

TABLE II.

Composition of Foods used in Experiment.

(The foods are placed in order as selected by the chicks.)

Food.	Moisture.	Crude Protein.	Fat.	Carbo hydrate.	Fibre.	Ash.
Whole Millet ...	14·16	9·19	3·86	55·50	14·13	3·16
„ Canary Seed	11·50	14·44	6·30	58·70	4·33	4·75
„ Dari	13·83	8·31	4·33	70·30	0·83	2·40
„ Hemp ...	10·00	25·25	24·36	20·20	15·10	5·00
Broken Rice	13·33	6·12	0·86	79·09	*Nil.*	0·60
Groats	10·73	29·31	7·53	49·04	1·56	1·83
Bruised Wheat ...	15·70	12·25	1·33	66·59	1·90	2·23
Kibbled Lentil ...	13·73	23·19	1·23	59·85	*Nil.*	2·00
„ Maize ...	14·33	8·75	1·13	73·33	0·76	0·70
„ Peas ...	15·16	20·12	1·96	57·63	2·63	2·50
Whole Linseed ...	7·30	16·19	32·53	35·29	4·76	3·93

Of the eleven foods, hemp is the only one that gives contradictory results in the two trials, all the other foods showing approximately the same order of preference. In the first trial hemp and linseed were equally distasteful, but in the second trial we find that the chicks actually consumed 86·6 per cent. of the hemp that was given them, and in order of popularity hemp was

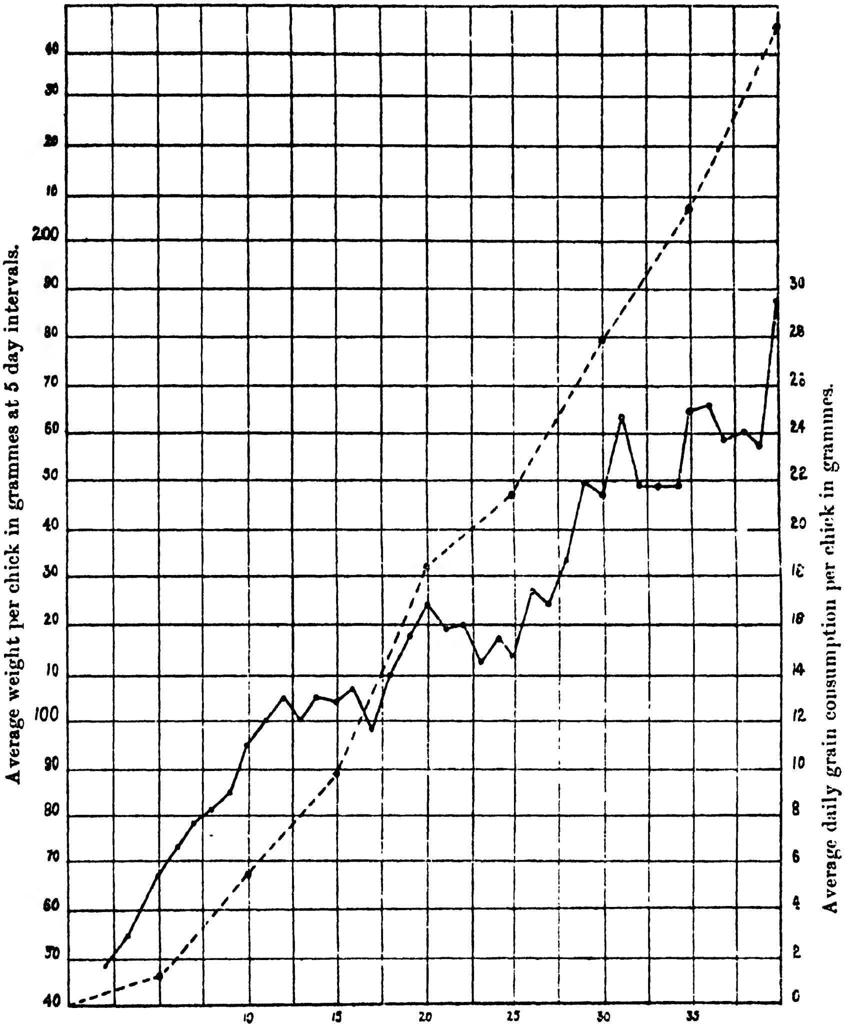


FIG. II.

Chart showing daily grain consumption (unbroken line) and live-weight increase (broken line) per chick.

practically equal to the grain which took third place, namely, dari. Considering that the chicks were kept under identical conditions during both trials, except that during the second trial the weather was colder, being in the middle of December as compared with June and July for the first trial, it is difficult to suggest why one set of chicks should decline to eat hemp and another to consume over 86 per cent. of what is offered to them. It may be that during the colder weather of winter the chicks instinctively selected foods rich in oil. With the exception of linseed (declined because of its unpalatibility), hemp, containing 24 per cent. of oil, is the richest in oil of all the foods of the mixture, and this may be the reason why, in these experiments, it was eaten during the winter and declined during the hot summer months. Further feeding trials are obviously needed in this connection.

One fact stands out clearly in this experiment, and this is that the first four foods selected by the chicks, namely, millet, canary seed, dari and hemp, are the only grains (with the exception of linseed) offered to the chicks in their natural state, i.e. neither decorticated nor kibbled. It may therefore be that the deciding factor in the natural selection of foods by young chicks is the condition in which they are offered, " natural " foods being selected in preference to " treated " foods.

As chicks apparently prefer whole seeds to decorticated, kibbled or crushed grains it seems advisable, so far as may be possible, to conform to their tastes, particularly as whole grains are presumably richer in vitamin B. Owing to the fact that linseed, kibbled peas, lentils and maize are clearly unpalatable to young chicks, it is suggested that these foods might with advantage be excluded from chicken grain mixtures.

The chart (Fig. II) shows the average daily grain consumption per chick and the average live weight increase per chick.

We are indebted to Professor R. G. Thin, D.Sc., F.I.C., for the analyses of the foods used in the experiment.

THE COMPOSITION OF SWEDES.[1]

ALEXANDER LAUDER, D.Sc., F.I.C.,

Edinburgh and East of Scotland College of Agriculture.

IN a paper communicated to a previous number of this JOURNAL (Volume IX (1926), 160), an account was given of the investigations carried out by the Committee appointed to investigate the composition of swedes; the work has been continued since then, and the present paper describes some of the results of more general interest which have been obtained. The first paper dealt with the crops examined up to 1923-24; the present paper gives the results of the work carried out by the Chemical Sub-Committee (Professor Hendrick and Mr. Godden, Aberdeen; Dr. Lauder, Edinburgh; and Professor Berry, Glasgow) on the crops of 1924-25, 1925-26 and 1926-27.

The varieties of swede grown were the same as before, viz., Aberdeenshire Prize (Inverquhomery type); Bangholm; Best of

[1] **Second Report on the work of the Committee appointed to investigate the composition of Swedes.**

All; Bronze Tankard; Caledonian (Bronze Top Globe); Kinaldie, Magnum Bonum; Picton (Superlative type); Stirling Castle (Monarch), and X'L All. The seed was obtained from the same source in each case, and the cultivation and manuring at the different centres was as nearly identical as possible. The swedes were grown at three centres, viz., Edinburgh (Boghall Experimental Farm); Aberdeen (Craibstone Experimental Farm), and the West of Scotland College Farm at Kilmarnock. An additional set of varieties was grown in 1924-25 and 1926-27 at the Seed Registration Station of the Board of Agriculture for Scotland at East Craigs, near Edinburgh.

The work on the crop of 1924-25 was confined mainly to a critical examination of the methods of determining the amount of dry matter in the roots; it is unnecessary to go into the details of this investigation here, but it may be stated that a satisfactory method was worked out; this has been used in the subsequent work at Edinburgh, Aberdeen and Glasgow, and in this respect the results are therefore strictly comparable; identical methods have also been used at the three centres for the other estimations which have been made.

In 1925-26 and 1926-27 the analytical work was concerned with a comparison of the differences between the varieties; the results will be discussed later.

The results submitted in the earlier paper showed the existence of two separate kinds of differences, viz.: (1) those due to locality, and (2) those due to variety.

1. **Differences due to Locality.**—Speaking generally the effect of locality and climate on the composition of the roots described in the earlier paper has been confirmed.

TABLE I.

Percentage of Dry Matter.

(Average of all the varieties.)

		1924-25.	*1925-26.*	*1926-27.*
Edinburgh (Boghall)	...	12·28	12·79	12·66
Aberdeen (Craibstone)	...	12·02	10·99	11·26
Glasgow (Kilmarnock)	...	10·28	9·35	10·32

In the comparison made in the previous paper the Craibstone roots contained the highest percentage of dry matter; at that time the Edinburgh roots were grown at the experimental station of the Board of Agriculture for Scotland at East Craigs, Corstorphine, which is only about 200 feet above sea level. Since then, however, the Edinburgh roots have been grown at the College Experimental Farm at Boghall, roughly about the same distance from Edinburgh as East Craigs, but lying at an elevation of 600-800 feet. It will be seen that the Boghall roots contain, on the average, rather more dry matter than the Craibstone roots. The difference between the roots grown at Boghall and East Craigs is shown in Table II—the roots being grown from the same seed in both cases.

TABLE II.

Percentage of Dry Matter.

(Average of all the varieties.)

	1924-25.	*1926-27.*
Boghall	12·28	12·66
East Craigs	10·58	11·31

These figures show, in a striking way, the effect of situation and climate on the composition of roots.

Composition of the Dry Matter.—It was shown in the previous paper that, on comparing centres, a high percentage of dry matter is associated with a high percentage of soluble solids and of sugar; the results of the more recent work confirm this.

TABLE III.

(Average of all the varieties.)

1925-26.

	Dry Matter.	*Sugar.*
Edinburgh	12·79	7·21
Aberdeen	10·99	5·83
Glasgow	9·36	4·68 [1]

1926-27.

	Dry Matter.	*Soluble Solids.*	*Insoluble Solids.*	*Sugar.*
Edinburgh ...	12·66	9·48	3·17	7·33
Aberdeen ...	11·26	8·93	2·33	—
Glasgow ...	10·32	7·83	2·49	6·41

2. **Differences due to Variety.**—When the varieties are arranged in the order of their dry matter content it was found in the earlier work that the order is the same, with trifling exceptions, at all centres, and also the same for different years; the present work confirms these earlier results without any important change. As before, the varieties have been divided into four groups.

TABLE IV.

Varieties arranged in order of their dry matter content.

Group.		*Average.*
I.	Kinaldie .. .. Bangholm .. .. Stirling Castle	11·78 per cent.
II	Aberdeenshire Prize .. .. Best of All .. .. Magnum Bonum	11·32 per cent.
III.	Caledonian .. .. X'L All	10·99 per cent.
IV.	Bronze Tankard .. .. .. Picton	10·61 per cent.

The average difference in dry matter between the roots in

[1] Estimated on the dry matter and not on the pulp as at Edinburgh and Aberdeen, and probably slightly lower than the corresponding results from these centres.

Group I and those in Group IV is a little over 1 per cent.; the difference between Kinaldie, the highest (12·06 per cent.), and Picton, the lowest (10·41 per cent.), is 1·65 per cent. The only difference from the order given in the earlier paper is that Stirling Castle and Aberdeenshire Prize have changed groups, but the difference between them is not great—11·56 and 11·19 respectively. When the results for the various years and the different centres are arranged in order of dry matter content it is seen that the position of some of the varieties is very constant, while others vary much more; Kinaldie, for example, is almost always at the top of the table and Picton at the bottom. This is shown in the following table—the figures indicate the relative order for the three centres and for the three years, nine observations in all.

TABLE V.

	Position.								
Kinaldie	1	1	1	1	1	1	2	2	2
Bangholm	2	3	4	2	4	6	1	1	3
Stirling Castle	3	5	3	3	3	4	3	5	1
Aberdeenshire Prize ...	4	2	6	4	9	9	9	4	5
Magnum Bonum ...	5	7	5	6	2	3	4	7	6
Best of All	6	4	2	5	5	2	6	3	4
X'L All	7	8	9	9	8	7	7	6	8
Caledonian	8	6	8	7	6	5	5	9	9
Bronze Tankard	9	10	7	8	10	8	8	10	7
Picton	10	9	10	10	7	10	10	8	10

The fact that Aberdeenshire Prize occupied the 9th position on three occasions (at Aberdeen in 1925 and at Edinburgh in 1925 and 1926) explains its lower position as compared with the previous table. It must not be inferred that the varieties at the bottom of this list are necessarily less profitable to grow than those at the top; the yield of roots per acre and, more particularly, the yield of dry matter per acre, must also be taken into account; compared in this way (see Table VI) it will be seen that there is little difference between the variety at the top and that at the bottom of the table.

In the hope of getting some analytical figure, which might be related to the quality of the roots, a large number of determinations of the various constituents were carried out; these included the estimation of the soluble and insoluble solids, the sugar, the total nitrogen and the true protein nitrogen, the mineral matter and the percentages of lime and phosphoric acid in the mineral matter. The figures obtained varied in an irregular manner, and this large amount of work has had little or no definite result except to confirm the view that the percentage of dry matter, other things being equal, is the most useful figure to determine.

Bearing this conclusion in mind, the next step appeared to be to compare, by an actual feeding trial, the nutritive value of the dry matter in Kinaldie, the swede having the highest percentage, with that in Picton, the one with the lowest percentage of dry matter. A feeding experiment with sheep with these two varieties was therefore arranged and carried out during the past season (1926-27) at Boghall, Craibstone and Kilmarnock.

Sheep Feeding Experiment.

Composition of the two varieties fed.

TABLE VI.

	Boghall.		Craibstone.		Kilmarnock.	
	Kinaldie.	Picton.	Kinaldie.	Picton.	Kinaldie.	Picton.
Dry matter	13·91	11·37	11·89	10·56	10·89	9·49
Soluble solids	10·55	8·53	10·03	8·94	8·63	6·81
Insoluble solids	3·36	2·84	1·86	1·62	2·26	2·68
Ratio—Sol./Insol. solids ...	3·14	3·0	5·39	5·51	3·82	2·54
Sugar	7·61	6·57	...	...	6·49	6·07
Total nitrogen	0·13	0·12	0·19	0·18	0·14	0·14
Protein nitrogen	. .	...	0·10	0·09	0·07	0·06
Ratio—T.N./P.N.	.	...	0·54	0·51	0·52	0·48
Mineral matter	0·89	0·68	...		0·55	0·45
Yield per acre (tons) ...	14·91	17·82	21·35	23·6	31·28	34·80
Yield of dry matter per acre (tons)	2·07	2·03	2·63	2·57	3·41	3·30

It was decided to feed not equal weights of swedes, but equal weights of dry matter; in this way a comparison of the nutritive value of the dry matter was obtained. The swedes were analysed once a month during the progress of the experiment, and the weight of roots fed adjusted in accordance with any change in their composition.

Rations.—These were kept intentionally as low as possible, as, if an abundant ration had been fed, any difference in the feeding value of the dry matter of the two varieties would have been quite obliterated; 16 lbs. Picton were fed per head per day, the amount of Kinaldie being adjusted to give an equal weight of dry matter. At Boghall, for example, this meant approximately 16 lbs. Picton to 13 lbs. Kinaldie. For the concentrated food a mixture of equal weights of Bombay cotton cake, dried brewers' grains and bruised oats was fed, beginning at the rate of one quarter lb. per head per day, the amount being increased to one half lb. during the progress of the experiment.

Sheep.—The sheep were Greyfaces and the number in the experiment at the various centres was as follows : 120 at Boghall, 120 at Craibstone, and 90 at Kilmarnock. They were divided in each case into two lots, which were as equal as possible. The sheep were marked, and weighed individually once a fortnight during the course of the experiment. At the beginning and end of the experiment they were weighed on three consecutive days, and the averages of these weighings were taken as the initial and final weighings respectively. The duration of the experiment was from 10 to 12 weeks—November 1926 till January or February 1927.

The results were as follows :—

	Craibstone.		Kilmarnock.		Edinburgh.	
	Picton.	Kinaldie.	Picton.	Kinaldie.	Picton.	Kinaldie.
Average live weight increase per sheep for whole period ... ... (lbs.)	16·3	16·1	17·4	16·7	14·5	14·6
S.E. of mean	±0·61	±0·50	±0·48	±0·49	±0·98	±0·95
Difference in favour of Picton	+0·2	±0·77	+0·7	±0·68	−0·1	±1·36

The experimental error involved in the various trials has been calculated, and it will be seen that this is greater or as large as any difference between the varieties. In the Craibstone figures, for example, the results show that the average live weight increase of the sheep fed on Picton was 0·2 lb. more than that of those fed on Kinaldie (16·3 and 16·1); the "experimental error" involved has been calculated and found to be ± 0·7 lb.; a difference to have any significance must be greater than the experimental error; in this case it is less and therefore we are unable to say that Picton is better than Kinaldie.

The results, therefore, so far as these experiments go, show no difference in the feeding value of the dry matter in the two varieties fed; this is what may be expected considering the similarity in composition of the dry matter. At Boghall the sheep fed on Kinaldie handled better and were better in appearance than those fed on Picton.

Conclusions.—The results obtained up to the present suggest that the swede which yields the largest weight of dry matter per acre is, other things being equal, the most profitable swede to grow. Unfortunately we have little accurate knowledge yet as to the yields of dry matter per acre given by the different varieties. Such figures as we have suggest that the difference between them is not great. The Committee hope to be able to arrange for further experimental work in this important question of yield. It has to be remembered, of course, that certain varieties on account of their time of ripening or their keeping qualities are more suitable for some districts than others, so that it is not quite a matter of indifference which variety the farmer grows. The most suitable variety for a particular locality can be determined only by experiment.

The Committee desires to express its indebtedness and thanks to the farm managers and staff at Boghall, Craibstone and Kilmarnock for the care with which they carried out the sheep feeding experiments.

"EDELMIST."

ANDREW CUNNINGHAM, B.Sc.,
Department of Bacteriology, College of Agriculture, Edinburgh.

DURING the past few years numerous references to a new method for making farmyard manure have appeared in the German scientific literature, and the method has aroused a considerable amount of interest among farmers in the countries of central Europe. The manure after treatment by this process is known as "Edelmist," for which the claim is made that it is superior in certain respects to dung produced under the best conditions in a heap or under cattle in covered courts. The discovery of the method is due to Captain Hermann Krantz, and is the result of experiments in the conservation of farmyard manure carried out over a period of about twenty years.

The characteristic of Edelmist which distinguishes it from ordinary farmyard manure is that in the early stages in its preparation it is encouraged to undergo an active fermentation. The dung is first of all piled up loosely in shallow layers, thus ensuring that it is well aerated and permitting of intense fermentative activity on the part of the micro-organisms present. As a result of the chemical changes produced in the latter the temperature of the heap rises rapidly in the course of the first few days. When the temperature reaches 55° to 65° C. (130° to 150° F.), the heap is thoroughly compacted by tramping, covered with a loose layer of fresh dung, and allowed to remain untouched for at least three to four months. In addition to dung, green manure crops are sometimes treated by the Edelmist process.

Advantages.—It is frequently observed that when unrotted or incompletely rotted dung is applied to the soil it exerts an injurious effect upon plant growth. This injurious influence is generally ascribed to the fact that the undecomposed and easily-decomposable non-nitrogenous organic substances of the litter encourage an abnormally abundant growth of soil micro-organisms, which then compete with growing plants for the available nitrogenous compounds of the soil and of the manures applied to it. The soil micro-organisms utilise the available nitrogenous compounds for building up their cells, and the plants suffer from nitrogen starvation. The nitrogen assimilated by the micro-organisms is converted temporarily into a form in which it can no longer be utilised by plants. When the soil germs die their cell substance undergoes decomposition, and the nitrogen contained in it is converted once more to a form in which it can be utilised for plant nutrition. The effect of incomplete rotting, therefore, is to delay the action of valuable manurial constituents of the dung. In the making of Edelmist it is claimed that the preliminary fermentation results in the decomposition of the easily-decomposable organic constituents of the straw, and so prevents retardation in the rate at which the nitrogen becomes available when the dung is applied to the soil. Thus Löhnis found that, when the manure was mixed with soil, from 18 to 32 per cent. of the total nitrogen added was converted to nitrate in one month.

During the heating of Edelmist the germs which are active in ordinary dung are gradually destroyed and replaced by forms which succeed best at high temperatures and which require abundance of air for their activity. When the heat is compacted by tramping, air is largely excluded, and these organisms become inactive and gradually die off as the temperature slowly falls. Edelmist after three to four months' storage, therefore, contains comparatively few germs—frequently not more than $\frac{1}{100}$ to $\frac{1}{1000}$ of the numbers found in ordinary dung. In it microbial activity practically ceases after the first few days, and the germs remain inactive as long as the dung is kept in a compact condition in the heap. The dung can, therefore, be left in the heap till required without undergoing undesirable changes. Thus the handling of the finished manure and the serious losses of nitrogen always associated with it are reduced to a minimum. The claim is made for Edelmist that it is more uniform in composition and in the effects it produces than ordinary farmyard manure, because it is made under more carefully controlled conditions.

In Edelmist the straw is as a rule well broken down and shows little of its original structure. As bacterial activity is at a standstill during the storage of the manure, it is generally assumed that the changes which take place in the straw are largely brought about by chemical agencies, although little direct evidence on this point has so far been submitted. The finished manure is " short " and as easy to handle as well-rotted dung, and is practically odourless. The high temperature of the preliminary fermentation should also ensure the destruction of weeds and weed seeds as well as most plant and animal disease organisms.

The Making of Edelmist.—In the making of Edelmist it is recommended that the concrete or other impervious foundation on which the heap is to be built should first be covered with a layer of branches or similar loose material to a depth of about 1 foot. This facilitates the heating of the material and also assists in draining off the liquid which escapes during the making of the manure. The whole of the first day's dung is then piled on a rectangular section, the area of which is just sufficient to give a depth of about 2 feet 6 inches, the dung being put together loosely in small quantities at a time in order to secure adequate aeration. The sides of the heap, if built without supports, should be sloped sufficiently to prevent sliding, and for the same reason it is important that the moister material should be placed in the interior of the heap. The temperature of each section should be accurately controlled by thermometer, and should be allowed to reach 55° to 65° C. before the manure is disturbed. Generally no difficulty is experienced in getting the temperature to rise to about 60° C. within the first two to four days except perhaps in the bottom layer of the heap, or in an open heap during very wet weather or if the dung contains much peat. Dung in which the litter consists entirely of peat moss is difficult to make into Edelmist, as the peat tends to retain so much moisture that the manure heats very slowly. Mixture with some drier material such as chaff assists in overcoming this difficulty. It is necessary to add water to Edelmist only when the weather is very warm or when the material which is being treated is exceptionally dry.

Each day's dung is placed on a fresh area until the temperature of the first section has risen to 55° to 65° C. As soon as the desired temperature has been reached in a particular section, the manure is firmly trodden down and immediately covered with a loose layer of fresh dung, and in this way the heap is gradually built up in the form of a series of steps. It is important that the heap should not be spread out too much, but that it should be built up in small sections at a time so that its height rises rapidly to the maximum. The height of the heap will vary according to circumstances but should not be less than 6 to 9 feet, and may even reach 18 to 20 feet. Height is an advantage in keeping the bulk of the manure compact and so minimising losses. Thus Löhnis found the following percentage losses in various layers of the manure :—

	Dry Matter.	*Nitrogen.*
Top layer	43	38
Third layer	32	29
Bottom layer	20	9

As those portions of the heap which are most exposed to the air suffer the greatest losses, it is obviously advantageous to diminish the proportion of surface exposed to total weight of manure by making heaps as large as is practicable. For the same reasons it is advisable to protect the outer layers of the heap, and the full benefits of Krantz's method are only obtained if the dung is stored in a special dungstead. This generally consists of a framework of vertical metal or wooden beams which carry a roof and are embedded in a concrete foundation, and to which planks are bolted to form a series of rectangular sections. The outer boarding remains in position till the manure is ready for carting to the field, but the inner divisions are removed gradually as the structure is filled and are only used to facilitate the building of the heap. The fact that the boarding can be easily removed, and that the uprights are so arranged that carts can be driven between them, assists the rapid emptying of the dungstead. The larger structures are also provided with cranes which run on rails laid across the tops of the uprights and assist in the filling of the sections.

During the fermentation and storage of the manure a large quantity of liquid escapes from the heap. It is usual, therefore, to have a storage tank constructed either below the dungstead or at one side, so that the liquid can be kept till required. The size of the tank is calculated on the assumption that in the

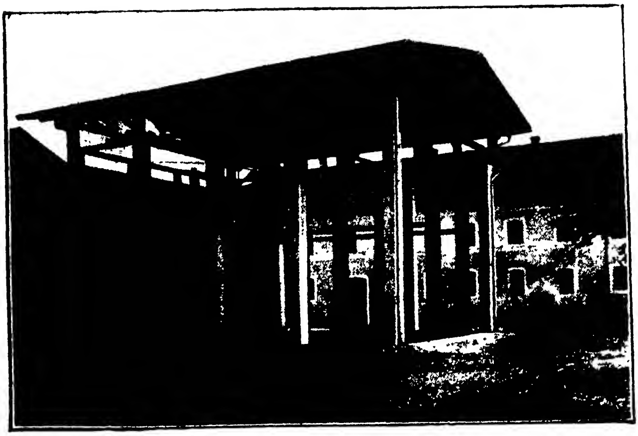


FIG. 1.—Large Dungstead for 65 to 95 Cattle. Built 1924 at Niederseeon, Grafing, Upper Bavaria.

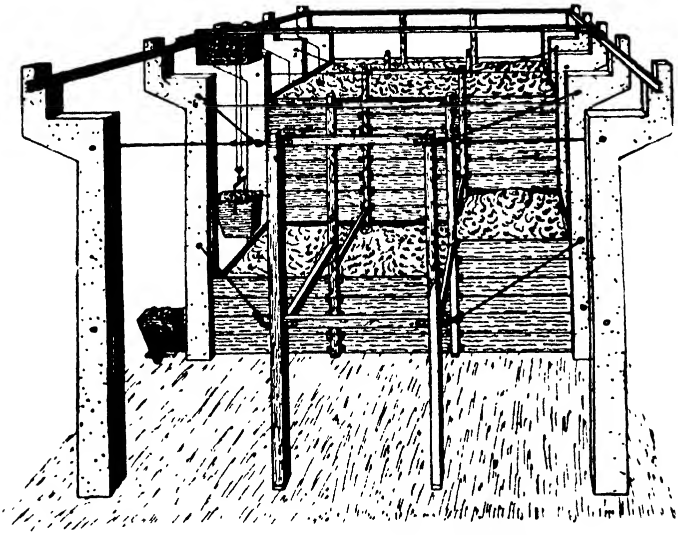


FIG. 2.—Dungstead showing sliding Crane.

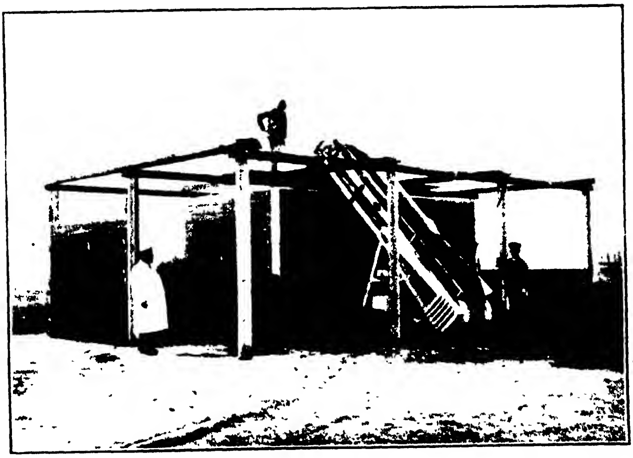


FIG. 3.—Dungstead with Elevator at the City Slaughterhouse, Munich.
[*Reproduced by permission of Gärstatt G.m.b.H.*

making of the manure about 15 per cent. of the original volume of the dung escapes in the form of liquid.

The Edelmist process is protected by British Patent No. 179,198 and the construction of special dungsteads by British Patent No. 189,128, the patentees being the firm Gärstatt G.m.b.H., München 2 s.w., Lindwurmstrasse 88. This firm provides plans for dungsteads in great variety from large roofed sheds to hold heaps 18-20 feet high to small wooden structures without roofs and 6-9 feet high. The main types of dungsteads in use are shown in Figs. 1-3.

Experiments with Edelmist.—Field and other experiments designed to test the value of Edelmist have been carried out in Germany for a number of years, though it is only recently that all of the factors involved have been taken into consideration in work of this kind. In 1924 Krantz and Schnabl summarised the results of field experiments with potatoes carried out in the years 1921-24 on five farms in South Germany on soils varying from sand to heavy loam. In these experiments equal weights of ordinary farmyard manure and Edelmist were applied, either alone or with phosphatic and potash fertilisers or with dressings of nitrogen, phosphate and potash in the form of artificial manures. The percentage increases[1] in yield obtained on the plots to which Edelmist was applied were as follows :—

Edelmist alone	240
+ phosphate and potash	276
+ nitrogen, phosphate and potash	390

Similar experiments carried out by Weigert in a single farm yielded smaller increases, viz. 194, 116 and 138. When comparing ordinary dung and Edelmist applied alone to potatoes Pohl obtained an increase of 230 for Edelmist, while for ordinary farmyard manure made in boxes under cattle (as distinct from that made in a heap) the corresponding figure was 140. This observation is particularly interesting in view of the fact that the manure made in boxes contained the whole of the liquid of the dung, while in the case of Edelmist the liquid was not included. When the liquid obtained from Edelmist was applied in addition to the dung, the percentage increase varied from 290 to 340. In preliminary pot experiments with ordinary farmyard manure and Edelmist, Löhnis observed a percentage increase due to Edelmist of 330 to 500.

In addition to the experiments already referred to, a number of field tests have been carried out in which equal weights of nitrogen in the form of ordinary manure and Edelmist have been compared. Krantz gives the results of three experiments in which the percentage increases for Edelmist were 116, 130 and

[1] In order to obviate the necessity for the conversion of the results which are stated in kilograms per hectare to tons per acre, the increases produced by Edelmist when compared with an untreated control plot are throughout this paper stated as percentages of the corresponding increases produced by ordinary farmyard manure.

549. In Weigert's experiments an increase of 125 was recorded, while Löhnis observed an increase of 712 in experiments carried out in 1925 and of 146 in those of 1926.

While the results so far obtained are somewhat variable, they agree in indicating that when tested by means of field experiments Edelmist is distinctly superior to ordinary farmyard manure. All of the experiments quoted, however, are open to the objection that they take no account of the losses suffered by the manure in making. On the other hand it must be remembered that the loss in the making of dung as a rule falls most heavily upon the readily available constituents. It is therefore improbable that, if the losses in the making of Edelmist were greater than those in the making of ordinary farmyard manure, the residual manurial constituents of the former would prove as effective as those of the latter. Löhnis has recently published the results of a carefully controlled series of experiments in which weighed portions of the same original material were made into ordinary farmyard manure and Edelmist. The following are the percentage losses after three months' storage :—

	Total Weight.	*Dry Matter.*	*Total Nitrogen.*
Ordinary manure ...	30·0	45·0	40·0
Edelmist	15·8	26·8	21·9

These experiments indicate that the losses in the making of Edelmist are about one-half those of ordinary farmyard manure.

The superiority of Edelmist to ordinary dung is therefore clearly indicated by the experimental data so far available. In considering the results presented in this paper it should be remembered that many of the experiments have been carried out at experiment stations where the ordinary dung was made under better conditions than those which prevail on the majority of ordinary farms. It is probable therefore that Edelmist would compare still more favourably with the dung made on most farms. Reference to the lack of uniformity in the results of the field experiments has already been made. This lack of uniformity is probably due at least as much to the variation in the effects of the ordinary dung as to that of Edelmist. Different samples of apparently well-rotted ordinary farmyard manure vary enormously in the effects they produce upon crops. Nevertheless it is of great importance that the degree of superiority of Edelmist over ordinary manure should be accurately determined if a reliable estimate is to be formed of the extent to which the extra value of the manure will compensate for the cost of the special dungsteads required and the labour of filling them. This can be done only by carrying out a large number of carefully controlled experiments in which weighed quantities of dung of uniform composition are made into ordinary manure and Edelmist, the losses in making are accurately determined, and the value of the finished manure is tested by carefully conducted field experiments continued over a number of years.

The patentees calculate that the enhanced value of the dung will pay for the cost of erecting the dungstead in three to five years. Doubtless many of the results quoted above would support that view, but the conditions are somewhat different from those prevailing in this country. In Germany a large proportion of the cattle are stall-fed, and the dung must in any case be removed to a heap or dungstead every day. In this country, however, most of the cattle are fed in courts or boxes, which are sometimes large enough to hold the whole of the dung till required. In this case the extra value of the dung would require to be very considerable to justify its daily removal to a special dungstead. On the other hand many farmers find it necessary to store a portion of their manure in a heap in the open till required. The losses due to the extra handling of the manure and to washing by rain are very high, and it is possible that in those cases the Edelmist process applied to fresh dung might prove to be of value. On most farms the methods employed in the storage of dung are very unsatisfactory and little or no attempt is made to regulate the changes which go on in the dung heap. Quite apart from other considerations the Edelmist process must be regarded as a decided advance on ordinary methods in that it affords a means of controlling the fermentation of the manure.

THE following article has been contributed by Mr. G. E. Fussell.

The 18th Century Demand for Agricultural Statistics.

The growth of political arithmetic in the late 17th and 18th centuries led to a number of statistical speculations, which covered nearly the whole field over which modern statistics are regularly collected. Naturally these speculations had extremely divergent results and their authors entered into violent, and often acrimonious, controversy with one another. Perhaps the most famous discussion of the period is that which dealt with the question whether the population was increasing or decreasing, but in addition to this question of population, the recurrent dearths, the increase in the price of foodstuffs, and the constant and increasing burden of the poor rates led speculators to deal with the question of food production very closely.

Often enough the calculations had no very firm basis, although those who made them were very ready to defend them, but in the absence of vital information, such as the size of the country, many were bound to be hopelessly inadequate.

This was recognised by the writers themselves, and the deficiencies of speculation became completely understood by the end of the century, although, in the absence of any mechanism, official or otherwise, for the collection of real statistics, speculation necessarily continued for another sixty odd years.

Nearly two hundred years before this country decided to collect agricultural statistics, the necessity for this information to be available had been recognised. Graunt in his "Observations on the Bills of Mortality," 1676,[1] speaks of the necessity for knowing such relevant details of the country's economy as the output per acre of corn, of hay, and the number of animals fed on the land, so that measures could be taken to supply any want that might occur if the crop failed, but he was much too far in advance of his time, if only because the current decentralised system of Government would have effectually prevented the collection of the information, there being, for practical purposes, no central department which could have been made responsible.

Nearly one hundred years later another voice cries in the wilderness.[2] There had been one or two calculations before that date, but the dearth of the times had impressed the owner of the anonymous voice, and he had realised that his own calculations were dubious. He thought that it would not be difficult to obtain a return of corn stocks every 15th November, and from this to judge whether corn should be exported, imported, or neither.

In the following year another anonymous pamphleteer concerned for his trade[3] declares that he has often wondered why there was no Parliamentary enquiry into the growth of corn, by which he means the collection of statistics.

Neither of these visionaries suggested how the matter might be conducted, but no such deterrent occurred to W. Pennington[4] who boldly says—"Would not the application of a few pensions . . . be better directed to maintain a proper number of inspectors in each county, men of judgment and reputed (*sic*) integrity; who might every summer receive an account from the constables, delivered upon oath and attested, what number of acres is sown, and with what kind of corn, in their respective parishes. A few experiments would enable them to judge how it yielded in general; and by comparing the produce of different years, it would be easy to discover whether there was sufficient for home consumption"; a singularly modern conception.

Donaldson,[5] only a few years later, went even further in his demands. He asked for a central Board of Agriculture, and proposes a statistical enquiry into the state of agriculture. He desires the information collected to include, amongst other details, the area under pasture and tillage, beasts kept, corn sown and quantity reaped.

Many speculations were made when the difficulties of the Napoleonic Wars confronted the country, but amongst them are singularly few demands for the only possible means of obtaining

[1] Sixth Ed., rep. in Birch's Collection of the Bills, 1759.

[2] A Compendium on the Corn Trade, 1757, p. 25.

[3] Sentiments of a Corn Factor on the Present Situation of the Corn Trade, 1758, p. 22.

[4] Reflections on the various advantages . . . Draining, inclosing . . . . large Commons, 1769, p. 47.

[5] Agriculture considered as a Moral and Political Duty, 1775, p. 172.

accurate information. The sufferings under the bad harvests and unprecedented prices, however, did stimulate an independent gentleman to recommend an agricultural census in 1800,[1] and his recommendation is supported in different ways by two other writers of that year. The Rev. J. Malham[2] feels the suffering caused by the war, and he is inclined to attribute it to profiteering, or in the language of his own day, "forestalling," but he confesses that one of his difficulties is to know whether the estimates he has formulated are correct, and thinks that the Government ought to collect the necessary information.

Another anonymous writer[3] asks for a census of corn in stock, of the people and the quantity of bread baked within a given period. The last two would enable the annual consumption to be calculated, and it would then be possible to tell how long the stock would last.

Again in 1808 an old tillage farmer,[4] who deals with the difficulties in expanding the tillage area more rapidly, suggests that the basic information required could be obtained through the parish priests, a method which had already been suggested for a population census,[5] and that it would be of the greatest value.

These few far-sighted writers of the 18th century, when added to the number of speculations produced by contemporary political arithmeticians, show that there was a steadily growing body of informed opinion in that century, which appreciated the desirability of accurate information upon which the Government of the day might act. It was, however, many years before the weight of that opinion became forceful enough and the organisation of centralised government had sufficiently developed, on the one hand to demand and on the other to permit the work to be done.

Notes from Craibstone.

Clovers and Grasses in 1927 : *Red Clover.*—A feature of the 1926 hay crop was the larger amount of Broad-leaved Red Clover present and the comparatively small amount of the Late-flowering type. In 1927 the reverse was the case. Plots where Late-flowering was included in the seed mixture were thick and vigorous, whereas those with Broad-leaved were only fairly good, even where English seed had been sown. The results with foreign seed were, as is generally the case, very poor. There were altogether 12 plots seeded with different samples of French Red Clover. The seed of these samples was good, the germination being in all cases well over 90 per cent. Nevertheless there was

[1] Thoughts on the present Prices of Provisions. p. 5.
[2] The Mischief of Forestalling . . . , 1800, p. 55 ff.
[3] Thoughts on the Dearness of Provisions, undated, c. 1800.
[4] Thoughts on Tillage, p 68.
[5] Thoughts on the Difficulties and Distresses in which the Peace of 1783 has involved the Kingdom of England. John King, 5th Ed., 1783.

hardly a plant of clover in any of the plots. Similar results were obtained with Chilian, Italian and Hungarian seed.

Among the late-flowering samples, those of Montgomery and Cornish origin were distinctly best, except in the case of one sample (out of nine) of the former, which turned out to be of the Broad-leaved type.

In plots sown in 1924, practically all the Broad-leaved plants had died. Plots sown with Montgomery, Cornish, Swedish and Altaswede were all good. Vale of Clwyd samples, except in one case (out of ten) had almost disappeared. There were plants of one sample of Canadian (out of four), American Mammoth and Wisconsin, but they were not at all vigorous.

The results indicate that it is essential to include both Late-flowering and Broad-leaved (English) in mixtures, and also that it would be well to include several different samples of each type so as to ensure getting a stand.

White Clover.—The most interesting results this year have been obtained with so-called "cheap" samples of Wild White Clover. These usually turn out in the end to be much dearer than samples of true Wild White. The following table indicates where the losses occur :—

Sample.	Dealer's Price.	Purity.	Germin-ation.	Real Quality.	Chemical Rest Reaction.	Real Price.
		Per cent.				
1.	7/6	98	93+ 3	91	Very strong (7).	8/3
2.	5/6	94	72+12	67	Weak (3).	19/3
3.	4/6	95	57+10	48	Very strong (7).	9/5

Sample 1 is an ordinary average sample. In sample 2 the chemical test (see April number of this JOURNAL) indicates that less than half the seeds were Wild White, whereas in sample 3, although it was Wild White, the germination was so low that it was considerably reduced in value.

About 30 samples of New Zealand were sown in 1925. While these trials are not sufficiently far advanced to draw definite conclusions, they indicate that great care must be exercised in buying New Zealand White Clover seed. Some samples were evidently capable of giving good results, while others are so far poor. So far as results go, the chemical test appears to give an indication of the value of samples of New Zealand White Clover.

Grasses. — Demonstration plots with different amounts of Perennial Ryegrass again showed that, so far as the hay crop is concerned, there was little difference in the yield. The most outstanding result was in the large amount of Timothy present. This is possibly due to the wet nature of the season, which undoubtedly favoured this grass. For the same reason, where Rough-stalked Meadow Grass had been included in the mixture, it showed quite fresh and green in the pasture, whereas in drier seasons it usually shrivels up.

Several plots had been seeded with leafy strains of Perennial

Ryegrass, the same amount of seed (13 lb.) being used as in the case of Ayrshire seed. In the hay, the result was quite marked, there being many more stalks of Perennial Ryegrass where the Ayrshire seed had been sown. On the other hand, the amount of Cocksfoot and Timothy was considerably greater where the leafy Perennial Ryegrass was used, although the seeding of Cocksfoot and Timothy was the same in all cases.

In the trial with different amounts of Italian Ryegrass, the adverse effect of this grass on the Red Clover was again very distinctly marked. In every case the hay crop was reduced in weight where it was used.

The inclusion of 4 or 5 lbs. of Timothy in mixtures for short periods again increased the yield by about 7 to 8 cwt. per acre, whether it was used along with or without Italian Ryegrass.

The effect of the previous treatment on the rapidity of the development of White Clover in second year's pasture has been very marked. The factors which influence this development are the exclusion of Red Clover from the seed mixture and the early cutting of the hay crop. Conversely, where the hay crop was late in being cut and the aftermath was very late in being eaten down, the development of White Clover was very slow.

In a small trial where the pasture was cut instead of being grazed, frequent cutting at the beginning of the second year allowed the White Clover to spread much more quickly than where the grass was allowed to become long before being cut. The total weight obtained from the latter treatment was, however, much greater than from the former, and the result indicates that, after the White Clover is established, greater production will be obtained where there is a good covering of grass and clover throughout the season.

Reviews.

The Journal of the Orkney Agricultural Discussion Society.—In its Journal for 1927 the Orkney Agricultural Discussion Society gives further evidence of vitality and usefulness. Its aim is described in the introduction to the Journal to be how best to meet or alleviate agricultural depression as it affects Orkney, and the claim is made that the formation of the Society has been amply justified by the unprecedented interest and anxiety shown throughout the county for progress and improvement and that already lasting benefits have been secured as a result of the Society's efforts.

In the subject matter of the Journal abundant support is given to the claim for stimulating interest in agricultural affairs. The papers are in the main eminently practical and appeal both to the self-interest and the social instincts of the Orcadian farmer. A glance at the table of contents shows that the interests of the members are wide and varied. There are two papers, informative and suggestive, on education related to agriculture. The advantages and disadvantages of agricultural co-operation are weighed and balanced in a report of a well-sustained debate on this vexed question. Similarly, the merits of large and small holdings are thoroughly discussed and contrasted and a pronouncement is made on the most economic size of holding. The possibilities of electricity on the farm in Orkney are advocated by an enthusiast. Papers on ploughing, seed potato growing, poultry keeping and feeding, pig feeding, Clydesdale breeding, stock feeding, manuring and seeding, are all pointedly practical and useful contributions, and the question of licensing bulls is debated with obvious knowledge. An exceedingly interesting historical article is contributed by Mr. J. Storer Clouston on the Runrig system in Orkney, to the writing of which much antiquarian research must have been applied. To some readers, the most illuminative discussion will doubtless be that which is concerned with the problem of whether it is wise for a farmer to remain a bachelor. The arguments submitted on either side are fully set forth, but the result of the deliberations is not revealed.

Ensilage of Fodder, L. F. Kuchler, Die zeitgemässe Grünfutterkonservierung. Ein Ratgeber für Silofragen. Munich, 1926, ii Vol., n 8°.—In this volume, the author discusses the important question of the silo, which is defined as a necessity for the poor, a luxury for the rich, but an improvement and independence in life for both.

The author tells the history of the silo from its beginnings from the references in Varro and Cato right up to the present day. He also demonstrates the advantages and disadvantages of this method of preservation, which nowadays has passed the experimental stage and is seen to be of great practical importance and of special value in times of stress.

The author examines and describes the complex processes developed in the silo and the tests by which the value of the foodstuff can be judged, detailing also the proper way to take samples, a condition absolutely essential to a right judgment on subsequent analyses.

The practical side of the preparation of the silo is largely developed; construction, loading, development of acidity, method of compression. Physical methods of preserving the silage, among which electricity is of special importance, are described, as are also the addition of chemicals and bacterial inoculation to help the formation of silage.

After these practical considerations he proceeds to deal with the choice of the type of silo to suit different farms and the best means of utilising the various kinds of fodder.

Finally there are notes on ensilage in various countries and on questions connected with it in Germany.

The Journal of the Ministry of Agriculture for Northern Ireland, 1927.—As stated in a foreword by the Right Hon. E. M. Archdale, Minister of Agriculture for Northern Ireland, the function of this new Journal—an annual one—is to provide a medium for the publication of the results obtained by the Research Divisions attached to the Northern Ireland Ministry of Agriculture. It is apparently intended to serve both as a record of these results and as a means of bringing them to the notice of Ulster farmers, so that useful results may be put into actual practice on the farm. There is and must always be a certain amount of difficulty in carrying out both these functions in the same medium. To record results of scientific work is a comparatively simple matter to the trained scientific worker. To put the record into such a form that it will be readable and attractive to the average farmer and entirely understandable by him is a more difficult problem. Whether it has been solved in this Journal time will show, but at all events it can be said that a most praiseworthy attempt has been made to "put over" the scientific results to the farming audience. And of most of the articles in the list of contents it can also be said that they deal with matters of very direct practical utility. Thus that on "Phosphatic Fertilisers" by Dr. Scott Robertson points clearly to the economic possibilities of using North African phosphates in place of the high-grade basic slags now disappearing from the market. This in a grazing country like Northern Ireland is of immense practical importance. Similarly the paper on the experiments relating to "Loss of Vigour in stocks of Potatoes" must be of great interest in a land where that crop is of such general value. The experiments described bring out the urgency of obtaining seed free from the virus diseases, chiefly Leaf Roll and Mosaic. Potatoes are also the subject of an article on the "Cutting of Majestic Seed Potatoes" by Mr. J. G. Rhynehart, in which is advocated the practice of cutting the seed immediately before planting.

Breeding and feeding of live stock is a widely established department of farming in Northern Ireland, and an article on "Silage Investigations" by Messrs. Robertson, Dickinson and Houston should command attention. It treats of (1) Silage and Roots as Farm Crops, (2) the Feeding Value of Silage for Dairy Cows and Fattening Bullocks and (3) the Effect of Fermentation in the Silo on the Feeding Value. The experimental results are fully set forth in tables and charts, and a useful summary gives an excellent guide to growing, making and utilising silage to the best advantage.

Two articles by Mr. R. G. Baskett dealing with "Mineral Supplements fed to the Breeding Sow" and "Mineral Supplements and Vegetable Protein in Bacon Production" appeal specially to the pig industry, so important in Northern Ireland; and a useful account of the "Control of American Gooseberry Mildew" by Messrs, Muskett and Turner emphasises the need for early and efficient spraying.

A number of reviews and notices of recent agricultural publications completes a very interesting budget. The Ministry of Agriculture of Northern Ireland is to be highly complimented on this—the first issue of their Journal.

The Trench or Pit Silo.

In 1925 the Board initiated a series of demonstrations in the use of the trench or pit silo. For the small farmer or crofter the ordinary tower silo is out of the question owing to the comparatively heavy expenditure involved not only in the erection of the silo but in the purchase of the necessary machinery for cutting and filling. The trench silo, however, enables the small farmer to make silage at a small capital cost, apart from the labour, which he is often able to undertake himself.

The demonstrations were carried out by the Colleges of Agriculture. In 1925 demonstration silos were built at 9 centres and in 1926 at 12 centres. These were situated in the northern and western parts of the country where, generally speaking, more difficulty is experienced in providing an adequate supply of winter keep for stock.

The structures of the silos varied considerably at the different centres, but the general principles were the same, the walls being faced with cement and the floor, where not sufficiently hard, also being cemented or concreted. The following report by the North of Scotland College of Agriculture on one of the larger and more elaborate silos will best illustrate the methods adopted :—

Site.—The site chosen is a sunken piece of ground which lies in the right-angle made by two cross roads, and is about 10 ft. below road level.

Type of Silo.—It is built of reinforced concrete—1 part of cement to 6 parts of sand. The inside dimensions are 14 feet long, 14 feet wide, and 12 feet deep. The walls, which are 6 inches thick, have a smooth surface inside and rounded inside corners. In one of the walls, opposite the roads, there is an opening 7 feet long by 3 feet 6 ins. wide, commencing about 4 feet above floor level. This opening acts as a door for taking the silage from the silo. When the silo is being filled, the opening is closed by 1¾ in. deals placed horizontally, one on the top of the other. These fit into grooves cut in the sides of the cement wall. A double wall of deal boards is made, and the space of 2½ ins. between them is filled with earth to keep the silo air-tight.

The cement floor has a slight slope to one corner from which a 3-inch pipe leads through the wall to the outside. Excess moisture drains from the silo through the pipe.

The silo is covered over by a permanent couple roof of 4 in. by 2 in. ties and purlins, and 24 B.W.G. corrugated iron sheets. The roof rests on the wall and is fastened to it by hook bolts. The gables are boarded up with ¾ in. deals. A two-leaved hinged door, 4 feet wide, is made in the gable next to the road.

Silage crop.—Towards the end of April 3 acres of a mashlum mixture were sown and also manured. The seeding of the mashlum mixture per acre was :—

70 lbs. potato oats, 56 lbs. rye, and 56 lbs. tares.

The manures were applied at the following rates per acre :—

3 cwt. supers (35 per cent.), 1 cwt. potash salts, and ½ cwt. sulphate of ammonia.

In addition to the above mashlum crop, two acres of Hamilton oats, and about one acre of meadow grass were used for filling the silo.

Filling the Silo.—The crop was harvested about the end of July. The crop was cut and carted into the silo (in the long state) on the following days. By the end of two days the crop settled down and more was added. The six acres of crop were put into the silo in five fillings, with intervals of two days between each. The crop was allowed to heat for about a week, and then pressure was applied by means of stones. The stones were moved about from time to time so as to equalise the pressure.

Quality of Silage.—When the silo was opened in January 1927 there was about 9 feet depth of silage. Two types of silage could be distinguished, viz. : (1) a dark brown silage layer at the bottom, and (2) a yellowish brown layer in the top part. The former was formed from the mashlum crop. The silage is of very good quality—not too moist and with no pungent odours, and the stock eat it readily. It is fed, at the rate of 25 to 30 lbs. per head, once daily to cross store cattle which are grazing on the hill and are not housed during the year. A small quantity is also fed to the horses with good results. In the past, winter keep has been often scarce, and in order to overcome this difficulty this experiment has been undertaken.

At the time of opening there were about 30 tons of silage in the silo.

Most of the other silos were smaller and less elaborate than that described above. In a number of cases it was found convenient to build the silo into a bank. The materials used generally consisted only of a few bags of cement and a small quantity of wood and corrugated iron, the latter for the roof.

The experiments are being continued at several of the centres this year, but the results of the past two seasons clearly demonstrate that sound, wholesome silage can be made by means of trench silos, provided proper attention is given to the following points :—(*a*) that the crop is cut at a succulent stage of growth; (*b*) that the crop is thoroughly tramped down, both in the centre and round the sides of the silo; (*c*) that the filling of the crop is done in sections, to allow of proper consolidation; and (*d*) that the silage is heavily weighted, covered with a considerable layer of bracken, rushes, &c., followed by a thick covering of turf or earth, and, if possible, roofed with corrugated iron.

The expense of erecting a small trench silo is within the means of many crofters and smallholders, and the formation of such a silo would therefore appear to be well worth consideration, particularly in districts where other winter keep for stock is difficult to obtain.

The Colleges of Agriculture will be pleased to advise any person who may wish to give this method of making silage a trial.

The Residual Values of Feeding Stuffs and Fertilisers.

SUGGESTIONS have been made, and in some cases adopted, for the revision of the tables drawn up by Dr. J. A. Voelcker and Sir A. D. Hall for values to be attached to manurial residues left upon the farm, due either to the consumption of feeding stuffs or to fertilisers purchased during the tenancy of the outgoing occupier. Since 1902, when these tables were originally drawn up, certain scientific evidence has been accumulated which calls for revision of some of the data on which the original tables were based.

The revision was in the first instance considered by a Committee composed of the leading agricultural chemists in Great Britain, including Professors R. A. Berry and James Hendrick and Dr. Alexander Lauder. This report was then reviewed from the point of view of practicability by a Joint Committee, including representatives of the various professional bodies. The Scottish members comprised, besides those mentioned above, Messrs. J. T. M'Laren (Highland and Agricultural Society), John Speir (National Farmers' Union of Scotland), Harry Armour (Scottish Chamber of Agriculture), Sir James I. Davidson, Mr. Joseph Murray, and the late Mr. A. Agnew Ralston (representing other professional bodies in Scotland), and Mr. James Mather (Board of Agriculture for Scotland).

The Joint Committee agreed on the terms of a report to be presented to the various Associations represented. The representatives of the National Farmers' Union of England and Wales and the Central Association of Agricultural and Tenant Right Valuers dissented on the ground that the time was not opportune for any disturbance of the existing practice of valuation. The Scottish members of the Joint Committee, however, addressed a letter to the Board of Agriculture for Scotland recording their entire approval of the report and recommending its adoption in Scotland.

In pursuance of the views expressed by the Scottish members of the Joint Committee, the Board of Agriculture for Scotland have issued the Report of the Joint Committee together with the Report of the Scientific Committee and the letter of the Scottish members, as Miscellaneous Publication No. 7, copies of which may be obtained on application to the Secretary of the Board, York Buildings, Queen Street, Edinburgh, price 6*d*. post free.

Scholarships.

The scheme for the provision of scholarships and maintenance allowances for the sons and daughters of agricultural workers and others was instituted in 1922. For the first five years of the scheme funds were obtained from the special provision for the promotion of agricultural development made under the Corn Production Acts (Repeal) Act, 1921. The cost is now met from the sum voted annually by Parliament for the work of the Board of Agriculture for Scotland.

Benefits under the scheme are confined to :—

(*a*) The sons and daughters of agricultural workers;

(*b*) The sons and daughters of other rural workers, including smallholders, whose financial circumstances are comparable to those of agricultural workers;

(*c*) Persons who are themselves *bona fide* workers in agriculture or its allied pursuits, whose financial circumstances are comparable to those of agricultural workers.

Four classes of scholarships are available, viz. :—

Class I.—Short Course Allowances, not exceeding 35*s*. per week for the period of the course, to enable the holders to attend short courses of from four to ten weeks' duration in agriculture, horticulture, dairying, poultry-keeping, &c.

Class II.—Certificate Course Scholarships, each not exceeding £30 in value, to enable the holders to attend courses of instruction in agriculture, horticulture, dairying, poultry-keeping, &c. These courses, as a rule, require attendance at classes during one session of about twenty weeks.

Class III.—Diploma Course Scholarships, each not exceeding £120 in value or £40 per session, to enable the holders to attend the courses of instruction for diplomas awarded by Agricultural Colleges in Scotland.

Class IV.—Degree Course Scholarships, each not exceeding £280 in value or £70 in any one year, tenable while students attend courses of instruction for the degree of B.Sc. (Agriculture) of a Scottish University during three academic years or thereby, or for the qualification of M.R.C.V.S. at the Edinburgh or Glasgow Veterinary Colleges, which extend over four sessions.

In addition to the allowances described above, class fees are paid in respect of all scholarships awarded. Travelling expenses may be paid either in addition to, or wholly or partly in place of, the allowances.

The sum which may be awarded in each case is a maximum, and assistance is given only to such an extent as is necessary to supplement private resources or bursaries held from Education Authorities or other sources.

The number of applications received during the five years

1922-26 was 590 and the number of scholarships awarded was 134, made up as follows :—

	Applications.	*Awards.*
Class I.	135	43
„ II.	146	36
„ III.	171	28
„ IV.	138	27
	590	134

Of the 134 awards made, 36 were to girls, mainly for courses in dairying and poultry-keeping.

Particulars of the occupations followed by the parents of successful candidates and the number of scholarship holders who were qualified in their own right under the scheme as being *bona fide* agricultural workers are given in the following statement :—

Occupation of Parents—	
Agricultural workers (including grieves, ploughmen, shepherds, labourers)	37
Crofters or smallholders	60
Other rural workers	9
Candidates who qualified in their own right as *bona fide* wage earners in agriculture	28
	134

Periodic reports on the work and progress of the students were obtained from the authorities of the institutions at which the scholarships were held. The reports on the whole were very satisfactory, and only in four cases were they of such an unsatisfactory nature as to necessitate the withdrawal of the scholarship.

From enquiries which have been made it has been ascertained that the great majority of the beneficiaries returned to practical agricultural work, and that their courses of instruction have been of great assistance to them in their work. Definite improvements in position have been reported. Instances have also been given of the introduction of improved methods of husbandry as a result of the instruction received.

One hundred and thirty-four applications have been received for assistance under this year's scheme, and the Board have awarded 24 scholarships, apportioned as follows :—

Class I.	7
„ II.	6
„ III.	7
„ IV.	4
	24

Guide to Current Official Statistics, Volume V.

THE fifth volume of the *Guide* dealing with statistical publications issued during the year 1926 and (in the case of annual publications) those issued in the earlier months of this year, was published at the beginning of July. The date of publication has thus again been substantially advanced, and the usefulness of the *Guide* correspondingly increased. The new volume is arranged, like its predecessors, on a plan that makes reference easy and rapid. The first part consists of a detailed index of subjects with numerous cross references, while in the second part the various publications are arranged under the names of the Departments responsible for them, each publication having a serial number, which is used in the first part as a key to it. The usefulness of the *Guide* has now been amply proved, and it is widely recognised as an indispensable work of reference. Copies may be obtained from H.M. Stationery Office, 120 George Street, Edinburgh, either directly or through any bookseller, price 1*s*. or by post 1*s*. 4*d*.

International Year Book of Agricultural Statistics.

THE new issue of this valuable work, which is published annually by the International Institute of Agriculture, has just appeared. It contains full particulars of the area and production of crops, the numbers of live stock and the trade in agricultural produce and requirements throughout the world, and supplies an immense amount of authoritative information, which only such an international body as the Institute is in a position to obtain. The volume extends to 580 pages, and may be obtained from the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1, price £1 post free.

Agricultural Returns, 1927.

THE Preliminary Statement of the Agricultural Returns taken in Scotland on 4th June 1927 shows that the total area under crops and grass amounts to 4,687,000 acres, comprising 3,173,000 acres of arable land and 1,514,000 acres under permanent grass. The total acreage is the smallest recorded since 1877, while the area of arable land is the smallest recorded since the returns were first taken in 1866, being less than in 1926 by 21,000 acres. The area under permanent grass has, however, increased by 15,000 acres, and the diminution in the total area under crops and grass is thus 6,000 acres.

The area under rotation grasses and clover, 1,492,000 acres, has increased by 7,000 acres, while the area under other specified crops is 29,100 acres less than in the previous year.

The total decrease is mainly accounted for by barley, oats, and turnips and swedes, which combined show a diminution of 47,800 acres. Wheat, potatoes and sugar beet all show increases.

The area under wheat, 64,000 acres, is greater than in 1926 by 10,200 acres; that under barley, 120,000 acres, is the smallest ever recorded, and is less by 2,000 acres than that of last year; while that under oats, 905,000 acres, is 35,000 acres less than in 1926. Mixed grain, beans and peas show increases of 600 acres, 400 acres, and 100 acres respectively as compared with 1926, while the area under rye shows a reduction of 400 acres.

The area under potatoes, 146,000 acres as compared with 142,000 acres in 1926, shows an increase of 4,000 acres, but is below the average of the preceding ten years by about 3,500 acres. The area under turnips and swedes, 380,000 acres, is less than last year by 10,800 acres, and is the smallest ever recorded.

Mangolds, cabbage, rape and small fruit show small increases. Sugar beet, which increased from 4 acres in 1923 to 1,500 acres in 1925, and 3,600 acres in 1926, now shows a total area of 7,500 acres. Minor crops for which returns are made, but which are not separately shown in the accompanying table, all show slight increases in area except flax, which has decreased by about 150 acres.

Of the whole area under permanent grass 173,000 acres were cut for hay and 1,341,000 acres were grazed, while of the area under rotation grasses and clover 401,000 acres were cut for hay and 1,091,000 acres were grazed. The area under permanent grass for mowing was greater than in 1926 by 6,500 acres, while that under rotation grass for mowing was less by 13,000 acres; the total area cut for hay is thus less by 6,500 acres.

The live stock returns show that horses have diminished in number, while cattle, sheep and pigs have increased.

Horses used for agricultural purposes, numbering 129,600, are fewer by 2,450, the total being the smallest since 1915. Unbroken horses of one year and above are fewer by 1,300, or 6·8 per cent., while foals show a decrease of 800, or 12·1 per cent. The total decrease in horses is 5,400, or 3·0 per cent.

The total number of cattle, 1,203,900, shows an increase of 6,100, or 0·5 per cent. The number of cows in milk, heifers in calf, and other cattle two years and above are less than in 1926, but the remaining classes show increases. The increase of 4,400 in cows in calf is almost balanced by decreases in cows in milk and heifers in calf. Bulls being used for service have increased in number since 1926 by 200, yearling feeding cattle by 9,100, and calves by 4,000, while feeding cattle over two years old have decreased by 7,400.

Ewes, which number 3,192,000, show the highest total ever recorded, and are more numerous than in 1926 by 76,700. The number of lambs, 3,171,200, is greater than last year by 117,300, rams by 4,100, and other sheep one year and above by 22,400. The total number of sheep, 7,423,600, is 220,500 more than last year, and is the highest recorded since 1908.

Pigs show a considerable increase, although the total of 185,520 is below the record high figure of 198,800 in 1924. All classes show increases, sows by 6,610, boars by 640, and other pigs by 32,870.

AGRICULTURAL RETURNS FOR SCOTLAND, 1927.

PRELIMINARY STATEMENT for 1927, compiled from the Returns collected on 4th June; and comparison with 1926. The figures for 1927 are subject to revision.

CROPS AND GRASS.

Distribution.	1927.	1926.	Increase.		Decrease.	
	Acres	*Acres.*	*Acres.*	*Per Cent.*	*Acres.*	*Per Cent.*
TOTAL AREA (excluding WATER)	19,069,683	19,069,683	..	..	..	..
TOTAL ACREAGE under all CROPS and GRASS (*a*)	4,687,000	4,693,000	..	..	6,000	0·1
ARABLE LAND	3,178,000	3,194,000	..	..	21,000	0·7
PERMANENT GRASS (*a*) — For Hay	173,000	166 500	6,500	3·9	.	..
PERMANENT GRASS (*a*) — Not for Hay ..	1,341,000	1,332,500	8,500	0·6	..	..
PERMANENT GRASS (*a*) — TOTAL ..	1,514,000	1,499,000	15,000	1·0	..	
Wheat	64,000	53,800	10,200	19·0	..	..
Barley (including Bere)	120,000	122,000	..	..	2,000	1·6
Oats	905,000	940,000	..	..	35,000	3·7
Mixed Grain	1,700	1,100	600	54·5		..
Rye..	4,500	4,900	..	..	400	8·2
Beans (to be harvested as Corn)	3,700	3,300	400	12·1	..	..
Peas	500	400	100	25·0	..	..
Potatoes	146,000	142,000	4,000	2·8	..	..
Turnips and Swedes	380,000	390,800	..	..	10,800	2·8
Mangolds	1,200	1,100	100	9·1	..	..
Cabbage	4,100	4,000	100	2·5	..	..
Rape	12,900	12,500	400	3·2	..	..
Vetches, Tares, Beans, Peas, Mashlum, etc., for Fodder	11,400	12,300	..	..	900	7·3
Sugar Beet	7,500	3,600	3,900	108·3	..	..
Small Fruit	8,000	7,800	200	2·6	.	..
RYE-GRASS and other ROTATION GRASSES and CLOVER — For Hay	401,000	414,000	..	..	13,000	3·1
RYE-GRASS and other ROTATION GRASSES and CLOVER — Not for Hay ..	1,091,000	1,071,000	20,000	1·9	..	..
RYE-GRASS and other ROTATION GRASSES and CLOVER — TOTAL	1,492,000	1,485,000	7,000	0·5	..	..
OTHER CROPS	3,900	3,400	500	14·7	..	..
BARE FALLOW	6,600	6,000	600	10·0	.	..

LIVE STOCK.

	No.	*No.*	*No.*	*Per Cent.*	*No.*	*Per Cent.*
Horses used for Agricultural purposes (including Mares for Breeding)	129,600	132,050	..	..	2,450	1·9
Unbroken Horses (including Stallions). — One year and above ..	17,700	19,000	..	..	1,300	6·8
Unbroken Horses (including Stallions). — Under one year ..	5,800	6,600	..	..	800	12·1
TOTAL	153,100	157,650	..	..	4,550	2·9
Other Horses	20,200	21,050	..	..	850	4·0
TOTAL OF HORSES .. .	173,300	178,700	..	..	5,400	3·0
Cows in Milk	355,400	357,300	..	..	1,900	0·5
Cows in Calf, but not in Milk..	47,300	42,900	4,400	10·3	..	..
Heifers in Calf	55,000	57,300	..	..	2,300	4·0
Bulls being used for Service	17,400	17,200	200	1·2	..	.
Other Cattle :—Two years and above ..	209.800	217,200	..	..	7,400	3·4
,, ,, One year and under two ..	274,700	265,600	9,100	3·4	..	..
,, ,, Under one year	244 300	240,800	4,000	1·7	..	..
TOTAL OF CATTLE	1,203,900	1,197,800	6,100	0·5	..	..
Ewes kept for Breeding	3,192,000	3,115,800	76,700	2·5	..	..
Rams to be used for Service	90,400	86,300	4,100	4·8	..	..
Other Sheep :—One year and above	970 000	947,600	22,400	2·4	..	..
,, ,, Under one year	3,171,200	3,053,900	117,800	3·8	..	..
TOTAL OF SHEEP	7,423,600	7,203,100	220,500	3·1	..	..
Sows kept for Breeding	24,910	18,300	6,610	36·1	..	..
Boars being used for Service	2,640	2,000	640	32·0	..	..
Other Pigs	157,970	125,100	32,870	26·3	..	..
TOTAL OF PIGS	185,520	145,400	40,120	27·6	..	..

(*a*) Excluding Mountain and Heath Land used for grazing.

Agricultural Conditions.

During the first half of June the weather was fairly dry, but cold winds were general and night frosts were frequent in many districts; in Aberdeen some snow fell on high ground. During the latter half of the month the weather was both cold and wet, and in some south-western districts the rainfall was excessive. The growth of grass was, in consequence, greatly retarded, and the sowing of turnips was delayed by the unfavourable conditions and the wet state of the ground. In July, throughout the greater part of Scotland, the weather was fairly warm but unsettled. Rain was frequent, especially during the first week or ten days of the month; in most cases growing crops made good progress. In northern areas, more especially in Orkney and Shetland, the weather was dry and bright throughout the greater part of the month. During August the weather was abnormally wet in most districts. The temperature was moderate but there was very little sunshine; in exposed districts night frosts occurred during the latter half of the month. The broken weather seriously interfered with the making of hay, while the cereal crops, which matured slowly, were badly lodged by storms. In Moray, Banff, North Aberdeen, Orkney, Shetland and the western islands, however, the weather was fine and dry, and in these districts the crops made excellent progress.

The weather conditions during the summer months were unfavourable for all grain crops. Wheat, however, generally maintained a strong and healthy growth, and at the end of August it was ripening well and, in most of the districts where it is grown, was almost ready for harvest. In a few southern areas cutting began during the last week of August, but in South-West Forfar and South-West Fife, and on high or exposed ground elsewhere, the crop was still green, and in these districts it was thought that cutting would not be general until the middle of September. A small part of the crop was lodged by heavy rain, but on the whole wheat withstood the storms much better than the other cereal crops. The harvest prospects are good and average yields are anticipated in practically every district where the crop is grown; in Fife it is estimated that the yield will be about 5 per cent. above the normal.

The barley crop made little progress during June, and at the end of that month, on heavy or wet soils, the braird generally was stunted and lacking in colour. During July, however, the plants showed better growth and the prospects of the crop became much more satisfactory. The straw lengthened and in most districts the crop had a healthy and vigorous appearance. During August the grain ripened slowly and considerable portions of the best and heaviest crops were laid and twisted by storms; on low ground in some areas harvest began before the end of August and it was expected that the work would be general about the second week of September. An average yield is estimated in most districts and on good soils it is thought that the crop may be slightly heavier than usual, while in North-East Forfar it is expected that the yield will be about 10 per cent. above the normal. Bere was ripening quickly at the end of August, and promised to be an average crop generally.

At the beginning of June the oat crop was reported to be backward generally, but there was little evidence of damage by grub and the plants were healthy. The crop made good progress during July, and as a result of the abundant rainfall, the straw was generally of a good length, although rather soft; later on, however, a considerable proportion of the crop was lodged by storms. On some farms harvest began during the last week of August, while in most districts at that time the ears were reported to be on the point of ripening; in some cases, however, the crop was still green owing to the lack of sunshine, and it was thought probable that the grain would not be ready for cutting until the second or third week of September. The lodging of the crop was most serious where it was grown after lea and in these cases harvesting will be difficult and expensive. In seventeen of the forty-three districts from which reports are received an average yield is expected, while in eleven other districts it is estimated that the yield will be slightly above the average of the last ten years; in six districts the estimate is 10 per cent. and in South-East Perth 15 per cent. above the normal. In South-West Forfar, North-East Fife, the Lothians, Peebles, Harris and Uist, on the other hand, the yield is estimated at about 5 per cent. and in Central Perth and Berwick about 10 per cent. below the average.

The early morning frosts experienced during the month of June somewhat retarded the growth of beans in eastern areas but the crop made fair progress generally, especially during the latter part of August; cutting had not begun at the end of August. In Stirling, where there is a much larger acreage under beans than in any other district in Scotland, the crop is expected to bulk about 5 per cent. below the average, but in almost every other district where the crop is grown it is thought that the yield will be an average one or slightly above the average.

The growth of potatoes was at first reported to be backward; at the beginning of July the later varieties were only just appearing above the ground. The warm damp weather of that month, however, was beneficial to the crop and the plants made rapid progress. At the beginning of September the reports were fairly favourable but in most of the important potato-growing districts the haulms were showing marked signs of blight, and in some varieties the disease was said to be spreading rapidly. Yields varying from 5 to 10 per cent. below the normal are expected in twelve districts, but in North-East Aberdeen, Central Argyll, Kintyre and Bute the crop has a very promising appearance, and in these localities it is estimated that the yield will be about 10 per cent. above the average; elsewhere an average crop is generally expected.

Reports on turnips and swedes are varied. In June resowing was necessary in several parts of the country owing to damage caused by the inclement weather and the ravages of the turnip fly; in Wigtown some third sowings were necessary. The crop brairded fairly well in July, especially in early-sown fields, but, owing to the excessive rainfall, weeds were very prevalent and there was more difficulty than usual in keeping the fields clean. At the beginning of September the roots generally were stated to be looking well, but in some districts a proportion of the crop was stunted and lacking in vigour, while in practically all of the eastern areas and also in a few western districts finger-and-toe was prevalent. In two-thirds of the districts of Scotland it is expected that the yield will be equal to or slightly above the average. In Caithness, Stirling and Central Argyll it is estimated at 15 per cent., and in Kincardine, Sutherland, Kintyre, Bute, Roxburgh and Selkirk at 10 per cent. above the normal. On the other hand a deficiency of 15 per cent. is expected in Central Perth and Kirkcudbright, and one of 10 per cent. in South-East Perth, North Ayr, Dumfries and Wigtown, while in several other districts a yield 5 per cent. below the average is expected. Mangolds are growing fairly well, but have suffered from the lack of sunshine. In most of the districts where the crop is grown, however, an average yield is forecasted, and in some cases it is expected that the roots may bulk rather heavier than usual; in North Ayr and Dumfries the estimate is 10 or 15 per cent. below the average. The sugar beet crop made fair progress during July and August, and on suitable land the roots now have a healthy and strong appearance but "bolting" is prevalent in many districts. The most satisfactory reports were received from North-East Banff, Central Aberdeen, North-East Forfar, North-East Fife, the Lothians, Berwick, Kintyre, Bute and Stirling.

The frosts and cold winds that prevailed during May and June more or less seriously affected all fruit trees and bushes. Strawberries were a much lighter crop than usual except in South-West Perth and North-East Forfar, where average yields were reported. Raspberries yielded rather better than was at one time expected; in Lanark the crop was an average one and in South-East Perth the produce was well above the normal, but elsewhere the yields were generally smaller than usual. In North-West Lanark the gooseberry and red currant crops were fairly good but other fruit crops were a failure; currants were a satisfactory crop in South-East Perth, but generally speaking the yield was more or less below the normal; gooseberries were an average crop in South-East Lanark and South-East Perth. In Dumfries the apple crop is expected to be about 5 per cent. and pears about 15 per cent. below the normal.

Pasture was rather scanty in June, but during July and August grass was plentiful although not of very good feeding value. Grazing cattle did moderately well, but in some cases their progress was rather slower than is usual in the summer months. Sheep on arable farms have thriven fairly well generally; owing to the lack of sunshine, however, lambs were rather below the normal in condition. Foot-rot was reported to be prevalent in Clackmannan, Kinross, South-West Fife and Berwick, while in North-East Aberdeen lambs were suffering to an unusual extent from scour, owing to the soft condition of the grass. Hill sheep made good progress generally but the lambs were not so well grown as usual; the condition of the general run of the lambs entered at the Lamb Sales this year shows clearly the bad effects of the wet weather.

Bees were adversely affected by the prolonged spell of inclement weather and the unusual want of sunshine. In some northern districts and in South-East Lanark the stocks are reported to be in fairly good condition and the yield of clover honey has been about the average; in North-East Banff, owing to an abundance of white clover, the yield of honey is said to have been very satisfactory, while in South-East Perth the honey flow was at first disappointing, but as clover became more abundant later in the season the yield of honey in consequence was increased. Elsewhere the yield of honey has been small.

The supply of regular workers is generally adequate for the season's requirements, but experienced harvesters were rather scarce in South-West and North-East Aberdeen, Ross, Skye, Dumbarton and Kirkcudbright at the end of August. The supply of casual workers was expected to be unusually short when harvest became general since the lodged cereal crops would have to be cut with scythe and sickle. Large numbers of labourers have come from Ireland to Central Perth, Berwick, Roxburgh, Selkirk and Wigtown.

SCIENCE AND PRACTICE.

The following extracts and summaries are supplied by members of the staffs of Scottish agricultural colleges and scientific institutions or are taken from recent bulletins of the International Institute of Agriculture. Full references to the original publications may be obtained on application to the Secretary, Board of Agriculture, York Buildings, Edinburgh.

CROPS AND SEEDS.

Studies in Rust Resistance. *By E. B. Mains, Purdue University. The Journal of Heredity, Volume* 17. *No.* 9.—A number of rusts have been studied since 1918, and the writer gives a summary of some of his results. Leaf Rust of Wheat, *Puccinia triticina* Eriks., was chiefly studied. More or less high resistance was noted in over 90 strains of wheat out of 2,515 studied. A high degree of resistance was found not only in the cultivated cereals, but also in species of wild grasses. Among the clovers, plants of red clover and crimson clover also showed high resistance. In barley, marked leaf-rust resistance was found in both six-rowed and two-rowed, hooded and awned white-and-blue seeded. It was also found that the rust resistance was occasionally found associated with susceptibility to such diseases as bunt, loose smut, &c. Various factors appeared to be involved in rust resistance; e.g., Kanred was more or less highly resistant to leaf-rust of wheat in a number of field nurseries, but when inoculated in the seedling stage in the greenhouse with the rust from the same nurseries, it proved to be highly susceptible. The mode of inheritance of rust resistance seemed to vary; in some varieties resistance was inherited as a simple dominant character, while in other varieties, resistance was inherited as a simple recessive character. Among the common wheats, Yeoman C.I. 6228 was resistant in all field tests, but so far showed no marked resistance in the greenhouse. Kanred showed pronounced resistance in 54 out of 63 field tests, but in the greenhouse it was resistant to only one physiological form.

Increasing Red Clover by Cuttings. *Sveriges Utsädesförenings Tidskrift. Argang XXXVII., Hafte* 2.—The experiments made at Svalof during the summer of 1926 show that red clover can be propagated by cuttings almost as successfully as alfalfa. In order to obtain the greatest possible number of slips, cuttings with only one node should be used. The cuttings should not be taken too late in the summer, but before the growth of the stalks has ceased and before the lignification of the lower part of the stalk has developed enough to hinder the development of adventitious roots at the base of the cutting. Cuttings develop well also in cold frame, but time is saved by the use of a hot bed. The sooner the transplantation in the open takes place, the more vigorous are the plants obtained, and the better fitted to endure the following winter.

Blindness in Barley. *By W. A. Millard and R. Burgess. Bulletin* 151, *the University of Leeds.*—It has long been recognised that so-called Barley "Stripe" is caused by the fungus *Helminthosporium gramineum*, and that this may attack the ears as well as the leaves of barley. The writers, however, have long been convinced that this so-called "Stripe Blindness" is not the only form of blindness in barley. Numerous cases of blindness have been examined in which no trace of helminthosporium or other pathogenic fungus could be found, and to this form of blindness they give the name of "Gapping." They state that Johannsen, the Swedish plant breeder, has shown that this "Gapping" in barley is a hereditary character and is therefore passed on from one generation to another. He adds, however, that climate and locality may exert a great effect on it, and that it may be produced by insects, frost, and the like. The experiments described in this bulletin were primarily planned with the object of ascertaining any differences in susceptibility to this complaint between well-known and commonly-grown barley varieties. At the same time a close observation was made of the growing crops with the hope of arriving at some conclusion in regard to the cause of blindness, and the effect, if any, of early and late sowing upon it. Further experiments were also carried out with the purpose of testing the hereditary nature of the disease.

The general conclusions arrived at were as follows :—

The so-called blindness in barley is of two kinds.

The first, which the writers have called "Stripe Blindness," is due to the action of the Stripe fungus (*Helminthosporium gramineum*) and may be recognised by the discoloration of the affected ear due to the presence of minute brownish black pustules of the fungus spores. The grain is shrivelled and is sometimes entirely absent.

The second, which has been called Gapping, may be recognised very soon after the emergence of the ear from the sheath by the transparent appearance of the affected spikelets. There is no discoloration of the ear and the unaffected spikelets produce perfectly healthy grains. This form of blindness is much more common than "Stripe Blindness," and possibly accounts for 80 or 90 per cent. of the complaint.

The cause or causes of gapping are still uncertain.

For the present investigation the conclusion is reached that the insect known as thrips is an important factor in the extent of the complaint.

The experiments described lend support to the view that the complaint is hereditary.

Certain varieties are much more susceptible to gapping than others. Standwell and Plumage are so susceptible as to make their economic value a matter of doubt.

Brewer's Favourite and Golden Pheasant are less susceptible.

Spratt Archer, Plumage Archer, Archer Goldthorpe, Binder, Primus, and Gold appear to be highly resistant.

In the experiment of 1926 early sown crops showed less gapping than later sown crops.

The Relations of Soil and Air Temperatures in their Influence on Crop Returns. *H. Kaserer, Fortschritte der Landwirtschaft, Vienna and Berlin,* 1927, *Jahrg. Heft* 7, *S.* 205-212.—The author, in his investigations on the cause of the poor corn harvest of 1924 in the Danube districts, attributable either to weather conditions or to vegetable or animal pests, was able to determine the important influence of the relation existing between soil and air temperatures on plant growth and hence on the final crop.

Whereas in practice in good years the soil temperature from the middle of April till the middle of May had been as high or higher than the air temperature, in 1924 it lagged considerably and only caught up for the first time towards the end of May.

In answer to the question how the influence of this temperature relation is important, the author adduces the relationship which recent work has shown to exist between air nutrition (CO_2 and light) and soil nutrition (nitrogen, phosphorus, potassium and water), as also the strong influence of the soil-generated CO_2. Soil nutrition as opposed to air nutrition induces increased growth of the vegetative organs at the expense of flowers and fruit, while air nutrition induces increased flower formation and better development of fruit. Only when the air nutrition, i.e. particularly the CO_2 nutrition of the plant, does not wait on the soil nutrition factors, can the flowers and fruit develop properly. It is therefore important for CO_2 to be at the disposal of the plant at the proper time, which is in particular the time of flower development and fruit formation.

As is now well known the CO_2 of the air does not satisfy plant requirements in respect of this food and the CO_2 of the soil has to make good the deficiency; consequently the development of the plant depends to quite an important degree on the production of CO_2 by the soil. CO_2 production is for its part dependent to a high degree on temperature relationships among other factors.

Hence it is very important for the crop that the soil should be fairly quickly dried in early spring, so as to free the top layers from water, which is a bad heat conductor, and replace it with air, which isolates the quickly warming soil layers above it from the still cold layers beneath.

It follows from the above that the proportion of grain to straw is very closely connected with these phenomena. Only therefore in years when soil temperature catches up air temperature early enough in the spring can a satisfactory grain-straw ratio be expected.

The author's conclusions have great practical value in addition to their scientific importance. If they are proved correct, it will be possible to make the manurial and cultural operations suit the temperature relations. Moreover, the relation of air to soil-temperature in spring will play an important part in crop forecasting.

Changes during Storage in the Composition of Mangels at the Albert Agricultural College. *J. P. Drew and G. C. Pyne, Department of Lands and Agriculture Journal, Dublin,* 1926. *Year XXVI, No.* 1.—The conclusions reached from work carried out on the storage of mangels (using two varieties, Red Intermediate and Yellow Intermediate) at the Albert Agricultural College, Glasnevin, may be summarised as follows :—

(1) The roots lose about 28 per cent. of their dry matter, and consequently of their feeding value. by the end of five months' storage. For roots used more or less uniformly throughout the storage period, say from January 1st, the average loss might be put at rather more than half the above figure, viz., 14 to 15 per cent., to which a further 2 per cent. loss from disease should be added, bringing the loss up to 16-17 per cent.

(2) There is a considerable fall in the nitrate content of the roots. This is usually assumed to correspond with the supposed improvement in fitness for feeding.

(3) Considerable differences in chemical composition, particularly in dry matter content, exist between roots of different varieties grown under the same conditions. Yields expressed in tons per acre are, therefore, of little value in comparing the feeding value per acre of different varieties, unless the dry matter content is taken into account.

The Effect on Stem and Root Development of the Removal of lateral Growths on young Apple Trees in Summer. *R. G. Hatton and J. Amos. Journal of Pomology and Horticultural Science, London,* 1927. *Vol. VI, No.* 1.—The material used for the experiment was about 170 one year old Allington Pippins and about the same number of Newton Wonder apples of the same age, budded on very vigorous stocks. Every alternate tree was allowed to send out normal lateral shoots on its second year stems. These are referred to as the "Feathered" trees. The others had these growths rubbed out on appearance. They are referred to as "Defeathered" or "Clean." In both series the current season's main leader growths were allowed to extend untouched.

At the end of the growing season the trees were lifted and the results examined and analysed. Tables are given showing the effects of defeathering on growth of the differing parts of the tree and of its subsequent effect on trees after they were transplanted and "headed back" in the third year.

The writers summarise as follows :—

(1) "Defeathering" in summer of the stems of young trees has been shown to affect the tree's weight and girth adversely.

(2) It also restricts root development.

(3) The remaining leader growths are not very materially strengthened (contrary to the opinion held previously by some authorities).

(4) Generally trees allowed to feather in the nursery show some slight gain in growth after transplanting.

(5) These facts have a practical application both in the raising of young trees and in summer pinching practices. They also shed some light on theoretical considerations of the root shoot ratio.

The Influence of different Root Stocks upon the Vigour and Productivity of the Variety budded or grafted thereon. *R. G. Hatton, The Journal of Pomology and Horticultural Science, London,* 1927. *Vol. VI, No.* 1.—A preliminary paper was published on the subject in the above journal in 1920. Since then very comprehensive trials have taken place on different varieties of root stock and on different soils of Bramley's Seedling, Worcester Pearmain and Lane's Prince Albert apples. More recently large areas have been planted out to test the effect of different root-stocks on a number of other commercial varieties.

In this paper the behaviour of Lane's Prince Albert upon 16 varieties of root-stock is considered in detail. A complete record of the performance of each tree has been made and contains such detail as exact vigour of growth and production, fruit bud formation, incidence of disease, root-hold and suckering of the tree, &c. &c. The article contains numerous tables, plates and diagrams, which greatly enhance its value. The following notes are taken from the summary given.

A single variety of apple budded upon 4 distinct varieties of root-stock behaves very differently upon each, both in amount of wood growth made and fruit produced. It may make five times as much wood growth on one as on another or fruit ten times as heavily.

The generally accepted antagonism between wood growth and fruiting is discussed and exceptional cases cited.

The percentage of flowers which set and form fruit has differed consistently upon different root-stocks, as has the position of the fruit buds on the trees.

The amount of variability between trees on the same root-stock is illustrated and the causes discussed. The general results of the experiments are confirmed upon the supplementary plots on very different soils, the *actual* performance of the trees on any particular stock differing greatly from soil to soil, but the *relative* performance remaining the same.

From the point of view of the horticultural experimenter it opens up the possibility of using much more uniform material for field work, as the variability of such material can now be gauged.

From the fruit-growers' standpoint the economic value of trees of known capabilities for size and cropping is demonstrated.

FERTILISERS AND FEEDING STUFFS.

Prejudicial Effect of Carbonate of Lime on the Action of Superphosphate. *Ernest Truninger. Annuaire agricole de la Suisse, Berne,* 1926, *an* 27.—It has been proved for some time that the use of bone meal and raw phosphates on a very calcareous soil or on land which has just received a dressing of lime gives little or no result, even if the soil requirements for phosphoric acid are considerable. It was, however, thought that the more soluble phosphates were not so affected, but the contrary is the case. The author has made trials with various crops; the addition of lime is prejudicial to the action of phosphates applied simultaneously to acid soils, but it has no effect on phosphatic manure if on neutral or alkaline soils.

The practical conclusion is that lime and phosphates should never be applied together on an acid soil.

Losses of added Phosphate by Leaching. *G. M. Robinson, M.A., and J. O. Jones, M.Sc. Journal of Agricultural Science, Cambridge,* 1927. *Vol. XVII, part* 1.—Experiments made to investigate the loss of beneficial effect of basic slag on N. Wales soils after 6-8 years. In their experiments the writers prove that the loss cannot be due either to the phosphorus removed by grazing animals, nor to a mere reversion of soluble phosphates to insoluble forms. The experiments have extended over 10 years in six different localities in N. Wales under very humid conditions.

The writers conclude :—(1) Under very humid conditions phosphoric acid applied to permanent grassland is fugitive in its effects; (2) from profile analyses it is shown that the surface layers revert to their original phosphorus status after 6-10 years; (3) The phosphorus of soils may be differentiated into that of the naturally occurring stable phosphate and the phosphorus of added dressings which is, under N. Welsh conditions, unstable and removable by percolating waters.

SOILS.

Soil Classification and Soil Surveys. *W. G. Ogg, Edinburgh and East of Scotland College of Agriculture. The Scottish Geographical Magazine, XLIII,* 4, 193 (1927).—A general account is given of the development of soil classification and soil survey work, and a more detailed description of the work which has been carried out in Hungary. For practical purposes this survey is useful in the selection of suitable crops and trees, in the selection of suitable artificial manures, and in questions of liming, drainage and tillage.

The paper also gives a list of the soil types which it was agreed to recognise in preparing a general soil map of Europe.

The Effect of Hydrogen Ion Concentration on the Growth of certain Plants. *W. L. Powers, Oregon Agric. Expt. Station. Soil Science XXIV,* 1, 1 (1927).—The experiments were designed to study the influence of reaction on certain plants and in particular to see whether legumes grow best in a slightly alkaline medium. The methods used included growing plants in culture solutions and in pots of soil of known reaction.

The results obtained in these experiments would appear to indicate that all the plants tested—including Alfalfa, Hungarian Vetch and Alsike Clover—grow best under slightly acid conditions.

The possible Role of Iron depositing Bacteria in the Formation of Hard Pan. *C. S. Mudge (University of California). Soil Science XXIII,* 6, 467 (1927).—The study of iron depositing bacteria suggested to the author that these bacteria might play a part in the formation of iron pan.

In this paper he describes how he was successful in propagating some iron-depositing bacteria from a small amount of material ground off a piece of hard pan.

He also points out that some pieces of pan examined under the microscope were found to show a coarse open structure with numerous cavities which sometimes contained a cobweb-like formation. When these filaments were examined under high magnification they appeared to be somewhat similar to certain of the higher bacteria.

The author suggests that, as we have here evidence of past microbial life and also of present microbial life capable of depositing iron from solution, there is offered a plausible explanation for at least one factor in the formation of hard pan.

ANIMAL BREEDING.

Cattle.

Grading up Beef Cattle at Sni-a-Bar Farms. *U.S. Dept. Agr. Misc. Circular No.* 74. (1926).— Mr. W. R. Nelson at the age of 71 in the year 1912 initiated on his farms in Missouri, near Kansas City, a demonstrational experiment in the improvement of livestock which is probably unique in the annals of animal breeding. The object of the work was to prove the value of the pure-bred sire and to educate the stock-breeder in the United States. Mr. Nelson started with 200 " common red cows " of approximately Shorthorn type. These he mated generation by generation to pedigree Shorthorn bulls, some of them of high standing in the showyard prize-lists. Continued selection has been practised and very complete records have been kept. The system of breeding employed was mating to perpetuate good qualities and to overcome defects, a practice commonly adopted by all good stockbreeders. Indeed in all respects it has been the aim of those in charge of the experiment to keep conditions as close as possible to those of an ordinary stock farm.

As this work has been conducted over a long period of years and has included some severe price fluctuations, in order to get the comparisons of the different crosses on to an equal basis all prices have had to be levelled to an index figure. The index numbers used showed how each lot of steers compared with the average marketing for that day and all other days. Over a ten-year period the steers of the original cows averaged in this way 8·80 dollars a cwt. as compared to the first cross, whose average was 10·80, and the second cross with 11·80. Further statistics are shown proving this.

Briefly, then, the following results may be summarised. The use of pure-bred sires of good quality results in an improvement of the calf crop as shown by conformation and market price. The greatest step occurs in the first cross. Subsequent crosses increase the value still more but to a lesser degree. Quality is roughly in proportion to the number of crosses of pure breeding. After the fourth cross the steers compare favourably with pure-bred stock and further improvement requires the use of an exceptionally good sire. Early maturity is a conspicuous result of beef cattle improvement through the use of pure-bred sires. "The demonstration shows clearly that breeding is a dominant factor in the production of high quality beeves and that good feeding and management will not return best results unless the element of good breeding is present also."

Altogether this is quite a remarkable piece of work. When the reviewer visited the farm three years ago, he was struck by the market results described above. Stock-raisers from all over the United States now visit Sni-a-Bar and are impressed with the lesson they get on the value of pure-bred livestock. While in this country the average quality of the livestock is higher, and we have fewer "scrubs" than in America, there is perhaps less need for such a lesson, but nevertheless the average farmer must not close his eyes to the fact that he must use bure-bred sires if he wants to produce top quality meat. And this is particularly so if he is trying to raise "baby beef."

A Comparison between the Number of Cattle before and after the War. *International Review of Agriculture.*—Although incomplete, the figures give a general idea of the situation.

In Europe where the number of head decreased during the war they increased considerably afterwards and at present have almost reached the 1913 level. In North America the opposite has been the case, as the high number of cattle there after the war were not maintained. In Asia, where the number of cattle in India preponderated, the number after the war increased, with a still further increase lately. Africa, during the period under review, has shown a constant increase. For the entire world, one can say on the basis of the data available, that the decrease in Europe during the war was more than compensated for by the increase on other continents. The period following the war shows a very slight world increase.

Pigs.

Inheritance of Resistance to Swine Fever. *E. Roberts*, 1927, *Proc. Am. Soc. An. Prod.*, 1925-1926.—The Department of Animal Husbandry at the University of Illinois has bred from pigs which were obtained from a serum plant and had been found to be resistant to hog cholera. There is no doubt that resistance is hereditary. Owing to the expense of the investigation only comparatively few matings have been made, and it is not yet possible to describe the exact mode of the inheritance of this resistance. The economic importance of this work requires no comment. Some facts are also given concerning the natural resistance to bacillary white diarrhœa in chicks.

The Spread of Tuberculosis among Pigs by young Chickens. *Poultry Farmer, Indianapolis, Oct.* 1927.—It is the general belief that chickens under one year of age seldom develop tuberculosis to the extent of becoming spreaders of the disease. Hence, it is thought that culling all birds above that age from the flock would soon eliminate the disease.

To determine the accuracy of this surmise, Dr. F. S. Rich, of the U.S. Department of Agriculture, in charge of tuberculosis-eradication work in the State of Michigan, conducted a general culling campaign covering all poultry flocks in one township in the State. Every chicken on 151 farms was individually examined, making a total of 15,377. From this number 1,494 were removed as culls and 86 were found upon post-mortem examination to be infected with tuberculosis. The disease was shown to exist in about 38 per cent. of the flocks examined. Three generalised cases were birds under one year of age. This was conclusive proof to Dr. Rich that young chickens, as well as old, are a source of danger in spreading tuberculosis to pigs and should be removed along with the rest of the flock when infection is discovered.

Poultry.

Causes of Death in Poultry Flocks. *Sivert Eriksen. Journal of the American Veterinary Medical Association, Detroit*, 1926. *Vol. LXIX, new series, vol.* 22, *No.* 5.—The information on which this paper is based is gathered from: (1) Three years of observation at the National Egg-laying Contest at the Missouri State Poultry Experiment Station. The subjects, coming from various parts of the United States and England, were divided into sixty pens of six hens each which, together with birds sent in to replace those dead, make a total of approximately 400 birds handled each year: (2) Two years' observation of the "State Pullet Test," where the birds, received from Missouri breeders only, are housed in flocks of 40 to 250 hens to each house. As soon as illness developed, each bird was removed from the pen and isolated in the hospital for individual care and attention. A careful autopsy was made of all dead birds and, when necessary, bacteriological examinations were made before a final diagnosis of the cause of death was recorded.

In the tables the writer gives the different causes of death and the organs affected, giving in each case the percentage of mortality, the mortality in different pens, and in light and heavy breeds separately.

His observations lead him to the following conclusions:—

(1) Losses in poultry flocks in which the birds come from a large number of sources have a yearly mortality of from 9·9 to 18·4 per cent. during their first productive year. The seven year average for 2,775 birds is 13·3 per cent.

(2) Deaths are listed under 68 separate causes.

(3) The incidence of mortality varies greatly with different pens kept under identical conditions. This tends to confirm the theory that longevity is hereditary.

(4) Heavy breeds had 0·5 per cent. higher mortality from a seven-year average than did the light breeds.

(5) Large flocks are liable to have a higher mortality than small flocks, not only because the spread of infection is greater, but also because it is more difficult in these flocks to find and treat the sick birds early.

Comparative Influence of Various Protein Feeds on Laying Hens. *Texas Agricultural Experiment Station. College Station. Brazos County Texas Bulletin No.* 317. *April* 1926.—Cottonseed meal may be used when fresh as a substitute for meat scrap and tankage in a ration for laying hens. It gave the best results in a ration composed of wheat bran 125 lbs., grey wheat shorts 75 lbs., maize meal 75 lbs., and cottonseed meal 120 lbs. When only limited quantities of fat-soluble A vitamin are present in the ration, the mortality of the hens is high and the egg production low.

The Importance of Marrow Examination for Determination of Tuberculosis in Table Poultry. *Dr. F. Schmidt-Hoensdorf. Zeitschrift für Fleisch- und Milchhygiene, June* 1926. *No.* 15, *p.* 285.—There is no doubt that man can be directly infected by poultry tubercle bacilli. Loewenstein considers the phenomenon of much more frequent occurrence than one is generally led to suppose by the fact that a clinical pathological picture of the disease differs so tremendously from that of a healthy bird. In soft boiled eggs living, virulent tubercle bacilli can be found.

Poultry tuberculosis is spreading continually. All hens which have got miserably thin owing to tuberculosis ought to be considered as useless for human consumption. In the book of instructions for inspection of meat, advice on recognition of poultry diseases is all too scanty. Tuberculous hens often go lame, although joint changes of a tuberculous nature, such as are adduced in the handbook as the immediate cause of lameness, were only found in one case by Schmidt-Hoensdorf. The lameness must be due then to other causes, and in all such cases tuberculous symptoms are discoverable in the marrow.

Mammoth Incubators in the Philippines. *F. M. Fronda. Poultry Science.* 1925-1926. *Vol. V, No.* 2.—In the town of Pateros are very interesting mammoth hatcheries for the duck industry. There are no less than twenty of these mammoth incubators with capacities ranging from about ten thousand to over sixty thousand duck eggs in each setting.

The writer gives an interesting description of the systems of incubating. From the entire number of eggs placed in the incubators, as many as 60 per cent. reach the hatching table. *Balut* is one of the trade products obtained from duck eggs and is very popular in Manila. The American, whenever *balut* is mentioned, gets an impression of a rotten egg and of a foul odour. On the contrary, *balut* is an extremely fresh young developing duck, varying from 14 to 20 days in the incubator and surrounded by the natural juices and components upon which it is living. The Chinese also are reputed to be very fond of such eggs, especially those containing well developed chicks.

The infertile eggs are hard boiled and sold side by side with *balut* under the local trade name *penoy*.

The legal Age of "New-laid Eggs." *Zeitschrift für Milchygiene. Stuttgart,* 15 *April* 1926, *S.* 226.—In Freiburg and Karlsruhe a police order has been issued according to which only those eggs may be termed "new-laid eggs" which are perfectly clean, home-produced, not more than 8 days old and of excellent condition and freshness. Against this order, which satisfies the well-grounded hopes of the buyer, the Association of German egg-importers protests, stating that it is impossible in their trade to determine the age of the eggs, and that this could only be made possible by indicating the date of laying on the egg, a practice rarely encountered. Moreover, the quality of eggs does not depend only on their age. In consequence this Association proposes the following order—" only very fresh, specially good, well-flavoured, sound eggs may be termed ' New-laid.' "

Co-operative Egg Circles in South Africa.. *Farming in South Africa, Vol. I, No. 9, Pretoria, December* 1926.—*Farmers' Gazette, Vol. V, No.* 113, *Pretoria,* 21 *January* 1927.—Co-operative export of eggs has increased from 2·9 per cent. of the total exports in 1922 to 20·87 per cent. in 1925. The Port Elizabeth and District Co-operative Poultry Products handled 42,000 dozen, and paid members an average price of 1*s.* 4*d.* per dozen. The Natal Co-operative Egg Circle exported 4,286 boxes; the advance made to members amounted to 1*s.* 7½*d.* per dozen. The Cape Egg Circle handled 1,233,000 eggs more than in the previous year, the total value of eggs handled being £20,661, and 1*s.* 7·38*d.* per dozen being paid to members. The Department of Agriculture urges the farmers to become members of these egg circles for the following reasons :—(1) the prices paid to the farmer for eggs are usually fixed by an outside combination; (2) agents frequently make up consignments with good, bad and indifferent lots, thus tending to give a bad name to the South African article; (3) through egg circles, producers of first-class eggs get full value for their outlay, labour and effort, as only first-class eggs from members are being handled by the circles; (4) egg circles pay cash and do not barter the produce, while farmers receive their cheques monthly; (5) the egg circle depot provides the natural link between country producer and town consumer.

Sheep

The Influence of the Age of Parents on their Progeny. *R. Prawochénski and B. Kaczkowski. Pamietnik Paústwowego Instytutu Naukowego Gospodarstwa wiejskiego w Putawach, Cracow,* 1926, *T.* 7, *Czesé A.*—The flock of pure-bred Southdowns belonging to the farm of the Government Institute for Agricultural Research at Pulawy was used in an experiment on the influence of the age of ewes on the rate of growth of their lambs. All the ewes were served by the same ram and the lambs were divided into two groups, (1) those from the young ewes; (2) those from the old ewes.

The experiment was also made on certain lots of lambs belonging to the native Polish race or cross-breds, for the purpose of comparison.

The experiment showed that the weight of the new-born lambs of young ewes is greatly inferior to that of the new-born lambs of old ewes. The increase in weight of the lambs up to the time of weaning is rather greater in the progeny of the old ewes, but the difference observed disappears very quickly.

As soon as the lambs become independent and start grazing, those from young ewes grow more quickly and very shortly overtake with ease the lambs from the older ewes.

It is probable that, up to weaning, lambs from older ewes are in a better position than the others owing to the fact that the milk glands of their mothers are better developed.

Rabbits.

Rabbit-breeding Experiment Station at Ontario, Cal.—The object of this new Station, which stands in 5 acres of ground, is the economic study of rabbit products, both flesh and fur, methods of breeding and feeding, infectious diseases, and diseases caused by vermin, the utilisation of carcases, &c. for fertilisation purposes. According to the *Experiment Station Record* (Vol. 55, No. 9, *December Abstract Number*) there was every probability that this Station, which is under the charge of the National Rabbit Federation, would be in working order by the beginning of last March.

ANIMAL NUTRITION.

The Nutritive Value of Dried Spent Hops. *By W. L. Davies and R. S. Sullivan, J. Agri. Sci., Vol. XVII, July* 1927.—Spent Hops is a residue from the brewing industry and is used in the moist state as an organic manure of low value. In a dry state it possesses a high absorptive capacity for water and can be used as a " filler " to soak up such by-products as molasses and treacle. It possesses a high crude protein value, its ether extract is high for a fibrous food and the amount of crude fibre is about the same as in good meadow hay. There is a high percentage of mineral matter present. The digestibility of the material has been determined by feeding with hay chaff and linseed cake meal to three sheep. The spent hops were not readily eaten and could only be included in a ration in an amount equal to one-seventh of the dry weight of the total ration. Its digestibility is low, a fifth of the crude protein and the nitrogen-free extractives, one-half of the ether extract, one-twentieth of the crude fibre and one-fifth of the total organic matter only being digested. The production starch equivalent was 24·5. Spent hops included in the ration had the property of depressing the digestibility of the mineral constituents of the basal ration.

Bulk in Animal Feeding. *By F. Proctor and N. C. Wright, J. Agri. Sci., Vol. XVII, July* 1927.—The practice of stating capacity of an animal for food in terms of dry matter appears to the authors to be misleading, since there is no evidence that with different foods the same weights of dry matter will occupy identical bulks in the stomach, even when attention is confined to concentrates alone. The object of the present investigation, therefore, was to measure the bulk occupied by equal weights of different foods *in the stomach* and the method employed was to determine the increase in volume of foods when soaked in water at body temperature. The results of this work showed that as a consequence of soaking there were variations in swelling ranging from approximately 10 per cent. to 260 per cent., being lowest in fish and meat meals and highest in some vegetable cakes like linseed and coconut. It was therefore decided to carry out some feeding trials with pigs and calves to see whether the volume occupied by the food on entering the stomach would be a limiting factor in consumption. Pigs were fed on rations fairly equally balanced as regards starch equivalent and digestible proteins, but the volumes to which equal weights of the mixtures swelled on soaking were widely dissimilar. The "change over" system of feeding was adopted. It was found that in the case of pigs of 40 to 80 lbs. live weight, the bulk occupied by the foods did affect the quantity of food taken. With calves the swelling capacity of the concentrated food did not yield any definite results so far as food consumption was concerned.

Fish Meal in the Fattening of Pigs. *P. Dechambre. Revue de Zootechnie, Paris,* 1926. *Year* 5, *No.* 12.—Experiments made at the School of Grignon with two groups of two pigs each of the same weight, age and breed, with the object of determining the effect of various methods of preparation of foods on their digestibility in pig feeding.

Experiments were made with the different methods of preparation :—(1) cereal whole grains, barley meal and wheat offals (of consistency varying with milling); (2) moistening, or softening of the food; (3) reduction to paste or boiling.

The co-efficients of digestibility for the different degrees of grinding are shown by a table which shows that the digestibility of the organic matter increases with the degree of fineness. In very coarse kibbled maize the increase of digestibility is small, viz., scarcely 0·77 per cent., as compared with the whole grains (the percentages being respectively 90·42 and 89·65), while in medium kibbled it is 4·1 per cent., and in fine kibbled (1 mm.) it is 5·25 per cent. This increase is primarily attributable to the easier assimilation of the crude fibre. While only 52·39 per cent. of this is digested in the case of the whole grains of maize, 55·6, 75·86, 78·05 per cent. are digested respectively in the case of coarse, medium and fine kibblings.

This is also the case with barley, which shows digestibility respectively for the whole grains, for coarse kibbled (2 mm.) and fine kibbled (0·5 mm.) as follows :— digestibility of the crude protein, 60·32, 79·08, 84·40 per cent.; of fats, 36·68, 54·77, 75·53 per cent.; of the crude fibre, 11·7, 19·05, 30·2 per cent.; of the N-free extract, 75·14, 86·43, 89·62 per cent.; for organic matter, 67·05, 79·28, 84·60 per cent.

Similar results were obtained with barley meal and wheat bran. The effect of grinding on the increase in digestibility of the organic matter varied; an increase of 5·08 per cent. (77·07 per cent. as compared with 71·99 per cent.) in the case of the fine barley meal as compared with the medium; and only 2·37 per cent. increase (68·51 per cent. against 66·14 per cent.) for the fine wheat offals as compared with the ordinary quality.

The increases in digestibility of the crude fibre and of the N-free extract run parallel.

Soaking the kibbled grain or the whole grains increased digestibility; this result, however, is contrary to other results obtained in the same Institute, and the question is not yet definitely settled.

Steeping, reduction to paste and boiling all clearly had an unfavourable effect.

Maize steeped as whole grain lost, as compared with the dry grains, 3·86 per cent. of the digestibility of the organic matter; kibbled barley made into a paste showed a digestibility of 78·81 per cent. of the organic matter as against 79·28 per cent. when merely soaked; in barley grains in the natural state, or boiled for an hour, the digestibility of the organic matter was respectively 67·05 and 69·41 per cent.

Herring-Meal and Cod-liver Oil for the Prevention of Rickets in Pigs. *O. L. Bacroë. Zeitschrift für Tierzuchtung und Zuchtungsbiologie, Berlin,* **1926**, *Vol. VI, No.* 2.—Experiments in feeding for ascertaining the value of herring-meal and cod-liver oil in preventing rickets in pigs. The writer took twenty porklets, aged from two to three months, belonging to five different litters, and divided them into four groups, so arranged that all the litters were represented in each group. The basis of the food was mangolds, crushed maize, and soya meal. Skimmed milk was given to all the animals at the beginning of the experiment.

The following additions were made to the staple rations :—

Group I—Herring-meal 70-150 gm. per head per day.

Group II—Herring-meal ash obtained by the daily burning of the same amount of herring-meal as given in Group I; with casein equal to the amount of protein in the rations of Group I, and cod-liver oil equal to the amount of fat content in the herring-meal given in Group I.

Group III—Herring-meal ash and casein as for Group II, but instead of the cod-liver oil, an equal weight of solidified oil of earth-nuts.

Group IV—The same amount as for Group III, also 10 gm. per head per day of phosphate of lime.

The food was weighed daily, and the pigs weekly.

The results of this experiment show that for porklets developing in the winter a diet composed of mangold, crushed maize, and soya meal, with the addition of mineral substances in the form of herring-meal ash and phosphate of lime, is not sufficient; development was irregular and growth arrested.

An addition of herring-meal up to 150 gm., or of cod-liver oil in the proportion of 15 gm. per head per day, improves the general condition and, when this is given, development is satisfactory and growth normal.

It is possible that an increase in the amount of herring-meal up to 200 gm. might be advantageous.

DAIRYING.

The Variations in Milk Yield caused by the Season of the Year, Service, Age, and Dry Period, and their Elimination.—*Part I, Season of the Year. By H. G. Sanders,* 1927. *Journal Agric. Sci. XVII.*—This is an exhaustive work and highly technical in parts, involving an appreciation of mathematics. Nevertheless, the writer has kept before him many practical points. He states that the lactation record is the result of two sets of factors —genetic and environmental—and for purposes of selection and breeding he says that it is important to be able to make accurate allowance for the one so as to be able to arrive at the other. The chief measurable environmental factors are :—

1. Season of the year; i.e. time the cow calves.
2. Service; the interval between calving and fertile service.
3. Age of the cow; in this study it is measured by lactation.
4. Dry period.

"Throughout the country there appears to be a relation between the proportion of arable land and the average milk yield. In England, Milk Recording Societies were operating in 27 counties for the five years 1918-19 to 1922-23, and the average yearly yield per cow for these was published by the Ministry of Agriculture. Hammond and Sanders arranged these 27 counties in order of their five years' average milk yield, and found that from the top to the bottom of the list there was a definite trend from the arable areas to those in which the proportion of grass was highest; in this list Norfolk came 3rd with an average of 6,993 lbs. and Penrith 26th with one of 5,723 lbs." The average number of lactations through which a cow lives in Norfolk is only 3·27.

The length of the dry period for the different breeds studied in Norfolk is—

Ordinary cross cows	51 days	(1,167 observations)
Red Polls	48 „	(441 „)
Lincoln Reds	68 „	(334 „)
Friesians	55 „	(255 „)

Thus Red Polls tend to milk closer up to the next calving time than do Lincoln Red Shorthorns. The average length of dry period all over is 54 days, and varies from 47 days if the cow calves in September to 63 if it calves in December, falling to 56 in January, down to 49 in May, and rising in June to 58 and falling back to 49 and 48 in July and August. The short months of July to October are attributed to the spring "flush" of milk.

The length of time between calving and service is longest in the case of cows calving between July and January, the average for the year being 83 days. This is attributed to the heat periods being longer in summer than in winter when it may be only seven hours, and consequently the greater are the chances of the cow being missed.

"In these data there is also a relation between the age of the cow and the month of calving, for whereas the percentage of first calf heifers included in the records varied from 15 to 21 for the months of calving January to July, from August to December it lay between 23 and 37, with very high figures for September and October. It is, then, obvious that in many of these herds the practice is for heifers to calve in autumn, and allowance must be made for this in determining the effect of the month of calving on the lactation yield.

The time between calving and the next fertile service falls definitely from the first to second lactation and rises again after the sixth lactation; during the first lactation service is often deliberately postponed to avoid stunting growth (note also the large proportion calving in September and October) and the rise in the case of old cows might be taken as indicating that senility, even in its early stages, has an adverse influence on the reproductive function."

There is a tendency for milking heifers to be served later than the average for older cows and for them also to have a shorter dry period before beginning their second lactation.

The length of the average lactation period was found to be 43 weeks. For the ordinary cross bred cows it was 43; Red Polls, 44; Lincoln Reds, 41; Friesians, 44. When the length of time between calving and successful service is taken into account, Red Polls have a comparatively long lactation, Lincoln Reds a short one, while Friesians and cross breds approximate the average of all cows.

"A cow served three weeks after calving will, on the average, keep on milking for the first 33 weeks after pregnancy, but one not served till 60 weeks after calving will usually be dry 20 weeks later—in other words, though the length of the lactation is very highly dependent on the time of service, it shows a marked 'regression' to the normal period of 42 weeks."

As regards the effect of the month of calving upon the total lactation yield, the average for Norfolk cows of all months is 6,885 lbs. The variations though small are definite. May to September calvers are below the averages for other months. In Norfolk the figures show that the best time for a cow to calve for a high yield is from October to February. It is worth noting that these results do not altogether coincide with those obtained by the writer for cows in the Penrith area, where February calvers produce the lowest lactation as compared to June calvers in Norfolk. Again August calvers are the best yielders in Penrith, while it is October calvers in Norfolk. In this matter it appears as though Norfolk was some three months behind Penrith. The writer explains this by a comparison of the average lactation curves of the two districts.

As the grass gets older the drop in lactation is very great, and the writer suggests three methods of remedying this; a more thorough grazing of pastures during the summer, feeding of catch crops in June and July, and the feeding of cake.

"One other point is rather striking and might be emphasised—namely, that this seasonal variation is due almost entirely to the variation in the rate of fall of yield from month to month. The low yield of early summer calvers is due to the rapid drop during the summer, and if this drop could be arrested, there seems no reason why these cows should not give yields as high as autumn calvers; in fact it seems justifiable to conclude that the existence of this seasonal variation is evidence of bad management somewhere—and we have already remarked on the time of the year when this bad management is at its height—during summer. Yields are maintained best of all during the spring flush of grass and therefore the conditions seem to be optimum at that time; with more knowledge of foods and feeding it may be possible to get even better conditions than obtain then, but at present it would appear that the aim should be to imitate those conditions as far as possible throughout the year. It is interesting to note that Wylie, working with 2,900 records of Register of Merit Jerseys, found very much less seasonal variation than that found in these data; i.e. where feeding and management are on a very high plane the seasonal variation is almost obliterated."

In a comparison between Penrith and Norfolk, the writer states that the conditions of Norfolk (i.e. environment) appear to be worth 22 per cent. more milk than those in the Penrith neighbourhood.

As regards the effects on the lactation of the different breeds the writer produces some interesting data. Red Polls yield relatively well during the summer and poorly in the winter. Friesians and Lincoln Reds show a slight tendency in the opposite direction.

The writer found that high yielding cows had an average lactation period of 46 weeks, were dry for 37 days and had a period of 82 days between calving and service. Low yielders, on the other hand, had an average lactation of 39 weeks, were dry for 64 days and had 78 days between calving and service, a difference of 6 weeks, 27 days and 4 days respectively.

"The conclusion to be drawn, though, is that the effect of the month of calving is *proportionately* the same with all cows, good, bad, or indifferent; that, for instance, the high means obtained in Section A for cows calving in autumn were not due to increased yields with one grade only, but to factors that acted to the same extent over all of them (in actual pounds, though, it will be realised that the gain in autumn calving is greater with high yielding cows).

But these results do indicate that grass during June and July may not be good enough even for the low yielder; that with her small capacity it is too fibrous a food to maintain even her output, and that, if a fall is to be avoided, all cows should be given a cake feed (possibly a reduced one) according to yield, before being allowed to fill themselves in the field. Perhaps an even better practice would be to supplement the pasture by a succession of catch crops fed in the young state—if any benefit is inherent in 'succulence,' this would provide it."

The excess of yield of the high yielders over the low yielders which amounts to 66·2 per cent. is apportioned as follows :—

"To greater physiological capacity—	31·5 %=	47·6 %	of the difference.
To better maintenance of yield—	20·0 %=	30·2 %	,, ,,
To longer lactation—	14 7 %=	22 2 %	,, ,,
	66·2 %=	100·0 %.	

"If cows are selected from a district for high and low total yields, we have seen that one half of the difference is due to what we have called physiological capacity and one half to persistence of yield; the question then naturally arises —how much of this latter is due to the cow herself and how much to her environment? In the Penrith records it was found that persistence was a very definite individual characteristic, besides being subject to environment; a further analysis of this is eminently desirable, to show, if not how much is possible in the way of improving yields by management, at least how much difference is caused by management in practice; it is hoped to provide figures bearing on this at a later date."

Some of these results are obvious to the practical dairy farmer; others may surprise him somewhat. The writer is certainly to be congratulated upon the manner in which he presents his data.

The Influence of the Age of the Cow on the Yield and Quality of the Milk. *By Margaret K. White and T. J. Drakeley*, 1927, *Journal Agric. Sci. XVII*, 420-427.—Using the same data as in their previous paper abstracted above, the authors set out to discover the effect of the age of the cow on yield and quality of the milk. The conclusions of Mackintosh and Tocher are suspected on the ground that they used too large a proportion of Ayrshire cows, whereas in this paper nine different breeds have been studied.

It was found that age did not affect the morning yields or composition of milk as compared to the evening. The yield of milk of all breeds of cows at first increases rapidly with age, reaches a maximum and then gradually falls off. The age at which this maximum is reached differs slightly for different breeds, as also does the length of time during which the greatest yield is given.

The relative effect of age on the yields of milk of Ayrshire cows agrees with that given by Tocher, although, as would be anticipated, the actual values of the yields differ.

The Shorthorn breeds attain their maximum yield rather later than the Jersey and Guernsey cows, and their yields show a greater variation with age. Thus, two year old Shorthorn cows give only 60 per cent. of the yield given by the mature cow, whereas two year old Jersey and Guernsey cows give 80 per cent.

An interesting conclusion at which the authors arrive is that records for Jersey cows indicate that they apparently maintain their yield of milk with advance in lactation to a greater extent than other breeds.

The percentage of fat in the milk of all breeds of cows at first increases slightly with age and then decreases, and for all breeds the quality of the milk of very young cows is richer than that of cows over six or seven years of age. The age at which the milk contains the maximum percentage of fat differs very slightly for various breeds; thus Shorthorn cows give the highest percentage of fat in the milk when they are four and five years of age, whereas Guernsey, Kerry and Dexter cows attain their maximum at three years.

The actual weight of fat given by cows of each breed rises to a maximum between the 5th and 8th year and then decreases. The percentage of fat in the total solids of the milk shows but small variation, but in general it gradually rises to a maximum between the 5th and 8th year and then diminishes.

The percentage of solids-not-fat decreased continuously with age, although in some cases the decrease is almost imperceptible until after the 3rd year, whilst the actual weight of solids-not-fat increases until about the 8th year.

The Influence of the Stage of Lactation and the Breed of the Cow on the Yield and Quality of the Milk. *T. J. Drakeley, Ph.D., M.Sc., F.I.C., and Margaret K. White, M.Sc., Journal of Agricultural Science, Cambridge,* 1927. *Vol. XVII, part* 1.—This is an account of the weighed results of analyses of the milks of the cows exhibited at the past 48 Annual Dairy Shows held by the British Dairy Farmers' Association between 1876-1925.

Five of the factors influencing the yield and quality of milk are thereby more of less eliminated, namely individuality of cow, efficiency of milker, temperature and weather conditions, health and feeding, and the writers proceed to study the remaining four, viz. :—(1) stage of lactation, (2) breed of cow, (3) interval between milkings, (4) age of cow.

It must, however, be noted that the 3,282 cows concerned are above the average, and that the period of lactation studied is only the first 210 days.

The averages obtained for the yields of milk, fat percentages, and solids-not-fat are given in Table I.

Extract of Table I :—

All Breeds.

Days since Calving.	Morning's Milk.			Evening's Milk.			Day's Milk.		
	Yield.	Fat.	Solids not fat.	Yield.	Fat.	Solids not fat.	Yield.	Fat.	Solids not fat.
	Lbs.	%	%	Lbs.	%	%	Lbs.	%	%
15	23·7	3·98	9·34	20·8	4·60	9·21	44·5	4·26	9·29
30	23·9	3·68	9·18	21·8	4·35	9·03	45·7	3·93	9·11
50	21·3	3·69	9·10	19·0	4·34	9·05	40·3	3·99	9·08
100	19·7	3·93	9·17	17·3	4·52	9·06	37·0	4·20	9·12
150	17·2	4·43	9·20	14·8	4·84	9·13	32·0	4·64	9·16
210	15·7	5·08	9·29	14·1	5·50	9·19	29·8	5·27	9·24

Fat percentage.—The minimum fat content is reached about the 30th day, after which there is a steady increase.

Solids-not-fat percentage.—The figures here though with smaller variations show much the same curve.

Yield.—The average yield increases till after the 30th day when it starts and continues to decrease.

Interval between milkings.—Generally speaking the shorter the intervals, the smaller the yield for that milking, and also the solids-not-fat percentage, but the greater the fat percentage.

The influence of the *actual date of calving* and of whether the *cow is in calf* or not is not examined in this study.

Actual yield of butter fat and solids-not-fat.—The actual weights of fat given by the heavier milking breeds at first decrease rapidly, then remain constant till the later stages of the lactation period when there is a tendency to rise slightly.

Influence of breed on quantity and quality of milk.—Comprehensive comparative tables show the considerable differences existing between the breeds. Of 10 breeds discussed, the order from the point of view of yield is British Friesian, Dairy Shorthorn, South Devon, these three being nearly bottom of the list in fat percentage, where Jersey, Guernsey and Kerry cows with a comparatively low yield are first, second and third respectively.

Immediate Influence of Feeds upon the Quantity and Quality of Cow's Milk: Effect of Ground Flax. *W. E. Petersen, Journal of Dairy Science, Baltimore,* 1927. *Vol. X, No.* 1.—An investigation undertaken at the University of Minnesota to determine the immediate influence and the extent to which the quantity and quality of cow's milk might be affected by certain feeds. The writer deals with the influence of ground flax, first referring to the results of former investigations, which have established that no feed exerts a permanent specific influence on the quantity and quality of the milk produced; he then deals with the possibility of ground-flax exerting a specific influence upon milk or milk-fat production of cows immediately after ingestion; the uniformity of response from time to time; individual variations, their probable causes and the factors that might be correlated with them; and the significance of results as applied to semi-official testing.

All cows on official test at University Farm during the year were included in the experiment. The flax feed period consisted of the forty-eight-hour period immediately following the regular official inspection period. The tests of the milk and milk-fat production during the flax-feed period were conducted in the same manner and by the same supervisor as for the official test period.

From the results of the investigation it may be concluded that:—

(1) The response of animals to the feeding of ground-flax depends upon unknown individual factors. Different animals respond in different ways and to different degrees, and such differences are not correlated with season of the year, breed, amount of yearly milk production or normal fat percentage of the milk.

(2) When ground-flax is fed at the rate of three pounds daily the majority of cows will show an increase of fat percentage. Such increases ranged from no effect to 7·1 per cent. and averaged 2·9 per cent.

(3) The slight decrease in fat percentage in two cases out of sixteen cows will not warrant the conclusion that ground-flax may cause a decrease in fat percentage but, rather, that in some cases it has no appreciable effect.

(4) The feeding of ground-flax will in the majority of cases cause an increase in the amount of milk, averaging 1·1 per cent. but going up to 8·9 per cent., but ground flax may also have a depressing influence upon the milk production with a few cows.

(5) On the average the combined influence of flax upon the amount of milk and fat percentage increased the total fat production 4·5 per cent. This influence varied from a decrease of 3·0 per cent to an increase of over 12·0 per cent.

(6) With cows showing appreciable responses, on the average the response was uniform from month to month, making it possible to secure more than actual credit for cows on official test.

(7) The response, whether an increase or decrease, was immediate with most cows, appearing in most cases within eight hours after the first feeding. This makes detection of such feeding practices impossible from inspection of official test records.

The Tethering of Dairy Cows on Vetch and Oats. *W. P. Ustjanzeff, I. I. Grigorenko and N. S. Perekrest. Milchw. Forsch. Vol.* 3, *No.* 1.—Two lots of four cows were stall fed during the first and third periods of a trial, while in the second period one lot was tethered on vetch and the other lot were stall fed on green vetch and oats.

Both lots showed an increase in production when getting the green feed, the tethered group increasing 25 per cent. in milk production and the stall-fed lot 12 per cent.

The Influence of Gluten Feed on the Milk Production of Cows. *H. Bunger and H. Lamprecht. Milchw. Forsch. Vol.* 3, *No* 1, 1926.—Maize gluten feed was found to be slightly better for milk production than an equal weight of a mixture consisting of equal parts of coconut cake, bean meal and vetch.

The Value of grinding Hay for Dairy Cattle. *South Carolina Station Report.* 1926.—Grinding lucerne hay had no influence on the palatability of the ration or on the amount of milk or butter fat produced, but it increased the cost of production considerably.

Chopping Hay for Dairy Cows. *E. B. Hart et al. Wis. Sta. Bul.* 388. 1926.—No advantage was obtained by chopping lucerne hay for cows. There was no increase in production on chopping soybean hay, but less feed was wasted.

The Marketing of Co-operative Creamery Butter in California. *Hoard's Dairyman, Vol.* 72, *No.* 1. *Fort Atkinson (Wisconsin),* 10 *January* 1927.—The Challenge Cream and Butter Association, which acts as a sales agency for 17 co-operative creameries in California and other States, including the Milk Producers' Association of Modesto, said to own the largest co-operative creamery plant in the world, and the Danish Co-operative Association of Fresno, markets more than 25,000,000 lbs. of butter annually. It deals direct with hotels, restaurants and retail stores, thus avoiding the intermediate handling by the jobber. After achieving great success in Southern California, the Association opened a sales agency in San Francisco in September 1925. At the time there existed a misleading daily paper quotation which gave the public the impression that the retailer was paying 3½ cents per pound less for butter to the jobbers than was actually the case. The jobbers were making about 8 cents a pound on their handling of butter and the retailer was selling on a margin of about 5 cents a pound. Within a month after opening a sales agency in San Francisco, the Association began selling butter at the price actually quoted for extra grade butter, which meant a reduction in price to the retailer of 3½ cents per pound. This policy of co-operation with the retail trade was quickly successful and the sales of butter rapidly increased.

The Association lays stress on quality and uniformity. It supervises the operations of the creameries which market their butter through it. Expert creamery operators employed by the Association go to each creamery and standardise the output. This service of inspection is costly but it saves a great deal of trouble and expense in marketing, it being possible to sell all the butter as a single, uniform product. In addition to butter, the Association markets eggs, cheese and condensed milk.

Vitamine Content in Ordinary and in Dried Milk. *G. C. Supplee, O. D. Down and J. W. Nelson. Le Lait, Lyons*, 1927. *An.* 7, *t. VII, n°* 61.—The writers give the results of their studies on the comparative content in vitamines A, B and C, of the same samples of milk before and after desiccation. Their experiments were made on guinea-pigs and white rats reared on experimental rations tested and standardised in their laboratories. Both the liquid and dry milk used was obtained daily from a dried milk factory where the Just desiccatory cylinder process is employed. No experimental modification was introduced into the conditions of the liquid milk treatment before or during desiccation.

The writers give technical details and diagrams of their experiments which were made separately for each vitamine study. Their conclusions are as follows :—

The results of the experiments on comparative feeding show that there is no measurable deterioration of vitamines A, B, or C, during the desiccation of fresh milk by the Just double cylinder process; the deteriorations or decreases of these vitamines, which are sometimes observed in isolated samples of milk dried by this process, must therefore be attributed to other factors than the actual process of drying.

Antitubercular Vaccination of Dairy Cattle in Uruguay. (*Bulletin of the Pan-American Union, Washington, D. C., March* 1927).—In order to render more effective the regulations requiring the antitubercular vaccination of all dairy cows, further dispositions have been made providing for the registration of all vaccinated cows, with a photograph of each, the date, method, and result of the vaccination, and any other data required to make the information complete.

MISCELLANEOUS.

Acceleration of Plant Growth. "*Nature,*" *Saturday, September* 3, 1927.—At the Boyce-Thompson Institute for Plant Research in New York, experiments are being carried on for the purpose of investigating the conditions necessary to accelerate plant growth. In a *News Bulletin* recently issued by Science Service of Washington, Dr. John M. Arthur gives a review of the work being carried on. The results include spring wheat harvested 35 days after sowing, red clover in flower 38 days after seeding, and a large head of lettuce grown in three weeks. These remarkable results have been obtained by the use of artificial light, heat and atmosphere. The process of photosynthesis in a plant is somewhat inefficient, only about one per cent. of the radiant energy falling on its leaves being utilised. More than a century ago de Saussure showed that green plants could utilise more carbon dioxide than is actually available in the atmosphere, but no application was made of that fact until the war. Then, under pressure of food shortage in Germany, processes were perfected by Riedel and others for scrubbing gases from combustion of coal, coke and charcoal to produce carbon dioxide, which was piped into greenhouses among growing plants. With high temperature and high light intensity, a concentration of less than 0·5 per cent. of carbon dioxide (the normal amount present in the air is 0·03 per cent.) just about doubled the dry weight of plant tissue produced. Similarly, many plants can use more light than they get in Nature. If such plants are kept continually under an arc lamp, or if artificial light is used to supplement daylight, their growth is hastened. Wheat and clover can stand 24 hours of light a day. The tomato, however, grows fastest with 12 hours of daylight supplemented by 6 hours of artificial light. Unfortunately, commercial application of these facts is not yet in sight, and will not be until electrical power can be produced at a much cheaper rate than at present.

The Allotment Movement. *A. Abergsson. Särtryck ur Svenska Stadsförbundets Tidskrift. Stockholm*, 1926.—*Stockholms Stadsfullmäktige Motioner, No.* 45, 1923.—At the end of last century workmen's allotments were still rather scarce in Sweden and the movement did not take root among the inhabitants of the capital before 1904. In 1926, however, allotments had been created in 40 Swedish cities to the number of 31,400, or 16 per thousand inhabitants. For the 37 cities having more than 10,000 inhabitants the corresponding figures were 29,300 and 21·8. In Stockholm there are about 7,000 allotments (18 per 1,000 inhabitants) with a total area of 2·1 million square metres. Assuming that every allotment holder has a family consisting of wife and two children, 28,000 persons in the capital thus receive the benefit of allotments. In Sweden as in other countries the scarcity of food during the last years of the world-war and the introduction of the eight-hour-day have, of course, contributed in a high degree to the development of the movement.

The town councils have willingly leased ground for these gardens and in some cases free of charge during the first years. In many places they have also made loans or grants for establishing the allotments or have defrayed the expenses for fencing, planting wind-screens, erecting tool-houses, making roads, laying down water-pipes, &c. The direct costs, which the cities in this way have had to bear, have, however, frequently been well compensated through rents received; the allotments on the ground belonging to the city of Stockholm, for which the holders pay rent amounting to 4-12 öre per square metre (including fee for water and some other services), show, thus, a surplus in the city budget.

The holder himself, however, has often invested considerable sums in his allotment, which of course is especially the case, where cottages of a more spacious type may be erected according to the building regulations. The costs which the holders have had to bear for cottages, fences, plantations, &c. have been calculated to amount to 6½ million crowns in Stockholm alone, and for the whole country the corresponding figure cannot be estimated at less than 20 million crowns.

It must nevertheless be pointed out that the allotments in Sweden, as a rule, have been established in a more particular and expensive manner than in most other countries. A special feature of the Swedish allotment movement is that the cottages are planned rather spaciously and that they are allowed to be inhabited day and night during the warmer half of the year. In Stockholm they may now be built with an area of 22 square metres including one room, kitchen and a porch. The cottages are usually erected by the holders themselves, but they must as to measurement, architecture and colour be approved by the allotment board of the city, which also supplies the holder with plans. Every allotment colony has also as a rule a playing ground for the children and frequently an open-air dancing enclosure, &c.

The importance of the allotments for the economy of the family is considerable. The value of the crops produced by the holders in their spare time in the allotments of the capital amounts to more than 2 million crowns a year, that is on an average 1 crown per square metre or 300 crowns per allotment. The size of an allotment in Stockholm is usually from 200 to 500 square metres. For all the allotment gardens in the Swedish cities with more than 10,000 inhabitants the total output cannot be estimated at less than 9½ millions a year. Any remuneration for the work done by the owner and his family is not included in these figures.

Evidently, however, the profit for the owners and the society of the allotment movement is not completely indicated by means of the figures mentioned above. The life in the open air, the cultivation of the soil, the variation of a monotonous diet, made possible through the products of the garden, are benefits which cannot be indicated by a mere statement of the crops produced.

At present there are only relatively few of the greater cities in Sweden which have created allotment colonies as a permanent part of the town plan. Several flourishing colonies have therefore on this account already been obliged to give way to garden cities, tenement houses and factories, and the colonists have been driven still farther out towards the outskirts of the towns. The advocates of

Edinburgh and East of Scotland College of Agriculture.

Winter Session, . . October to March.
Summer Session, . . April to June.

The Day Classes provide a full course of instruction in Agriculture, Horticulture, and Forestry, and qualify for the Degrees of B.Sc. in Agriculture and in Forestry of the University of Edinburgh, the College Diploma in Agriculture, and the College Certificate in Horticulture.

CALENDAR showing Complete Courses in Agriculture, Forestry, Horticulture, and Allied Sciences in Day and Evening Classes; Short Courses for Farmers and Foresters; Syllabus of County Lectures and Experimental Work, and Scheme of Bursaries for Students resident in the College Area, may be had from the Secretary—

THOMAS BLACKBURN, 13 George Square, EDINBURGH.

Now Ready

COLLINS'

FARMERS' DIARY

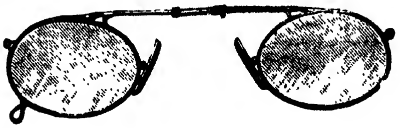
1928

A vital annual to "the man of the land".

60 PAGES FARMING NOTES BY EXPERTS, INCLUDING TABLES AND FARM RECORDS, PAGES FOR STOCK AND CROP REGISTERS, GESTATION TABLES, MEASUREMENTS AND CALCULATIONS, READY RECKONERS, &c.

Ask your Stationer

London Collins' Clear-Type Press Glasgow



GEO. PRESCOTT & CO.

CONSULTING OPTICIANS.

Principal: J. H. MURRAY. **Telephone:** 21478.

—:o:—

All our lens grinding and assembling is done in Edinburgh under the direct supervision of our refractionists—and particular attention is given to the aesthetic value of the glasses prescribed.

—:o:—

98 LOTHIAN ROAD,

EDINBURGH.

the allotment movement in Sweden hope, however, that by the pending revision of the town-planning legislation there will be not only the obligation for the towns to establish allotments as a permanent part of the town plan, but also a stipulation that the allotments shall be within a certain distance of the dwellings and of a fixed minimum size, determined according to the number of inhabitants of the town.

Agricultural Credit in France.—A Decree of the Ministry of Agriculture of 7th April 1927 (*Journal officiel, No. 85, of 10th April* 1927) fixes the rate of interest on individual and collective long term loans, granted in pursuance of the Law of 5th August 1920 on co-operative credit and agricultural co-operation. The rate of interest of individual long term loans for facilitating the acquisition, improvement, transformation and reconstitution of small farms and houses for rural workers is fixed at 3 per cent. This rate of interest may be reduced to 2·75 per cent. if the borrower is a ward of the nation, or to 2·85 per cent. if the borrower is a former graduated student of certain State agricultural schools. A reduction of interest may also be granted according to the number of legitimate children alive and less than sixteen years of age, in the borrower's family at the time when each annual amortization payment falls due. The rate of interest on loans made to agricultural co-operative societies, to agricultural vocational unions and to societies acting in the general interests of agriculture is fixed at 3 per cent.

The Return to the Land as the Result of the Electrification of the Rural Districts. *Edouard Amanieux. L'Information, Paris, 29th year, February,* 1927.—After a delay of six years the electrification of the rural districts is being vigorously pressed forward, the intention being to use it as a means for remedying unemployment, and the evils arising out of the economic crisis and the rural exodus.

Within the next few years rural electrification will very possibly effect a complete reversal of the data of economic problems. Unemployed men are finding work in the electrification depots in both the Upper and Lower Dordogne, and in the Lannemezan and Auvergne tablelands. In a few years there will be electric lighting and electric power in the smallest villages and on the farms, and decentralised industries will have been established in the open country. The worker will be able to work at home, either as journeyman or craftsman, as is already the case with the ribbon makers of the Loire, the cutlers of the Haute-Marne, the shirt-makers of Berry, and the cap-makers of the Santerre.

It is hoped that the workpeople of the electrification depots may be induced by the new economic conditions to settle on the spot and so to supply the labour required both for the original agriculture and for the industry which has found a place in the country.

Soldier Settlers. *Times, No.* 44, 512 (*New Zealand Number*). *London.*—Provision was made early in the war for placing New Zealand soldiers on the land on discharge from the Forces. Briefly, the Discharged Soldiers Settlement Act of 1915 provided for the setting apart of Crown or Settlement Lands for selection by discharged soldiers, by ballot, under previously existing tenures, or under special tenures, i.e. with deferred payment and renewable lease with purchasing clause. The period of the renewable lease was for any period not exceeding 33 years in the case of settlement land, and 66 years in the case of Crown land, with perpetual rights of renewal for similar periods. Provision was made for acquiring the freehold at the original capital value.

Up to 1919 there was a steady though small demand for land on these terms; in 1920, over 5,000 applications were lodged, and 930 allotments made, while in the following year, nearly 5,400 applications were lodged and just over 1,000 allotments were made. Since 1921 soldier settlement has steadily decreased.

In 1920 and 1921 consideration of the question of revaluation became imperative on account of the increasing difficulty found by the soldier settlers in meeting their obligations. The New Zealand Returned Soldiers Association in 1920 urged the setting up of local boards to consider applications for immediate relief pending revaluation. Later, the Government instituted district inquiry boards which reported that the revaluation of soldier rural properties was the only solution, and the Dominion Revaluation Board was set up in 1923. Review and readjustment of each settler's current account followed in 1924, and at the present time the soldier settlers of New Zealand are in the way of obtaining success. The total amount of capital invested in the scheme was £17,998,689, and the reductions by the Dominion Revaluations Board totalled £2,054,986.

STATISTICS.

PRICES of AGRICULTURAL PRODUCE, FEEDING STUFFS and FERTILISERS in June, July and August 1927.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	June.			July.			August.		
	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.
Aberdeen-Angus ...	62 10	56 7	43 7	65 5	58 9	44 11	64 9	57 11	44 4
Cross-bred (Shorthorn)	58 9	52 6	36 9	60 9	54 5	38 10	59 5	52 8	38 3
Galloway	57 7	51 6	...	57 5	52 6	..	55 1	50 5	...
Ayrshire	55 3	50 9	38 0	56 9	51 3	39 0	55 5	50 2	36 7
Blue Grey	58 3	...	...	...	...	...	...	...	...
Highland	...	...	...	...	...	...	...	...	...
	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
VEAL CALVES	16½	9	6	15¼	8½	5¼	15¼	8½	5
SHEEP –	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot	14½	13½	10¾	13¾	12¾	10¼	13	12	9¾
Half-bred	13¾	13½	8¼	13	12¼	9	12½	11¾	8¼
Blackface	13¾	13½	10¾	13	12½	10¼	12¾	12	9½
Greyface	14¼	13¼	9¾	13½	12½	9½	13	12¼	9
Down Cross	14¼	13¼	7¾	13½	12¾	7¼	12¾	12	7½
PIGS –	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs	13 3	12 2	...	12 4	11 5	...	12 7	11 11	..
Porkers	13 8	12 8	...	12 11	11 11	...	12 11	12 1	..

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description.	June.			July.			August.		
	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality	1st Quality	2nd Quality	3rd Quality
STORE STOCK:—									
CATTLE—	Per head.	Per head.	Per head.	Per head.	Per head.	Per head.	Per head.	Per head.	Per head.
Aberdeen-Angus:	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Yearlings	17 17	14 11	12 13	17 17	14 10	13 2	18 3	15 4	13 11
Two-year-olds ...	23 3	19 6	16 10	23 12	19 12	16 3	24 13	19 16	16 5
Cross-bred (Shorthorn):									
Yearlings	17 6	14 5	11 18	17 4	14 3	12 10	17 4	14 3	13 1
Two-year-olds ...	22 9	18 6	15 13	22 3	18 6	15 8	23 10	18 11	16 7
Galloway:									
Yearlings	15 13	12 5	...	15 10	...	...	15 4	...	...
Two-year-olds ...	24 8	19 15	...	22 0	18 15	17 10	20 10	19 10	...
Ayrshire:									
Yearlings	11 8	...	..	11 5	..	...	...	...	...
Two-year-olds ...	18 0	15 0	...	17 10	15 0	...	...	...	..
Blue Grey:									
Yearlings	...	...	.	16 15	14 10	...	...	...	...
Two-year-olds ...	...	...	...	...	21 0	17 15	...	...	...
Highland:									
Yearlings	12 7	10 8	8 13	11 16	9 12	8 0	...	...	...
Two-year-olds ...	15 13	14 1	12 3	15 3	13 0	...	...	...	...
Three-year-olds ...	18 10	16 11	15 5	17 12	15 5	...	...	...	...
DAIRY COWS—									
Ayrshire:									
In Milk	26 10	20 8	12 0	27 2	20 11	12 0	28 17	21 0	12 0
Calvers	26 7	20 11	14 12	27 13	21 0	14 10	28 2	21 0	14 4
Shorthorn Cross:									
In Milk	29 19	23 5	...	30 16	23 17	22 10	31 1	23 5	24 3
Calvers	28 1	20 11	15 19	30 3	22 0	16 10	30 16	22 3	16 7
SHEEP—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Cheviot Hoggs ...	45 3	36 10	30 0	44 6	36 8	31 0	34 3	...	...
Half-bred Hoggs ...	63 3	50 3	43 3	...	47 2	...	47 0	34 0	...
Blackface Hoggs ...	37 10	29 9	26 11	34 0	30 4	25 0	...	34 5	...
Greyface Hoggs ...	50 7	45 7	41 5	48 9	39 4	...	48 11	37 0	...
Down Cross Hoggs	61 9	56 2	...	..	...	...	...	...	...
PIGS—									
(6 to 10 weeks old)	45 11	31 11	...	40 0	26 2	...	32 11	22 4	..

Average Prices of Dead Meat at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	June. Dundee.	June. Edinburgh.	June. Glasgow.	July. Dundee.	July. Edinburgh.	July. Glasgow.	August. Dundee.	August. Edinburgh.	August. Glasgow.
		per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
Beef :—										
Home-fed—										
Bullock or Heifer ...	1	9⅛	9⅝	10¾	9½	9½	10⅞	9⅝	9⅝	11
	2	8¾	...	10¼	9	8¼	10⅝	9	...	10⅝
Bull	1	7⅛	8⅛	7½	8	8⅛	7⅝	7⅝	7¾	7½
	2	6¾	7¼	7	7	7	7⅛	7	6⅝	6⅞
Cow	1	6	6	7½	6½	5¾	7⅛	5½	5¾	7⅛
	2	5½	...	6⅞	6	5	7	5	...	6½
Irish—										
Bullock or Heifer ...	1	...	...	9½	...	...	9	...	...	8⅝
	2	...	...	9	...	...	8½	...	...	7¾
Bull	1	..	...	6¾	...	...	...	...	...	...
	2	...	...	6¼	...	...	...	...	...	...
Argentine Frozen—										
Hind Quarters ...	1	6½	6⅛	6	6¾	6⅝	6½	6⅞	6⅞	6½
	2	6	5⅝	...	6⅛	6	...	...	...	...
Fore ,, ...	1	3½	3½	3½	3⅞	3¾	4	3⅞	3⅞	4
	2	...	3¼	...	3¾	...	...	...	...	...
Argentine Chilled—										
Hind Quarters ...	1	7¾	7⅝	7½	7½	7⅝	7⅝	7⅞	7½	7½
	2	...	7	7¼	7¼	6¾	6⅞	...	7	7⅛
Fore ,, ...	1	4	3¾	3⅞	4⅛	3⅞	3⅝	4¼	3⅞	4
	2	...	3¼	3⅝	4¼	3⅝	3⅜	...	...	3¾
Australian Frozen—										
Hind Quarters ...	1	...	...	5½	...	...	6	...	...	6
Crops	1	...	...	3⅝	...	...	4	...	...	4
New Zealand Frozen—										
Hind Quarters ...	1	...	...	5⅞	...	...	6¼	...	...	6
	2	..	...	...	...	...	6	...	...	...
Fore ,, ...	1	...	...	3⅜	...	...	3⅝	...	...	3½
	2	...	...	...	...	...	3½	...	...	...
Mutton :—										
Hoggs, Blackface ...	under 60 lb.	13¼	12⅛	13¼	13	11⅛	11¾	12	10⅝	11
	60 lb. & over	12⅝	12	12¾	...	10½	11¼	...	...	10½
,, Cross	under 60 lb.	13¼	12⅛	12¾	13	11⅛	11¾	12	10⅝	11
	60 lb. & over	12⅝	12	12¼	...	10½	11¼	...	...	10½
Ewes, Cheviot	1	9¾	8	9¾	9½	8	8⅝	7¼	7⅛	7¾
	2	9¼	...	9¼	9	...	8⅛	6½	...	7¼
,, Blackface ...	1	9¾	8	9¾	9½	8	8⅝	7¾	7⅛	7¾
	2	9¼	...	9¼	9	...	8⅛	6⅝	...	7¼
,, Cross	1	7½	8	6⅞	7⅛	8	7⅛	6	7⅛	6¼
	2	6⅝	...	6⅜	7	...	6⅝	5	...	5¾
Argentine Frozen ...	1	...	...	4⅝	..	...	5	...	...	5
	2	...	...	4	...	...	4	...	...	4¼
Australian ,, ...	1	...	5½	4¾	...	5⅜	4¾	...	5⅝	4¾
	2	...	4½	3¾	...	4⅞	3¾	...	5⅛	3¾
New Zealand Frozen ...	1	...	..	5⅛	...	...	5½	...	...	5½
	2	...	...	4½	...	...	4½	...	...	4½
Lamb :—										
Home-fed	1	15⅝	14⅛	15¾	14	12⅞	12½	12	11⅝	12
	2	15	...	14⅝	...	12	11½	...	...	11
New Zealand Frozen ...	1	...	10	9½	...	9⅞	9¼	...	10	9¼
	2	...	9⅜	9¼	...	8⅞	9	...	9	9
Australian Frozen ...	1	...	...	7½	...	...	7½	...	...	7½
	2	...	...	7¼	...	...	7¼	...	...	7¼

Average Wholesale Prices of Provisions at Glasgow.

(Compiled from Reports received from the Board's Market Reporter.)

Description.		Quality.	June.	July.	August.
			s. d.	s. d.	s. d.
Butter:					
Irish Creamery	per cwt.	1	164 7	153 6	163 7
,, (Unsalted) ...	,,	1	169 10	160 0	168 5
Argentine (Unsalted) ...	,,	1	164 6	...	...
Australian	,,	1	166 0	159 0	163 0
Danish	,,	1	170 2	163 6	175 10
,, (Unsalted) ...	,,	1	175 2	168 6	181 0
New Zealand	,,	1	170 7	167 0	176 10
Swedish	,,	1	166 5	158 9	173 2
Cheese:					
Cheddar	,,	1	112 0	...	...
,, (New Seasons)...	,,	1	86 0	89 0	98 5
Cheddar Loaf	,,	1	112 0	108 0	113 2
		2	...	...	112 0
Dunlop	,,	1	111 4	...	...
,, (New Seasons)...	,,	1	85 7	88 6	97 2
Canadian...	,,	1	...	94 4	102 0
New Zealand (Coloured)	,,	1	94 2	94 0	100 2
,, (White)	,,	1	94 5	94 6	100 2
Bacon:					
Ayrshire (Rolled) ...	,,	1	151 2	143 0	133 7
Irish (Green)	,,	1	138 2	118 0	118 10
,, (Dried or Smoked)	,,	1	144 10	126 0	126 10
,, (Long Clear) ...	,,	1	132 0	126 0	123 0
Wiltshire (Green) ...	,,	1	139 2	129 0	127 5
,, (Dried or Smoked)	,,	1	147 0	135 0	132 5
American, Long Clear Middles (Green)	,,	1	109 6	101 0	93 5
,, Short Clear Backs...	,,	1	94 6	90 0	92 0
Canadian Sides	,,	1	96 7	96 0	93 10
Danish Sides	,,	1	105 0	98 6	100 2
Dutch, Wiltshire Style (Green)	,,	1	95 0	91 6	91 2

Description.		Quality.	June.	July.	August.
			s. d.	s. d.	s. d.
Hams:					
Irish (Smoked) ...	... per cwt.	1	207 0	207 0	207 0
		2	190 0	190 0	190 0
American, Long Cut (Green)	,,	1	113 5	106 3	99 7
American, Short Cut ...	,,	1	107 2	94 6	92 0
Eggs:					
Country	... per doz.	1	1 9	1 7	1 9
		2	1 7	1 5	1 8
Irish (Fresh) ...	... per 120.	1	13 3	13 8	15 5
		2	12 7	12 6	13 7
,, (Cold Stored) ...	,,	1	...	...	14 9
,, (Duck)	,,	1	11 9	11 9	11 0
Belgian (Fresh)	,,	1	13 6	12 6	14 6
,, (Pickled)... ...	,,	1	...	...	...
Danish	,,	1	13 11	13 10	16 1
		2	12 10	12 10	15 2
Dutch	,,	1	13 9	12 0	16 0
Polish	,,	1	9 5	9 2	10 4
		2	8 7	8 0	...
Swedish	,,	1	13 9	13 9	16 7
		2	12 9	12 6	15 2

Average Wholesale Prices of First Quality Fruit and Vegetables at Glasgow.

(Compiled from Reports received from the Board's Market Reporter.)

Description.	June.	July.	August.
Fruit:—			
Apples—	s. d.	s. d.	s. d.
British, Other dessert per case.	15 3	15 9	17 3
Imported: Australian ... ... ,,	15 3	...	...
Vegetables:—			
Beet ... ... per cwt.	4 10	§5 8	§4 1
Cabbage, Coleworts ... per doz.	1 0	1 3	1 7
Carrots, *British* ... ... per cwt.	5 0	*3 11	9 6
Cauliflowers, *British* ... per doz.	5 3	5 0	4 6
Cucumbers ... ... ,,	5 8	5 6	7 10
Lettuce, Cos. ... ... ,,	1 3	1 3	1 1
,, Cabbage ... ,,	1 4	1 3	1 2
Onions—			
Valencia ... ... per case.†	16 0	15 6	13 7
Egyptian ... ... per bag.‡	10 8	13 4	...
Spring ... ... per bunch.	0 6	0 8	0 5½
Parsley ... ... per cwt.	13 7	20 0	15 2
Peas, *Home Grown* ... ,,	20 0	32 10	18 5
Rhubarb ... ... ,,	6 4	9 3	6 0
Tomatoes, *British* ... per lb.	0 11	0 7¾	0 8
,, *Channel Islands* ,,	0 7	0 5¾	0 5½
Turnips ... ... per doz. bunches.	3 0	4 3	4 0

* per dozen bunches. † 9 stone. ‡ 8 stone. § per dozen.

Average Wholesale Prices of Potatoes at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Market.	Quality.	First Earlies.	Second Earlies.	Late Varieties. Red Soils. Langworthy and Golden Wonder.	Late Varieties. Red Soils. Other.	Late Varieties. Other Soils. Langworthy and Golden Wonder.	Late Varieties. Other Soils. Other.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
June.							
Dundee per ton.	1	...	...	...	...	...	6 1 0
Edinburgh ,,	1	12 10 0	...	...	...	...	7 5 0
Glasgow ,,	1	21 5 0	...	11 5 0	9 7 0	10 5 0	7 0 0
July.							
Dundee ,,	1	10 13 0	...	...	...	...	5 10 0
Edinburgh ,,	1	9 14 0	...	...	...	...	...
Glasgow ,,	1	9 13 0	...	...	...	..	...
August.							
Dundee ,,	1	5 15 0	4 3 0	...	...	...	...
Edinburgh ,,	1	5 10 0	4 7 0	...	...	...	...
Glasgow ,,	1	4 19 0	4 8 0	...	...	...	...

Average Prices of Roots, Hay, Straw, and Moss Litter at Dundee, Edinburgh, and Glasgow.

(Compiled from Reports received from the Board's Market Reporters.)

Market.	Quality.	Roots. Carrots.	Roots. Yellow Turnips.	Roots. Swedes.	Hay. Rye Grass and Clover.	Hay. Timothy.	Straw. Wheat.	Straw. Barley.	Straw. Oat.	Moss Litter.
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
June.										
† Dundee ... per ton.	1	...	...	...	100 0 ‡90 0	...	60 0	...	60 0	51 6
‡ Edinburgh ,,	1	...	...	...	92 0 †92 0	...	44 6	39 6	44 6	45 0
‖ Glasgow ,,	1	...	...	...	75 0	77 6	40 6	...	41 0	31 3
July.										
† Dundee ... ,,	1	...	...	...	105 0 90 0	...	63 9	...	63 9	51 6
‡ Edinburgh ,,	1	...	...	...	100 0 100 0	...	50 8	47 6	50 8	45 0
‖ Glasgow ,,	1	...	...	...	75 0	78 2	40 8	...	42 9	31 3
August.										
† Dundee ... ,,	1	...	...	...	105 0 88 0	...	69 6	...	69 6	51 9
‡ Edinburgh ,,	1	...	...	...	100 0 94 0	...	50 0	47 6	50 0	45 0
‖ Glasgow ,,	1	...	...	...	75 0	80 0	42 9	...	44 9	31 3

† Quotations for Hay or Straw, baled and delivered.
‡ ,, ,, delivered loose in town.
‖ ,, for baled Hay and Straw f.o.r.

Average Prices of Feeding Stuffs at Glasgow and Leith.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	June.		July.		August.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Linseed Cake—						
Home	11 14 0	11 0 0	11 13 2	11 0 0	11 17 6	11 0 0
Foreign	11 10 0	10 10 0	11 9 5	...	11 10 0	10 10 0
Decorticated Cotton Cake	11 1 3	11 0 0	10 17 6	11 0 0	11 5 0	11 0 0
Undecorticated Cotton Cake—						
Bombay (Home-manufactured)...	...	6 11 6	6 5 0	6 10 0	7 5 8	6 9 0
Egyptian (do.)	6 17 6	6 16 6	6 19 5	6 15 0	7 6 6	6 15 0
Palmnut Kernel Cake	9 17 6	...	9 17 6	...	9 12 6	...
Coconut Cake ...	10 17 6	...	10 17 6	...	11 2 6	...
Groundnut Cake, Undecorticated—						
37 per cent. Oil and Albuminoids	9 5 0	...	9 5 0	...	9 6 6	...
40 per cent. do.	9 10 0	...	9 8 2	...	9 11 3	...
Maize Germ Cake—						
Home	10 13 0	...	10 13 9	...	10 18 4	...
Foreign	10 10 0	...	10 10 0	...	...	...
Maize Germ Cake Meal	...	...	9 17 6	...	11 1 8	...
Barley Meal ...	11 16 0	...	12 0 0	...	11 8 9	...
Bean Meal	12 4 0	12 5 0	12 3 9	12 5 0	13 1 0	12 5 0
Maize Meal—						
Home Manufactured	9 1 6	8 13 0	9 2 6	8 10 0	10 3 6	9 0 0
South African (Yellow)	9 0 0	...	8 15 10	...	9 3 0	8 15 0
Rice Meal	7 8 0	...	7 12 6	...	8 0 0	...
Locust Bean Meal ..	9 5 0	8 12 6	9 3 9	8 15 0	9 1 11	8 9 0
Locust Beans (Kibbled and Stoned)	...	7 15 0	...	7 15 0	...	7 15 0
Maize Gluten Feed (Paisley) ...	8 7 0	...	8 9 5	...	8 17 0	...
Maize—Plate ...	8 1 6	7 19 0	8 0 8	7 10 0	8 18 6	8 4 0
Oats—Home ...	10 9 6	9 14 0	10 7 6	10 0 0	10 9 6	10 16 0
,, Plate ...	9 17 6	...	9 11 11	..	9 17 0	...
Barley—Feeding ...	11 17 0	9 14 0	11 17 6	10 0 0	12 3 0	10 0 0
,, Bran ...	9 16 8	...	10 10 0	...	10 15 0	...
Malt Culms... ...	7 0 0	6 0 0	7 0 0	6 0 0	6 15 0	6 8 0
Distillery Mixed Grains—Dried	7 10 0	8 0 0	7 19 5	8 0 0	8 13 2	8 8 0
Brewers' Grains—Dried	7 12 6	7 0 0	7 15 8	7 0 0	8 4 6	7 0 0
Distillery Malt Grains—Dried ...	7 10 0	...	7 15 0	...	8 5 0	...
Wheat—						
Middlings (Fine Thirds or Parings)	10 6 0	9 5 0	11 1 11	10 5 0	11 10 0	10 10 0
Sharps (Common Thirds) ...	8 1 6	8 2 0	8 10 8	8 11 3	8 16 6	8 10 6
Bran (Medium) ...	7 8 0	7 8 0	7 8 9	6 17 6	7 16 0	7 1 6
,, (Broad) ...	7 12 0	8 6 0	7 12 6	7 17 6	7 19 0	7 19 6
Feeding (Scotch)	13 14 6	12 10 0	13 10 0	12 10 0	13 6 0	12 18 0
Feeding Treacle ..	6 17 6	6 15 0	7 0 8	6 15 0	7 7 0	6 15 0
Crushed Linseed ...	21 6 0	...	21 2 6	...	22 13 4	...
Fish Meal	22 0 0	21 0 0	22 0 0	21 0 0	...	20 4 0
Beans—English ...	12 5 0	...	12 5 0	...	12 10 10	...
China	11 10 0	...	11 8 9	...	11 12 0	...
Rangoon (White)	9 10 0	...	9 10 0	...	9 11 0	...
Pease—China (White)	12 14 0	...	12 6 3	...	12 5 0	...

Average Prices of Fertilisers at Glasgow and Leith.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Guaranteed Analysis.	June. Glasgow.	June. Leith.	July. Glasgow.	July. Leith.	August. Glasgow.	August. Leith.
	%	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Nitrate of Soda ...	N. 15½	13 15 0	13 10 0	...	13 10 0	..	13 10 0
Nitrate of Lime ...	N. 13	11 0 0	11 0 0	11 0 0	11 0 0	11 0 0	11 0 0
Sulphate of Ammonia (Neutral and Granular) ...	N. 20·6	12 6 0	12 6 0	12 6 0	12 6 0	9 18 0	9 18 0
Calcium Cyanamide	N. 19	9 16 0	9 16 0	9 16 0	9 16 0	9 16 0	9 16 0
Superphosphate ...	S.P. 30	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0
"	S.P. 35	3 0 0	3 0 0	3 0 0	3 0 0	3 0 0	3 0 0
"	S.P. 38	3 5 0	3 5 0	3 5 0	3 5 0	3 5 0	3 5 0
Bone Meal—Home	N. 5, I.P. 40	8 15 0	8 0 0	8 15 0	8 0 0	8 15 0	8 0 0
" " —Indian	N. 3¾, I.P. 45	9 10 0	8 0 0	9 10 0	8 0 0	9 10 0	8 0 0
Steamed Bone Flour	N. 1, I.P. 60	7 0 0	8 0 0	7 0 0	8 0 0	7 0 0	8 0 0
†Ground Mineral Phosphate ...	I.P. 65	...	3 0 0	...	3 0 0	...	3 0 0
Basic Slag	T.P. 24	*2 7 6	...	*2 7 6	...	*2 7 6	...
" "	" 26	*2 11 6	‡2 12 0	*2 11 6	‡2 12 0	*2 11 6	‡2 12 0
" "	" 28	*2 15 0	...	*2 15 0	...	*2 15 0	...
" "	" 30	*3 0 0	...	*3 0 0	...	*3 0 0	...
" "	" 40	...	3 5 0	...	3 5 0	...	3 5 0
Sulphate of Potash (on basis of 90 per cent. purity)	Potash 48·6	10 2 6	10 0 0	10 2 6	10 0 0	10 2 6	10 0 0
Muriate of Potash... (on basis of 80 per cent. purity)	" 50	8 5 6	8 0 0	8 5 6	8 0 0	8 5 4	8 0 0
Potash Salts ...	" 20	3 2 6	3 1 0	3 2 6	3 1 0	3 2 6	3 1 0
" " ...	" 30	4 8 0	4 8 0	4 8 0	4 8 0	4 9 2	4 8 0
Kainit—In bags ...	" 14	2 15 6	2 14 0	2 15 6	2 14 0	2 16 8	2 14 0

Abbreviations:—N. = nitrogen; S.P. = soluble phosphate; I.P. = insoluble phosphate; T.P. = total phosphate.

* Carriage paid (4-ton lots) to Ayrshire and Renfrewshire; quotations for delivery in Lanarkshire and Stirlingshire 2s. per ton higher.

† Fine grist: 80 per cent. through standard 100 mesh sieve.

‡ Carriage paid (4-ton lots) to stations in the Lothians.

Printed under the authority of His Majesty's Stationery Office
By J. Skinner & Co., Ltd., Thistle Street, Edinburgh.

(6863.) Wt. 10761/348. 1625+11, pp. 473-481. 10.27. J.S.&Co.,Ltd. G. 19.