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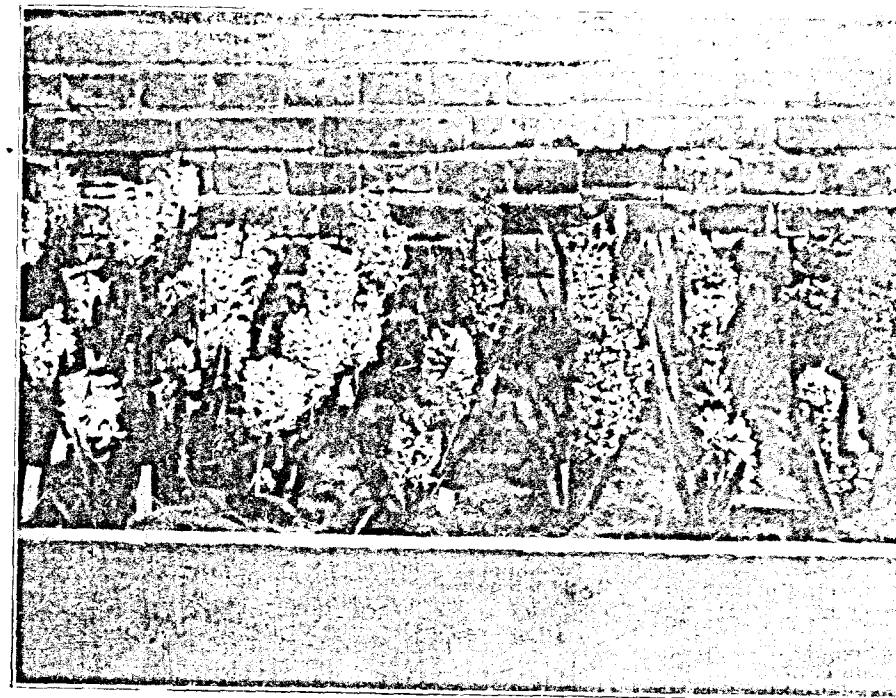


FIG. 1.—Hyacinths infected with Bulb mite.

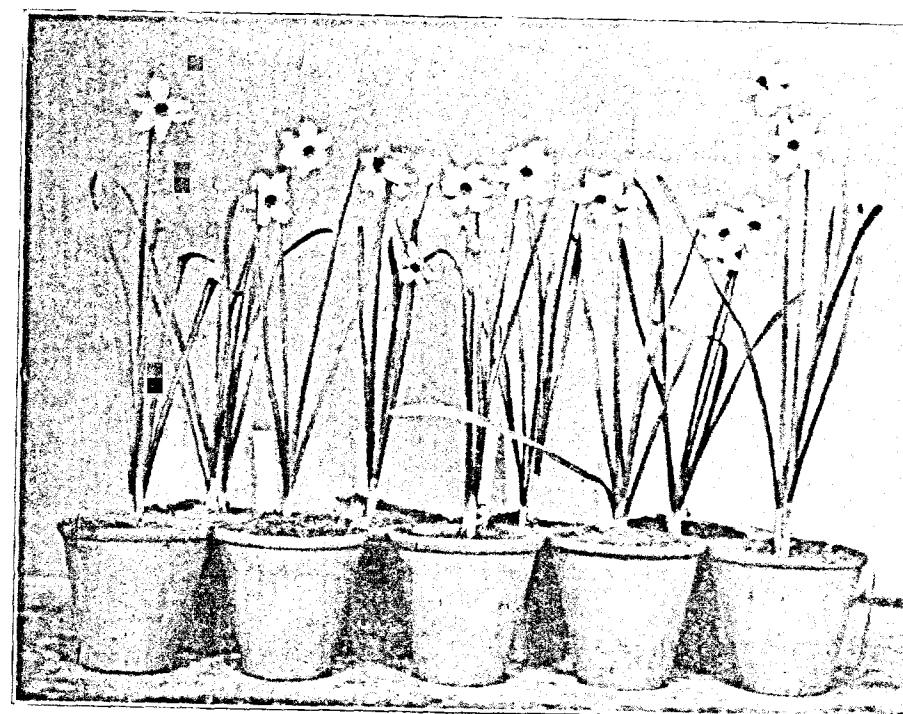


FIG. 2.—Narcissus P. ornatus infected with Bulb mite

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THE JOURNAL OF THE MINISTRY OF AGRICULTURE

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NOTES FOR THE MONTH

A SHORT note was given in the JOURNAL, of June last, regarding the progress then made in connexion with the Institute's proposal to hold a World Agricultural Census in 1929-30. A proposed form, containing the various main headings in respect of which the information is to be collected, was approved by the General Assembly in April last, and for a number of months Mr. Estabrook, the Director of the Census, has been engaged in visiting the authorities of the various countries of Europe and North Africa with a view to securing that the Census is taken on the general lines proposed by the Institute. As a result practically all the countries visited have provisionally accepted the proposals. Mr. Estabrook is now leaving for America and Japan on a similar mission.

The Institute has been in communication with the various Governments regarding the possibility of obtaining more complete statistics regarding production, imports and exports, stocks and consumption of wool. In its communication, the Institute remarked that, while estimates of production are already available in respect of some of the more important wool-producing countries, the data are frequently published too late to be of any very great practical value to traders, and are in general not sufficiently informative as to the quantities of the different types produced. Statistics of trade are not in any way uniform, while as regards stocks the importance was stressed of the necessity of securing reliable estimates, the absence of which has no doubt had considerable bearing on the wide and rapid fluctuations in prices which have occurred in recent years. It is to be noted that the International Wool Conference held in Turin last October unanimously recognized the necessity of establishing universal statistics of the production and consumption of wool. This subject was also considered at the recent Imperial Conference, and a resolution was passed

recommending that steps should be taken to secure the co-operation of foreign countries with Governments of the British Empire in the collection and publication on a uniform basis of international statistics regarding the production, stocks and consumption of wool.

Another matter to which the Institute has been giving attention recently is that of Forestry Statistics. The Forestry Congress, which was held in 1926, passed a resolution urging the Institute to take up this question, and proposing that Governments should be asked to make a special contribution for the purpose of establishing a Bureau of Forestry Statistics. The Institute is at present considering the best way in which to give effect to the terms of this resolution.

* * * * *

THE latest volume of the Ministry's series of marketing reports "has been prepared by the Ministry with the object of providing home growers with a comprehensive view of the methods of marketing fruit, and enabling them to consider what further steps can be taken by them to maintain their present position in the home market, and also, if possible, to increase their share of the total trade. . . . The conclusion to be drawn from the report seems to be that the fruit industry generally has much to gain by adopting methods of marketing which will enable produce to be put on the market in a manner more in accordance with the requirements of wholesalers and retailers."

The above quotation sounds the keynote of the report, namely, that the fruit industry should not be regarded from an angle of vision peculiar to the grower, but must be examined in the light of the requirements of distribution and adapted, where necessary, to conform with the needs and preferences of the market which, in their turn, are dictated by the consumer. The first essential for successful selling in any market is a knowledge of what the market wants.

Starting with a geographical survey of the sources of production at home and abroad, the first part of the report closes with a statistical analysis of supplies and prices. The second part is concerned with the critical steps of preparation for market, including picking, grading, packing, and that all-

* *Fruit Marketing in England and Wales* : Economic Series No. 15, Ministry of Agriculture and Fisheries. Obtainable from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, or through any bookseller. Price 6d. net, postage extra.

important means to improved marketing, namely, standardization. Then follow chapters dealing with three further stages preliminary to the final marketing of fruit, these being assembly—and here the significance of packing stations is discussed—conservation by storage, canning or other means, and transportation by rail or road.

In Part VI the story of the final stage is told, chapters being devoted to grower-retailer and grower-consumer sales, to the personnel of the wholesale trade (brokers, commission salesmen, commission buyers and wholesale merchants), to the port auctions, to the London and provincial wholesale markets, to the retail trade, and, finally, to the origin and prevention of gluts.

Part VII relates the steps that have been taken to advertise fruit in this country and affords some explanation why the home grower has not fully benefited from advertisement in the past. In Part VIII an account is given of the degree in which each section of the industry is organized.

Perhaps the most important chapter in the report is that in which the progress of standardization at home and abroad is reviewed, grades and standard packages for home-produced fruit are put forward, and a method outlined by which they might be made operative. These suggestions are submitted as a basis for discussion, and it will be for the industry to say whether action is required and, if so, on what lines, but it is clear that consideration of the standardization proposals contained in the report is a matter of great moment at the present time, and not least because of their bearing on the pressing and intricate problem of how home produce can be effectively advertised. Standardization is the foundation of successful advertisement. As the Linlithgow Committee pointed out nearly four years ago: "The British producer must break the inertia of custom; standardization, with organization, is the direction in which he must set his future course."

Every fruit grower and every distributor, whether wholesaler or retailer, should carefully study the report, which is exceptionally well illustrated and, with the aid of the grant recently made to the Ministry by the Empire Marketing Board, has been placed on sale at the nominal price of 6d. in order that it may be within reach of all. It is to be hoped that growers' organizations will aid in ensuring the widest possible circulation of the report among their members. Nearly 3,000 copies of the report were sold before publication.

THE Advisory Committee provided for in Section 23 of the Fertilizers and Feeding Stuffs Act, 1926, has now been appointed jointly by the Minister of Agriculture and Fisheries and the Board of Agriculture for Scotland.

Its constitution is as follows:—

Lord Clinton (Chairman).
 Mr. E. Richards Bolton, F.I.C.
 Mr. E. G. Haygarth Brown, I.S.O.
 Dr. Charles Crowther, M.A., Ph.D.
 Mr. J. Garton.
 Mr. C. W. Higgs.
 Mr. Arthur Holgate.
 Mr. Thomas Kyle.
 Mr. Alexander Main, M.A., B.Sc.
 Mr. John C. Menzies.
 Mr. Brian S. Miller.
 Lt.-Col. R. L. Norrington, C.M.G.
 Mr. J. W. Pearson.
 Mr. R. R. Robbins, C.B.E.
 Dr. G. Scott Robertson, D.Sc., F.I.C.
 Sir E. J. Russell, O.B.E., D.Sc., F.R.S.
 Mr. John Speir.
 Mr. George Stubbs, C.B.E., F.I.C.
 Dr. J. F. Tocher, D.Sc., F.I.C.
 Dr. J. A. Voelcker, M.A., Ph.D., D.Sc., F.I.C.
 Prof. T. B. Wood, C.B.E., M.A., F.I.C., F.R.S.

Mr. H. J. Johns, of the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1, is the Secretary. The immediate duties of the Committee will be to prepare recommendations as to the regulations which will require to be made before the Act can come into operation, and to consider a number of suggestions with regard to the contents of the Schedules to the Act.

* * * * *

THE following note has been communicated by Mr. A. S. Buckhurst, of the Ministry's Plant Pathological Laboratory.

Notes on Bulb Mites and Eelworms out with bulb mite (*Rhizoglyphus echinopus*) and with the potato race of the stem eelworm (*Tylenchus dipsaci*).*

In continuation of these experiments further small trials were undertaken in 1926, in order to confirm or amplify the results obtained in the previous year.

Bulb Mite.—The question whether the bulb mite is capable of causing serious injury to healthy bulbs has often been

debated, and it is one of some importance to the bulb trade, especially to those interested in exporting bulbs to countries overseas. In an attempt, in 1924 and 1925, to obtain further light on this question, several varieties of narcissus and a small number of hyacinths were infected with mites and were grown on to determine if damage was caused by the mite attacks. In this experiment the only bulb which showed any trace of damage was a single *Narcissus poeticus ornatus*. In 1925–26, a further trial with a greater number of this variety was therefore carried out, and a number of hyacinths were included in the experiment, as only a very small number (eight bulbs) had been tested during 1924–25.

The general procedure followed was the same as that adopted in the experiment of the previous year: 65 hyacinths, mixed, and 50 *poeticus* were used, 50 of the hyacinths and 35 of the narcissus being infected with mites, the remaining 15 of each being uninfected and acting as controls. About 100 mites, taken from a culture fed upon diseased narcissus and hyacinth, were placed on each bulb, being introduced into the neck of the narcissus bulbs and between the scales of the hyacinths at the time of planting. The bulbs were potted in October in sterilized soil, plunged in an ashbed, and covered with sterile fibre. The bulbs were again allowed to flower in the ashbed, and, with the exception of one narcissus control, which was destroyed by eelworm, all produced good normal flowers. The infected bulbs are illustrated in the accompanying plate, Fig. 1 showing the hyacinths in the ashbed, and Fig. 2 a selection of the narcissi, this being necessary, as the time of flowering was rather irregular. At the end of the season, mites were found to be present on all the bulbs, both infected and control, but no damage whatever was apparent. This experiment seems to confirm the impression gained in 1925 that under normal circumstances the bulb mite is¹ not a primary pest to either narcissus or hyacinth. So far as these plants are concerned, therefore, it is believed that, provided the bulbs are sound and of good health, the presence of bulb mites is of no importance. Where, however, there is disease present, or where the bulbs are suffering from unfavourable conditions, as, for instance, from being kept out of the ground too long, then the bulb mite seems capable of extending the damage due to the disease, or of starting an attack on any tissue which is unhealthy.

Stem Eelworm.—One of the strangest characteristics of this and some other species of eelworm is the development of races

* This JOURNAL November, 1925, p. 736.

or strains confined, or apparently confined, to certain food-plants, and since the only method of dealing with eelworm-infested land is to "starve out" the pests by not growing crops susceptible to attack, it is of great importance to know which crops are subject to attack by each strain. In this connexion, it may be recalled that, within the last few years, a potato strain of the stem eelworm has been discovered, and, in 1925, attempts were made, without success, to infect oats by means of eelworms taken from potato. In 1926, a similar attempt was carried out with narcissus.

Twelve bulbs each of Golden Spur, *Barrii conspicuus*, and *Poeticus ornatus* were potted in sterilized soil, a single bulb to each pot. Potato tubers, heavily infested with eelworm, were cut up and the pieces mixed with the soil in 18 pots, six of each variety of narcissus. The other 18 pots were not infected and acted as a control. A further control was obtained by planting potatoes in two pots into which infected material had been introduced. The narcissi all flowered normally, and the foliage showed no signs of eelworm attack, nor were any traces apparent in the bulbs on lifting. The two potatoes, however, both produced tubers heavily infested with eelworm. Although carried out on such a small scale, this experiment seems to indicate that stem eelworms from potato will not readily infect narcissus; and there would seem as yet no reason, so far as eelworms are concerned, why potatoes should not be planted on land which has previously carried narcissi and *vice versa*.

* * * * *

THE Report* on the results of the statistical inquiries made in 1925, in connexion with the Census of Production, as to the output of all kinds of agricultural produce

The Agricultural Census of England and Wales and as to the agricultural industry generally was issued on March 18. A brief survey of the changes shown by the agricultural statistics of the last fifty years is also included in the Report.

The summary of the figures of output shows that the estimated total value of the output from the agricultural holdings of England and Wales in 1925 was 225 millions sterling and of this total live stock and live stock products accounted for rather more than two-thirds, farm crops for

* *The Agricultural Output of England and Wales, 1925.* [Cmd. 2815.] Price 3s. 6d. net, or 3s. 9½d. post free, to be obtained from H.M. Stationery Office at the addresses shown, or through any bookseller.

about 20 per cent., and fruit, vegetables, glasshouse produce, etc., for nearly 11 per cent. The report contains details of the production and output of each kind of agricultural produce and a large number of maps are included showing the distribution of crops and live stock throughout the country.

The results of a special inquiry as to the capital employed in agriculture and the average rents of agricultural holdings are included in this publication. It is estimated that the amount of capital employed as "tenant's capital" in England and Wales is about 365 millions sterling, and that the value of the land with the necessary houses, buildings, etc. (*i.e.*, what is usually known as "landlord's capital"), is about 815 millions sterling. The varying amount of capital required and rents paid for holdings of different types and sizes in different parts of the country is shown in the Report.

There are chapters dealing with employment in agriculture and the motive power used on farms. It is shown that the number of persons engaged in agriculture and horticulture in England and Wales is about 1,100,000, of whom about 800,000 are employees and 300,000 are farmers, market gardeners or nurserymen who are either employers or working on their own account. A comparison of the numbers of persons engaged in agriculture over a series of years is also given. The figures of the number of engines in use on agricultural holdings as compared with pre-war are of interest in showing the very rapid extension in the use of oil or petrol engines. In addition, there are chapters dealing with the prices of agricultural produce, with the number of holdings of different types and sizes on which the industry is conducted, and the distribution of crops and live stock thereon.

This Report should be of great value to all persons interested in agriculture.

* * * * *

As¹ stated in the March issue of this JOURNAL, an essential feature of the Ministry's programme of marketing work is the practical demonstration, at agricultural

Marketing Demonstrations at Agricultural Shows shows, of improved methods of marketing, including packing and grading. The commodities to be dealt with during the coming summer are eggs and poultry, fruit, potatoes, pigs and pig products.

The demonstrations contemplated by the Ministry involve much organisation of an intricate and difficult kind. Suitable buildings have to be arranged for and specially adapted to the

purpose in view. A large amount of equipment and machinery of various kinds, including refrigerating plant, has to be brought together, and installed. Live pigs and poultry, dressed carcasses of pork and dressed poultry, sides of bacon and supplies of eggs, potatoes and fruit, all of various grades, have to be assembled in the right condition, at the right time and at the right place. Posters and diagrams have to be prepared and explanatory leaflets drafted and printed. In addition, assistants have to be specially trained for demonstrating.

There are obvious physical limitations to the number of such demonstrations which can be arranged during any one show season; while coincidence of dates is a further limiting factor. For the present year, the Ministry has decided, therefore, to confine the demonstrations to the shows mentioned in the sub-joined list. The proposals in regard to the shows later in the year are naturally of a provisional character, as definite arrangements are not yet possible, but the full list is given to show what is at present contemplated.

Show	Place	Dates	Subjects
Oxfordshire	Oxford	May 18 and 19	Eggs and Poultry.
Bath and West	Bath	May 24 to 28	Eggs and Poultry; Pigs and Pig Products; Fruit.
Suffolk	Ipswich	June 2 and 3	Eggs and Poultry.
Three Counties	Worcester	June 7 to 9	Fruit.
Cornwall	Truro	June 8 and 9	Eggs and Poultry.
Lincoln	Spalding	June 22 to 24	Eggs and Poultry.
Royal	Newport	July 5 to 9	Eggs and Poultry; Pigs and Pig Products; Fruit.
Yorkshire	Darlington	July 19 to 21	Eggs and Poultry; Pigs and Pig Products.
Royal Welsh	Swansea	July 29 to August 2	Eggs and Poultry; Pigs and Pig Products.
Durham Potato	Newmarket. Durham	Not yet known	Potatoes.
York Potato	York		Potatoes.
Lincolnshire Potato	Spalding		Potatoes.
Lancashire Potato	Ormskirk		Potatoes.
Dairy	Agricultural Hall, London	October 18 to 21	Eggs and Poultry; Pigs and Pig Products.
Imperial Fruit	Manchester	Oct. 28 to Nov. 5	Fruit.
Norwich Fat Stock	Norwich	November 17 to 19	Pigs and Pig Pro ducts.

Show	Place	Dates	Subjects
Birmingham Fat Stock	Birmingham	November 26 to December 1	Eggs and Poultry; Pigs and Pig Pro- ducts.
Smithfield	Agricultural Hall	December 5 to 9	Pigs and Pig Pro- ducts; Potatoes.
West of England	Plymouth	December 14 and 15	Pigs and Pig Pro- ducts.

* * * * *

It will be recalled that, in January of last year, the Ministry issued a *Report on the Marketing of Eggs in England and Wales*, this report being No. 10 of the **Egg Marketing** Economic Series. It surveyed the whole marketing field, and made a number of suggestions for the consideration of all interests concerned. Following the issue of the report, the National Farmers' Union and the National Poultry Council formed a Joint Committee for the purpose of examining these and other proposals for improving marketing methods. This Joint Committee has recently called into consultation representatives of the distributive trade.

In these circumstances, and as a matter of interest, it has been arranged to reprint in this issue (see p. 25) an explanatory article on the Marketing of Eggs Acts, 1924 and 1926 (Northern Ireland), which appeared in the *Scottish Journal of Agriculture* for January last.

The writer of this article, Dr. Gordon, concludes his review by the following observations:—

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.

It will be recalled that legislation on similar lines is in force in the Irish Free State.

THE King has been pleased to appoint a Royal Commission on Land Drainage with the following Terms of Reference :—

Royal Commission on Land Drainage relating to Land Drainage in England and Wales and its administration throughout the country, to consider and report whether any amendment of the law is needed to secure an efficient system of arterial drainage without undue burdens being placed on any particular section of the community, and to make recommendations having regard to all the interests concerned."

The members of the Commission will be as follows :—

The Rt. Hon. Lord Bledisloe, K.B.E. (Chairman).

The Lord Clinton.

Lt.-Col. Sir George Courthope, Bt., M.P.

Lt.-Col. F. D. W. Drummond, C.B.E.

Sir George Etherton.

Mr. Leopold Harvey.

Major. J. W. Hills, M.P.

Mr. H. A. Learoyd, M.A., LL.B.

Sir Joseph Priestley, K.C.

Sir Albert Pritchard.

Mr. Rowland R. Robbins, C.B.E.

Mr. Walter R. Smith.

Mr. H. Meadows

Mr. D. B. Toye, O.B.E. } Joint Secretaries.

The Hon. Arthur Peel, Assistant Secretary (unpaid).

Since the war, especially as a result of the impetus afforded by the Lane Drainage Act, 1918, there have arisen in various drainage districts, all over England and Wales, difficulties of great and increasing magnitude. The main cause of this is probably to be found in the fact that the drainage legislation of this country, which is largely based on a Statute of Henry VIII, is inadequate and unworkable in the light of modern conditions. The Government have therefore come to the conclusion that the whole of the present drainage law requires to be closely examined with a view to possible alteration, and it is with this object in view that the Royal Commission has been appointed.

All communications relating to the Royal Commission should be addressed to the Joint Secretaries to the Royal Commission on Land Drainage, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1.

CHARACTERS WHICH DETERMINE THE ECONOMIC VALUE OF GRASSES

II. RATIO OF LEAF TO STEM

PROFESSOR R. G. STAPLEDON, M.A.,

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In the previous article it was shown that the blade or lamina of the leaf of grasses is very decidedly richer in nutrients than either the sheath of the leaf or the stem proper.

Preference by Sheep.—Observations made during a number of years have also shown that sheep, in particular, display a strong preference for leaf over sheath or stem. Recent trials at Aberystwyth have proved that sheep do, in fact, graze leaf blades more freely than stem, while they also graze green leaf in preference to the burned leaf of grass or to weeds. These experiments have been conducted by sampling a series of plots before a grazing period and again immediately afterwards.* The grazing has been very heavy for a few days between each sampling in order to reduce to a minimum any error due to contemporaneous growth. A synopsis of results so far obtained is given in Table I. The figures represent the percentage amount of the total weight of each part of the grass available which has been eaten by the sheep.

TABLE I.—TO SHOW THE PERCENTAGE AMOUNT OF THE DIFFERENT PARTS OF THE RYE-GRASSES† EATEN BY SHEEP DURING AN INTENSIVE GRAZING PERIOD OF A FEW DAYS

Separations brought under consideration	Date of Grazing Period				
	July, 1926†	Aug., 1926†	Jan., 1927§	Mar., 1926§	Mar., 1926§
Stem and (or) sheath..	24	33	49	35	15
Leaf : green	66	68	79	76	70
Leaf : burned .. ..	—||	—||	50	34	9
Approximate age of herbage when grazed	4 weeks	6 weeks	6 weeks	3 months	6 months

† Results quite similar in character have been obtained with Cocksfoot.

‡ Perennial Rye-grass.

§ Italian Rye-grass.

|| Burned foliage wholly absent.

It will be noted that a far larger proportion of the leaf than of the stem has been eaten on each occasion—two-thirds

* See "The Animal Complex and the Pasture Complex," *Bul. Ser. H*, No. 5, 1927. The Welsh Plant Breeding Station, Aberystwyth.

or more of the available green leaf has always been eaten, while less, and generally much less, than half of the sheath and stem has been taken. It is interesting to note that, in proportion as the herbage is old, so does the sheath and stem tend to be more and more neglected. This is particularly noteworthy in the case of Italian Rye-grass standing ungrazed throughout the winter. The burned leaf is eaten to about the same extent as the stem, and, like the stem, is neglected in proportion as it is old.

The Leaves of Grasses in Relation to Shoots.—The shoots of grasses can be conveniently classified as "leaf shoots" and "stem shoots." The former consist only of the blade or lamina of the leaf with the adhering sheath, and contain no true stem. The latter consist of both true stem and leaf (blade and sheath). The majority, or at least a large proportion, of the stem shoots will bear inflorescences, when they may be termed panicle shoots. During the winter and dead season, herbaceous grasses consist wholly or almost wholly of leaf shoots. That is to say, the herbage consists of what are frequently described as "root" leaves when the herbage offering is wholly or almost wholly leaf blades and sheath. When growth commences, stem shoots begin to develop, but the precise date at which such shoots become in evidence varies over a fairly wide margin for the different species. Equally the proportion of stem shoots to leaf shoots at and about heading stage is normally very different for the different species.

Speaking broadly, species which maintain a good development of leaf shoots throughout the growing season provide better summer grazing than species running chiefly to stem shoots. For, as explained in the previous article, root leaves maintain growth over a prolonged period and remain in a juvenile condition (and, therefore, in a nutritive condition) much longer than do stem leaves. The greater capacity for continuous growth of root leaves, as compared with stem leaves, is well exemplified by the fact that the former (if left uncut or ungrazed) attain to much greater length than the latter. Thus the length of fully grown root leaves of Cocksfoot varies from about 21 cm. to 76 cm., the average figure for 361 plants being 51.6 cm. The length of the longest leaves on panicle shoots at flowering time varies from about 14 cm. to 37 cm., the average figure for 94 plants being 25.4 cm.*

* In each case the plants were well spaced, vigorous and two years old, and fully represented all the strains and types of Cocksfoot under study at the Station.

It follows, from the above discussion of the available evidence, that the relation of stem shoot to leaf shoot constitutes a very important economic characteristic of grasses. A number of species are, therefore, compared with reference to this relationship in Table II.

TABLE II.—TO SHOW THE RELATION OF LEAF SHOOTS TO STEM SHOOTS RESPECTIVELY AT PRE-HEADING AND AT HEADING STAGE FOR A NUMBER OF STRAINS AND SPECIES OF GRASSES.

Percentages on Spaced Single Plants.

Species and Strain	April 2-10 Pre-Heading stage		May 9-14 Heading stage	
	Per cent. Leaf Shoots	Per cent. Stem Shoots	Per cent. Leaf Shoots	Per cent. Stem Shoots
Cocksfoot : Commercial ..	91	9	30	70-80*
" " Indigenous ..	100	0	69	31-64*
Perennial Rye-grass—agg. ..	85	15	20	80†
Timothy : Commercial ..	100	0	2	98*
Tall Oat-grass : Commercial ..	77	23	18	82
" " Indigenous ..	94	6	54	46
Red Fescue : Indigenous ..	98	2	36	64
Hard Fescue : Commercial ..	39	61	25	75‡
Meadow Foxtail—agg. ..	77	23	45	55‡
Sweet Vernal-grass—agg. ..	69	41	9	91‡

The relationship is never an absolute one and depends largely on soil fertility and weather conditions. The figures show, however, that earlier grasses, like Sweet Vernal-grass, Meadow Foxtail, Hard Fescue and French Tall Oat-grass, run to stem shoots much sooner than the later grasses. At heading stage, grasses, like Timothy, French Tall Oat-grass, Hard Fescue and Sweet Vernal-grass, consist predominantly of "stem" shoots, while Perennial Rye-grass and Commercial Cocksfoot are also very prone to run excessively to stem at this stage. It is particularly to be noted that indigenous Tall Oat-grass and indigenous Cocksfoot maintain a higher proportion of leaf shoots than do the non-indigenous strains of the same species, while Meadow Foxtail is another grass which, all through the season, consists largely of leaf shoots.

* End of May, i.e., practically hay stage.

† Considerable variation as to strain. Some strains at hay stage consist of over 90 per cent. stem shoots.

‡ Hay stage.

Contribution of Leaf-Blade to the Different Types of Shoot.—

In order, further, to demonstrate the effect on leafiness of the contribution made to herbage by the different types of shoots, the percentage of blade or lamina in "leaf shoots," panicle-bearing stem shoots and non-panicle-bearing stem shoots, at or about heading stage, is shown in Table III for a number of species.

TABLE III.—TO SHOW PERCENTAGE OF LEAF (=BLADE OR LAMINA) IN THE THREE TYPES OF SHOOTS FOR A NUMBER OF GRASSES AT OR ABOUT HEADING STAGE.

Percentages on Spaced Single Plants.

Species	Leaf Shoots*	Non-panicle-bearing stem shoots†‡	Panicle-bearing stem shoots‡
Cocksfoot	70	47	27
Perennial Rye-grass .. .	74	30	21
Red Fescue .. .	75	33	7§
Rough-stalked Meadow-grass ..	63	25	18
Sweet Vernal-grass .. .	63	33	10§
Meadow Foxtail .. .	80	26	6§

The stem shoots of Cocksfoot are more leafy than those of other grasses; in practically all cases, however, the leaf shoots contain at least twice as much leaf as the stem shoots.

Production of Panicle-bearing Shoots under Grazing Conditions.—The grasses vary very considerably in their capacity for throwing up panicle shoots under grazing conditions. This is clearly shown by comparing the number of panicles produced per plant when left to develop hay with the aggregate number produced per plant under a system of monthly pasture cuts. Such a comparison is made in Table IV.

The different species will be seen to vary very considerably in their inherent capacity for the production of inflorescences. Thus Red Fescue and Sweet Vernal-grass are very prolific, while Perennial Rye-grass, Meadow Fescue and Rough-stalked Meadow-grass produce many more inflorescences than Cocksfoot, Timothy, Tall Oat-grass and Meadow Foxtail. All the species have produced less panicles under pasture than under hay conditions. Sweet Vernal-grass and Red Fescue have, however, produced an abundance of inflores-

* The "stem" separation, consisting wholly of sheath.

† Or at all events, inflorescences not exerted.

‡ The "stem" separation, consisting of sheath true stem with inflorescences in the case of the panicle-bearing stem shoots.

§ These early grasses were in a more advanced stage than the others and, therefore, the figures are not directly comparable.

TABLE IV.—TO COMPARE THE NUMBER OF PANICLES PRODUCED PER PLANT UNDER HAY AND PASTURE CONDITIONS RESPECTIVELY. AVERAGE FIGURES PER PLANT BASED ON COUNTS MADE ON SINGLE SPACED PLANTS. THE RANGE OF FLOWERING DATES UNDER PASTURE CONDITIONS IS ALSO SHOWN.

Species	Hay conditions No. per plant	Pasture conditions; under a system of monthly pasture cuts	
		No. per plant	Dates produced
Cocksfoot	55	41	Nearly all June 7
Perennial Rye-grass ..	180	80	Most June 7; few till July 31
Timothy	97	7	All July 31
Tall Oat-grass (French)	37	7	All June 7
Meadow Fescue .. .	125	43	Nearly all June 7
Rough-stalked Meadow-grass ..	187	38	Nearly all June 7
Sweet Vernal-grass .. .	262	222	May 8 till August 2
Red Fescue .. .	325	127	June 7 till June 30
Meadow Foxtail .. .	59	51	May 8 till June 7

cences under the former conditions. The paucity of panicle production by Timothy and French Tall Oat-grass under pasture is noteworthy, while the considerably greater production by Perennial Rye-grass than by Cocksfoot is equally striking. It will be seen that Cocksfoot, Meadow Foxtail, and Sweet Vernal-grass have been affected least, by repeated cutting, in the matter of relative panicle production. Meadow Foxtail, Red Fescue, Sweet Vernal-grass, and Perennial Rye-grass continue to send up inflorescences over a longer period than do the other grasses.

General Comparison of Leaf to Stem for the Various Species.—

The figures in Table V afford material for comparing the average leafiness of some of the chief species of grasses.

Considering the average figures for hay, pasture, and aftermath, it will be seen that Cocksfoot is amongst the most consistently leafy of grasses; it is closely followed by indigenous Timothy. (Unfortunately figures are not available for commercial Timothy as the plants were very badly rusted—commercial Timothy, however, is not nearly as leafy as indigenous.) Highly leafy plants, also, are Meadow Fescue, Tall Fescue, Meadow Foxtail, Red Fescue, and indigenous Tall Oat-grass. Amongst the least leafy are French Tall Oat-grass, French Golden Oat-grass and Crested Dogtail. Perennial Rye-grass and Rough-stalked Meadow-grass take an intermediate position.

TABLE V.—TO COMPARE THE PERCENTAGE LEAF OF THE VARIOUS SPECIES OF GRASSES FOR HAY, AFTERMATH AND PASTURE. AVERAGE FIGURES ARE ALSO GIVEN FOR THE SUM OF HAY, AFTERMATH AND PASTURE, THESE AVERAGES BEING BASED ON ALL THE FIGURES SO FAR COLLECTED AT THE STATION. DATA FOR SINGLE SPACED PLANTS.

Species and strains	General average for sum of hay, aftermath and pasture	Hay	Aftermath	Pasture					Average of pre-hay, hay, and post-hay periods	Sept.-Oct.
				Autumn of seed-ing year	March and early April	Pre-hay period	Hay period	Post-hay period		
Cocksfoot: Indigenous ..	66	19	91	87	97	84	39	88	70	94
" Commercial ..	61	13	90	87	97	56	34	92	61	95
Perennial Rye-grass: Indigenous ..	57	10	87	85	92	57	23	57	46	94
" Commercial ..	50	8	82	88	90	59	19	63	47	95
Timothy: Indigenous* ..	66	19	97	79	95	86	47	76	89	94
Tall Oat-grass: Indigenous ..	60	15	82	77	96	62	62	69	64	91
" French ..	35	7	31	65	92	50	26	57	44	80
Meadow Fescue: Commercial ..	64	11	98	86	95	75	19	85	60	94
Tall Fescue: Commercial ..	64	—	—	—	—	—	—	—	—	—
Golden Oat grass: French ..	37	—	—	—	—	—	—	—	—	—
Crested Dogtail—agg. ..	42	—	—	—	—	—	—	—	—	—
Sweet Vernal-grass—agg. ..	63	18	†	77	93	67	28	63	52	90
Red Fescue: Indigenous ..	66	17	97	84	90	77	50	93	73	97
Rough-stalked Meadow-grass: Commercial ..	50	10	72	73	88	69	36	60	55	78
Meadow Foxtail—agg. ..	60	26	62	82	90	64	38	76	60	90

* Commercial Timothy not available, the plants having been almost completely killed by rust.

† Very variable, depending on date of hay cut. If hay cut early, aftermath will be about 50 per cent., the crop approximating to a second hay cut. If cut late, aftermath will be about 90 per cent.

In view of what has been said as to panicle production, it is interesting to observe that the pasture at about the time of hay harvest is much less leafy, for all species alike, than at other times. Taking the immediately pre-hay, hay and post-hay periods together, Perennial Rye-grass and French Tall Oat-grass show to very poor advantage compared with Cocksfoot and Meadow Foxtail, for example. The figures serve to show why it is that Cocksfoot, under proper management, affords such excellent summer pasturage, while Perennial Rye-grass is often disappointing at this period. The excessive leafiness of after grass is demonstrated by the figures—French Tall Oat-grass alone showing to poor advantage.

The figures for hay vary both in relation to the date of "putting up" for hay and date of cutting, a very few days' difference in cutting having a very considerable effect on percentage leaf. The stemmy nature of Perennial Rye-grass and French Tall Oat-grass hay is, however, indicated. The fact that leaf shoots predominate during the dead season is reflected in the pasture figures for March, which in practically all cases show a percentage of leaf in excess of 90 per cent.

The Effect of Management on Leafiness.—It is well known, of course, that pastures kept well grazed tend to be maintained in a high state of leafiness. This fact has been further demonstrated by the trials conducted at the Plant Breeding Station, where both individual plants and sward plots have been subjected to a system of repeated "pasture cuts."

The statement hereunder, for Cocksfoot, may be regarded as typical of numerous results obtained at the Station, and indicates the magnitude of the effect of close grazing:—

PER CENT. LEAF (= blade or lamina) OF COCKSFOOT.

When cut three times during the growing season ..	49.5 per cent.
" seven " " " ..	67.7 "
" ten " " " ..	74.5 "
" seventeen " " " ..	81.3 "

More recent trials have shown that continued cutting during one season also has the effect of making for a more leafy growth in the next. This would appear to be connected with the effect of such repeated cutting, more particularly upon the panicle-bearing, or at least upon the potential panicle-bearing, shoots.

It has been shown that, even during a current season, the continued removal of inflorescences as they are produced tends to make for greater leafiness. Thus, in the case of a

number of spaced plants representing 14 different species or strains during 1924, one series was kept continually plucked while the other was allowed to grow to normal hay. A little after normal hay harvest, all the inflorescences were carefully picked off the hay plants and both series were then allowed to grow on until August 1, when all the plants were cut and weighed and the produce separated into leaf (lamina) and stem (chiefly sheath, in some cases with a little true stem). In nine species or strains out of the 14*, the plucked series gave the highest percentage of leaf, the average figures for all the species plants involved being:—

Plucked plants	63.5 per cent. leaf (= lamina).
Non-plucked plants	57.0 " "

These figures would appear to be in support of the contention that on sheep pastures, for example, it is a sound practice to run the mowers over the fields at or about the time of hay harvest—a practice which not only removes benty and drying material, but which, probably, also actually encourages the development of a more leafy herbage.

The effect of one season's treatment on potential panicle development during the next is, however, altogether more marked. In the case of the 14 species and strains subjected to the plucking treatment above referred to, without exception, a system of 11 pasture cuts compared with a hay and aftermath cut in 1925 showed in 1926 a substantial reduction of panicle tillers. The comparison hereunder shows typical examples.

TABLE VI.—NUMBER OF PANICLE TILLERS PER PLANT AT HAY TIME WHEN SUBJECTED TO PASTURE AND HAY CONDITIONS RESPECTIVELY DURING THE PREVIOUS YEAR.

	After 11 pasture cuts	After a hay and aftermath cut
Cocksfoot: Indigenous	24.5	53.7
" Commercial	16.8	52.3
Tall Oat-grass: Indigenous	35.6	107.1
" Commercial	5.5	41.1
Perennial Rye-grass: Commercial	43.0	105.7
Meadow Fescue	13.0	60.3

Field plots kept cut from year to year on a pasture system compared with a hay system, have also shown that, on the

* The four lots which gave higher percentages of leaf on the non-plucked plants were the two strains of Perennial Rye grass (the difference in the commercial strain being only very slightly in favour of the non-plucked) and the highly leafy indigenous Cocksfoot, and indigenous Meadow Foxtail.

former plots, the tillers tend to be smaller than on the latter—while pasture following pasture tends also to be distinguished, from pasture following hay, by tillers of a smaller size. The facts, therefore, suggest that repeated cutting or heavy grazing tends in the direction of inhibiting the formation of panicle (the larger) tillers both during and subsequent to the season of heavy grazing or cutting and chiefly on this account makes for a more leafy herbage.

It is, however, at least probable that a failure to produce potential panicle tillers in normal amount denotes a loss of vigour on the part of the plants concerned. This is an aspect of repeated cutting or of heavy grazing that must be given serious consideration in relation to systems of management designed to keep pastures always in a state of super-leafiness, super-palatability and super-nutritiveness. The matter will, however, more conveniently be dealt with from this point of view in the next article, which will be concerned chiefly with tiller production.

It will have been appreciated that the evidence discussed in this article has been based on single plant data. Trials now in progress on field plots, however, show that the behaviour of the majority of the plants is qualitatively, if not actually quantitatively, similar whether grown as single plants or in sward.

Thanks are due to Miss Grice, formerly on the staff of the Station, who was responsible for the conduct of the trials upon the evidence of which this article has been chiefly based.

VIRUS DISEASES OF POTATOES AND THE RAISING OF SEED POTATOES IN THE IRISH FREE STATE

H. SOUTHWELL, A.R.C.Sc.,

Ministry of Agriculture and Fisheries.

IN marked contrast with bygone days, when a change of seed was seldom thought of, much less adopted as a regular procedure, the experience of the last few decades has developed in potato growers generally a belief that deterioration in varieties and stocks of potatoes is due to senile decay; and that, to ensure an average crop, it is necessary always to plant seed which has been grown in higher latitudes. The rapid loss of vigour and consequent loss of yield in "home-saved," sometimes called "once-grown" or "twice-grown," seed is popularly explained as a

penalty incurred through present-day specialization in potato production; but this supposition is not supported by scientific opinion.

Research into Virus Diseases of Potatoes.—Research on the problem has been carried out in several countries: by Dr. Quanjier in Holland, various workers in America, a few in this country, and, notably, by Dr. Paul A. Murphy and his assistant, Mr. R. McKay, at the Albert Agricultural College, Glasnevin, near Dublin. These investigations show conclusively that deterioration in potatoes is mainly, probably entirely, due to the presence of what are called virus diseases: the term "virus" being used because no organism has yet been isolated; and "disease," because all the symptoms and attendant results can be produced in otherwise healthy stock by natural infection and artificial inoculation.

In July last the writer visited the experimental station at Glasnevin and had the privilege of studying the results of several years' research work carried out there by Dr. Murphy, which go to confirm and supplement the results obtained by other investigators; also of visiting various places in the Irish Free State, where the practical application of the basic principles deduced from these researches are being commendably applied in the raising of seed potatoes free from virus diseases.

Some of Dr. Murphy's early researches were carried out with stocks regarded at the time as virus free, but which his subsequent investigations showed to be infected—a discovery that necessitated a revision of some years of work and a fresh interpretation of the results obtained through it. That potato stocks intended for experimental work must be free from any form of virus disease was thus recognized as essential; and no plants are now used until they have been proved by experiment to be healthy.

Testing for Presence of Virus Diseases.—This is determined by growing in a pot a virus-free tuber of such a variety as President or Arran Victory, which, when infected, are good indicators of any and every form of virus disease, the growing plant being carefully protected from external sources of accidental infection. When the haulm of such a plant is about half-grown, the terminal 2 in. is removed, and in its place is grafted the terminal 2 in. of the haulm of the plant to be tested. If any virus is present in this scion, the first leaf which subsequently arises on the stock below the union will show in marked degree the slightest trace of its presence.

Another successful method is that of tuber grafting. From the tuber to be tested a core of about 13 mm. diameter, without an eye, is removed by means of a cork borer, and inserted into an opening previously made in a healthy tuber by the removal of a similar core. The latter healthy core may contain an eye and be used as a control. This and the grafted tuber are then planted and grown under insect-proof conditions. If any virus were present in the implanted core, its effects will appear as disease symptoms in the tuber shoot; while the growth of a healthy plant from the control core is proof that the tuber employed in the test was not itself diseased.

Classes of Virus Diseases in Potatoes.—The results of the work carried out on these lines go to show, as was already known, that there are at least two well-defined classes of virus diseases, *viz.*, leaf roll and mosaic, and that the two classes are not interchangeable, *i.e.*, the virus producing leaf roll will not produce mosaic, and *vice versa*. Further, different types of mosaic have been recognized and given such names as Aucuba mosaic, rugose mosaic, crinkle, etc., and it is thought that the virus producing each type is specific for that type. These virus diseases, too, may exist together in one and the same plant; and when leaf roll and one or more types of mosaic are present in one plant, we get that characteristic stunted-looking potato plant described as "curly dwarf." The successful identification of the various kinds of mosaic diseases is the special business of the expert, and it is hardly likely that they could ever be identified by the casual observer; but when once familiar with the appearance of the healthy plant, the diseased plant can easily be seen and removed from an otherwise healthy stock.

Leaf Roll.—Leaf roll is by far the most serious of the virus diseases, but fortunately it is not as prevalent as mosaic. No potato variety has been shown to be immune from leaf roll; neither does it appear so far that strongly resistant varieties occur commonly. The transmission of the leaf roll virus to any healthy plant produces nearly the same disastrous result whatever the variety may be, and thus the reduction in yield per acre is closely correlated with the number of plants infected. With a severely infected crop the yield per acre is very low indeed, and when once a plant is infected there is no recovery.

Mosaic.—The case is somewhat analogous with mosaic. Some varieties are tolerant of it and others are not. The

meaning here of "tolerant" is that some varieties of potatoes show mosaic, but the vigour and yield are not very much reduced however much mosaic is present; and, as mosaic is very prevalent, there are certain tolerant varieties of potatoes which, outside experimental grounds, are not known entirely free from it. British Queen and Up-to-Date are cases in point. Both these varieties are well known and have been grown commercially for years, but recently they have lost prestige because (1) they are not immune from wart disease; (2) both are susceptible to and suffer greatly from blight, but neither variety is worn out. They do crop well even if mosaic is present, providing blight, wart disease, and leaf roll are absent. Varieties intolerant of the disease are most markedly affected in appearance and in yield by the virus of mosaic; and amongst such varieties may be mentioned Irish Chieftain.

Thus there is an explanation for the transient existence of many varieties of potatoes, which proved very promising when on trial, but which have been disappointing when grown commercially; and it is now possible to foretell with some degree of accuracy whether any new variety of potato is likely to become a popular, commercial, and useful potato by its tolerance or otherwise—not its susceptibility, for that bears no relation to tolerance—of mosaic. At present a new variety is tested for its immunity from wart disease, as such immunity is highly desirable; but it is of equal importance to test new varieties for their tolerance of mosaic, which is far more widespread than wart disease, and which has in intolerant varieties a more immediate and disastrous effect on the yield.

Mature and Immature "Seed."—It has been the custom in England to say that the increased vigour and greater crops resulting from Scotch "seed," compared with once- or twice-grown English "seed" of the same variety, lay in the fact (assumed or otherwise) that potato crops grown in Scotland did not mature as early or as fully as those grown in England; and thus the virtue of Scotch "seed" lay in its immaturity or its comparative lateness in maturing. Very many experiments have been carried out in England which in the aggregate proved that English "seed" obtained from crops lifted while green yielded better crops than the equivalent "seed" obtained from crops which had been permitted to mature; and growers in this country have been advised from time to time

to lift crops when green if intended mainly for "seed," and so secure the equivalent of Scotch "seed."

Dr. Murphy has clearly shown in one experiment that, if "seed" potatoes are free from virus diseases, very immature "seed" will not produce either as early or as large a crop as identical "seed" obtained from matured crops. If, however, virus diseases are present in one crop and not in the other, the matured "seed" obtained from the virus-infected plants will yield a smaller crop than the matured "seed" obtained from the virus-free plants, other factors being equal. Further, if the infected crop has resulted, not from infected "seed," but from infection during the growing season, then immature "seed" obtained from such a crop will contain less virus than the "seed" from the matured crop, for the virus in the haulms and foliage will not have had the same opportunity of reaching the tubers; and the immature "seed" in this case is most likely to produce an earlier and larger crop than the matured "seed." Thus, maturity, as such, has no bearing in the matter; it is simply a question of the presence or absence of virus diseases in the "seed."

Indeed, the summation of many years' research work on virus diseases points to the fact that the main determinants of productivity of "seed" potatoes are very closely proportional to the amount of serious virus diseases present in the planted "seed," and that the place of origin in itself is no reliable guarantee of health and productivity. As the diseases are spread by insects, the factors governing the production of healthy "seed" in any district are (1) the extent to which potatoes are grown in the district; (2) the introduction of diseased "seed"; (3) the rotation; and (4) the presence of "volunteer" plants. Where potato growing is congested the area may become, and often is, virus infected. It is no coincidence that the "seed" from the Lowlands of Scotland, from Ayrshire, yields little if any better crop in Lincolnshire than does Lincolnshire "once-grown" (Class I) "seed," while the best quality of "seed" is obtained from those areas in Scotland where potato growing is not so congested, and where the grower has at least a four years' rotation of crops.

"Seed" Potatoes from the Irish Free State.—It is these facts which the Department of Lands and Agriculture of the Irish Free State are endeavouring to put into practice in order to produce healthy and productive "seed." Nowhere in that country, except perhaps in the neighbourhood of towns, are potatoes grown to the same degree, taking area for area, as

in South Lincolnshire, and the crops are remarkably free from virus diseases. In such uncongested areas, throughout the Irish Free State, certain varieties of Scotch "seed" potatoes have been introduced with the object of raising such "seed." In one case, as much as 80 per cent. of the growing plants were removed because of "degeneration diseases." In other cases the removal of 50 per cent. was common, while in yet others a nucleus stock was selected from the stocks raised by the above treatment, every plant of which was proved to be healthy by grafting experiments; and these nucleus stocks were visited as they were being propagated in isolation, and finally the "seed" planted in a suitable area.

The minimum treatment given to these "seed" crops is a drastic roguing out of all and every sign of "degeneration diseases," and roguing for blackleg, as well as for purity, by competent pathologists and inspectors. These "seed" crops, about one or two acres each in area, are very strong, very vigorous, and true to type. The "seed" from such crops which is for sale is taken to a common store, and the Irish Free State employs inspectors whose business it is to see that one and the same variety is put together, and while being bagged for sale the inspectors reject any unsound tubers and seal the bags with the Free State seal. In this work the Irish Free State has not forgotten wart disease. The Order is very exacting and ruthlessly applied. No "seed" potatoes are permitted to leave the scheduled areas. When potatoes are being moved, inspectors are posted like guards to prevent their exit. There is every reason, then, to believe that if English potato growers obtain "seed" potatoes from the Irish Free State, in bags bearing the Free State seal, satisfactory crops will result, as has been the case with samples of this Irish "seed" grown in Essex in 1925.

In these stocks, the Free State growers, under the guidance of the Department of Lands and Agriculture, have gone farther than the Scotch "seed" potato grower in removing "degeneration diseases," the disastrous effects of which can only be judged by comparing the vigour and health of virus-free plants with virus-diseased plants. Up to the present, however, there is not an unlimited amount of this "seed" available; and it will demand the continuance of the present measures, with considerable determination and fixity of purpose, to ensure the fullest measure of success for this work. The advent of another competitor in the "seed" potato trade ought to be of advantage to the English grower. Nor is that all, for as the production of healthy "seed" potatoes is not directly affected by

such climatic variations as are normally experienced in the British Isles, it may be carried on in suitable parts of England where facilities exist similar to those in Ireland or Scotland.

In conclusion, the writer desires to acknowledge his indebtedness to Dr. Murphy for his kindness in explaining his experiments, and to Mr. W. D. Davidson, of the Irish Department of Lands and Agriculture, for the excellent arrangements made for the tour to see the numerous potato plots.

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MARKETING OF EGGS ACTS, 1924 AND 1926 (NORTHERN IRELAND)

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THE Department of Agriculture for Ireland was established in 1900, and during the ensuing 21 years devoted considerable attention to the marketing in Great Britain of Irish agricultural produce, viz., butter, eggs, potatoes, etc.

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 realized 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 January 1, 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 connexion 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.

Realizing 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 January 1, 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 realized when it is mentioned that during the first year of the operation of the Act no fewer than 1,734 licences were issued. A licence—the fee charged is 20s.—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, dispatch 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 requires.

(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 authorized 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, etc., 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 12 eggs in any 120 shall weigh less than 28 oz.
- Grade 17 lb.—For eggs of uniform size weighing 17 lb. per 120. No 12 eggs in any 120 shall weigh less than 26½ oz.
- Grade 15½ lb.—For eggs of uniform size weighing 15½ lb. per 120. No 12 eggs in any 120 shall weigh less than 24 oz.

Grade 14 lb.—For eggs of uniform size weighing 14 lb. per 120. No 12 eggs in any 120 shall weigh less than $21\frac{1}{4}$ oz.

Grade "Smalls."—For eggs too small for inclusion in the 14 lb. grade and weighing less than $21\frac{1}{4}$ 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 rehandling 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 dispatch of the last grade ("smalls") to markets in Great Britain, there are in effect only three main grades for export, viz., 17 lb., $15\frac{1}{2}$ 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 ones 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 $17\frac{1}{2}$ per cent. of the eggs offered for sale—more than 82 per cent. being $15\frac{1}{2}$ 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 $16\frac{1}{4}$ 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.

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DISPLAYS OF HOME PRODUCE

British Industries Fair.—A preliminary note on the display of home-produced foodstuffs at the British Industries Fair appeared in this JOURNAL last month (p. 1074). Now that the Fair has been held, a more detailed account may prove of interest. The Fair as a whole has been more successful than in any previous year. Nearly 100,000 people visited it, of whom practically three-fourths were trade buyers from all parts of the world.

The section which, perhaps, attracted most attention was that organized under the auspices of the Empire Marketing Board, the design and lay-out of which were entrusted to the

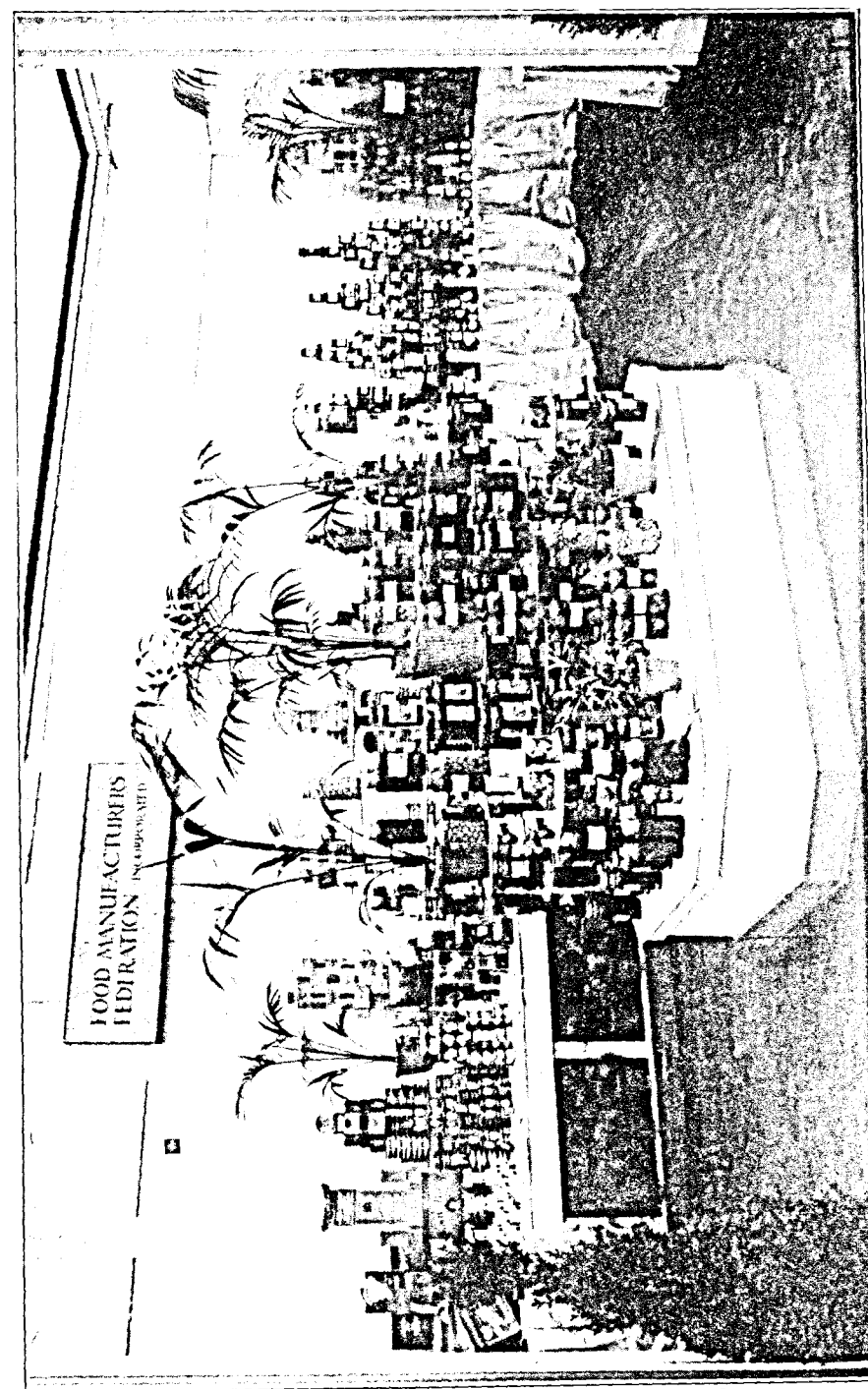
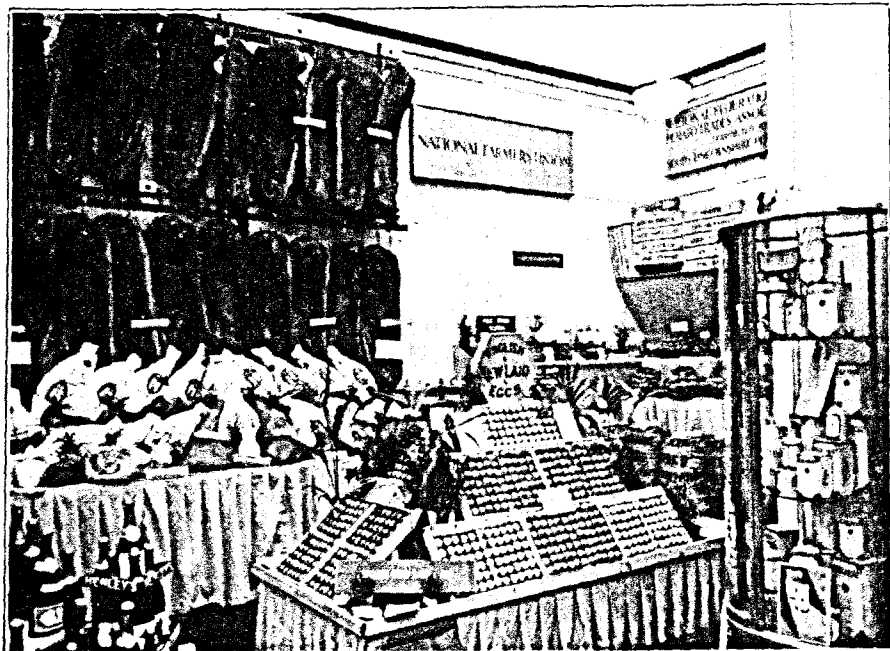


Photo Statue
Display of British packed goods; arranged by the Food Manufacturers' Federation at the British Industries Fair.

32c.



Display of produce; arranged by the National Farmers' Union
at the British Industries Fair.

(Photos: Scaine)

Department of Overseas Trade. All concerned are to be congratulated on the excellence and dignified arrangement of this symbol of Empire trade. No higher compliment could be paid than to say that it was worthy of the Empire it represented.

A spacious court of honour with a statue of St. George as centrepiece, and surrounded by a frieze depicting historical subjects, formed the centre of the section, whence wide avenues, 100 feet long, ran out on each side. Bordering the avenues, were stands in which all the Dominions and most of the Colonies, as well as India and the Mother Country, staged displays of their products.

The Great Britain section occupied a quarter of the available space and was divided into three bays. As the exhibits in this section were confined to foodstuffs, the Ministry was invited to make the general arrangements. All the produce shown in this section was of English, Welsh or Scottish origin. The first bay was devoted to a number of agricultural products arranged by the National Farmers' Union, with the assistance of other organizations, and, where necessary, of representative firms. On each side of this bay, facing the avenue, was a decorative window, in one of which the British Glasshouse Produce Marketing Association staged an attractive display of early produce, including cucumbers, rhubarb, mushrooms, seakale, grapes and flowers. These came from the Lea Valley and Worthing districts. In the other window were small items of dairy produce, such as crustless cheese in cartons, dried milk, etc. The remainder of the dairy produce was arranged inside the stand, and comprised cheeses of all kinds, including Cheddar, Cheshire, Wensleydale and Stilton, as well as further samples of the small cartons of processed cheese which are at present so popular. Home buyers were particularly interested in the produce of individual farmers.

The Western Curers' Association, the Midland Curers and the St. Edmondsbury Co-operative Bacon Factory were responsible for a representative display of home-cured bacon and hams, which greatly interested both British and foreign buyers. The exhibit of seed and ware potatoes from Lincolnshire and Scotland also attracted considerable attention. This was arranged by the National Federation of Fruit and Potato Trades' Associations, and resulted in a considerable number of orders and inquiries, both for the home market and for export. Another exhibit which, although small, was significant, was that arranged by the British Sugar Beet Society. Specimens

of sugar from the various British beet factories were shown, also samples of molasses and dried pulp.

In the centre of the stand was a pyramid display of bottled cider staged by the National Association of Cider Makers. On each side of this was a striking exhibit of graded eggs put up by the Wiltshire Egg Producers, Ltd., and the West of England Egg and Poultry Merchants' Association respectively. Here much business was done, which fully justified the action of the National Farmers' Union in laying down the rule that only graded eggs should be shown. Considerable interest was shown in the system adopted by Wiltshire Egg Producers, whereby each egg is stamped with a trade-mark, which carries with it a guarantee that the egg when sold to the consumer is not more than 14 days old. This firm delivers the eggs to the retailer within four days of laying, and the retailer buys on condition that he will not sell the eggs after 10 days from the date of receipt. The firm has means of checking that this condition is observed.

The next bay contained a representative display of British canned fruit staged by the National Food Canning Council. This is an industry which has recently shown promising activity and, although by far the greater part of the canned fruit consumed in this country is still imported, it is satisfactory to see that British canned fruit more than holds its own so far as quality and variety are concerned. Practically every fruit grown in this country can now be obtained in tins all the year round. Many inquiries were made by overseas buyers.

The third bay was devoted to a representative display of packed foodstuffs arranged by the Food Manufacturers' Federation. This covered such diverse subjects as bottled and canned fruits and vegetables, meat and fish in tins and jars, cereal products in packets and tins, preserves, jellies, pickles, biscuits and beverages. Here again it was gratifying to see that the Mother Country is abreast of developments in modern methods of processing and packing foodstuffs. Many inquiries both for home and export markets were received.

Ideal Home Exhibition.—The general arrangements for Empire products were similar to those at the British Industries Fair, except that home-grown produce, through the Ministry, was allotted more of the available space. Unfortunately the National Farmers' Union was not able to participate in this

Exhibition, but arrangements were made by the Ministry for the Food Manufacturers' Federation, the National Food Canning Council, the British Glasshouse Produce Marketing Association and the National Cider Makers' Association to stage effective displays. An exhibit of British bacon and hams was included with the products staged by the Food Manufacturers' Federation. In addition, the National Milk Publicity Council arranged a good display of dairy produce, including cheese of all kinds, as well as fresh, condensed and dried milk.

The demonstrations of cooking with Empire produce, which were given continuously in four fully equipped kitchens, proved an attractive feature. Home produce received adequate attention in these demonstrations, a large quantity of material for this purpose having been supplied gratis by the Food Manufacturers' Federation, the National Association of British and Irish Millers, the National Milk Publicity Council, and the National Federation of Fruit and Potato Trades Associations. In addition, and with a view to stimulating the consumption of potatoes, arrangements were made by the Ministry for the chef of the First Avenue Hotel, Holborn, to give a demonstration every evening of the culinary possibilities of potatoes. This aroused great interest. A special leaflet, showing 20 of the more popular ways of cooking potatoes, was prepared by the Ministry for circulation at this demonstration.

In conclusion, it may be added that participation in the British Industries Fair and in the Ideal Home Exhibition was undertaken with a two-fold purpose: (1) to demonstrate by collective advertisement that home-grown produce can hold its own in point of quality with the more widely advertised imported goods, and (2) to encourage a sentiment in favour of home produce. Without exception, those who exhibited produce agree that, in both respects, the Great Britain sections have amply justified themselves. There is no doubt that the King and Queen were voicing the views of the majority of the visitors to the British Industries Fair when, after making a thorough inspection of the stands, Their Majesties expressed their gratification that British produce was so well represented.

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SUGAR BEET GROWING

FOR the first time in history, this country is now producing within its shores a substantial proportion of the enormous home consumption of sugar. The rapid increase in the area under sugar beet during the past few years—from 3,000 acres in 1920 to 125,000 acres in 1926, and probably a further increase to 200,000 acres in 1927—is due to the interest taken by successive Governments in the crop, culminating in the generous subsidy granted in 1924 for a period of ten years. This subsidy is on a sliding scale: for the first four years, *viz.*, 1924 to 1927, it is at the rate of 19s. 6d. per cwt. of sugar produced; for the next three years, at 13s. per cwt.; and for the last three years, at 6s. 6d. per cwt. In addition, a certain fiscal advantage is enjoyed as compared with sugar produced outside the Empire. With the help of these concessions, sugar-beet factories are now able to offer an attractive price to farmers, sufficient to produce a wide expansion of the area under beet. This price must inevitably fall with the subsidy, and when the latter ceases the home sugar-beet industry must stand on its own feet, enjoying only such fiscal advantage as may be granted to sugar produced within the Empire.

The advantages of the crop, both nationally and from the point of view of the farmer, are many. The sugar beet is a deep-rooting plant, requiring good cultivation and heavy manuring, which react favourably on succeeding crops. The crop provides an exceptionally large quantity of human food per acre. It is grown by the farmer under contract with the sugar factory, so that he is saved the trouble of finding a market for his produce, and it provides an excellent cleaning crop in the rotation, for which the farmer receives a cash return in place of the ordinary root crop of mangolds or turnips, which is expensive to grow and often unremunerative. It encourages good cultivation, since the price the farmer receives depends on the sugar content and yield of his crop; and the residues, in the form of tops and leaves, as well as the dried pulp obtained after the extraction of the sugar, provide useful food for stock. The manufacture of sugar in the factories has to be carried on day and night for a period of about 100 days, from October to January, and this provides work for about 500 men at each factory at a time when the labour requirements on the land are practically at their lowest.

From every standpoint, therefore, it is to be hoped that the home production of beet sugar will prove to be permanent, but if this end is to be attained the cost of production and manufacture must be reduced within the next few years, so that when the subsidy terminates the industry will still be attractive to all concerned.

There are still points connected with the growing and harvesting of the crop on which the best method of procedure is debated, and a wide series of trials is at present being laid down to investigate these questions. It may be said at once, however, that the relatively low average yield of eight tons per acre, which is at present obtained in this country, must be substantially increased if the industry is to continue as an economic proposition when the subsidy is withdrawn. Existing knowledge of cultivation methods is already adequate in most respects, and high yields are obtained by farmers who choose their land with care, make the crop a first consideration in their farming policy, and give it the attention which it needs.

The notes which follow, dealing with the growing and handling of the crop, are compiled from various sources,* and represent experience both in this country and on the Continent. Although the broader lines of good cultivation are established, however, it should be emphasized that the farmer must experiment for himself. Only by constant attention to the crop in the effort to secure the maximum yield at the minimum cost can sufficient improvement be secured to maintain the home production of sugar as a permanent industry in this country.

Climate.—The English climate is exceptionally favourable for sugar-beet growing, and the relatively mild autumn and early winter enable the farm and factory processes to be continued for a longer period than on the Continent. The crop requires a long growing period, the latter part of which must be fairly warm and not too wet. At the time of ripening the formation of sugar takes place, and this is materially expedited if a few days of frost terminate the growing period during autumn. A warm summer with sufficient rainfall at the start

* For more detailed information readers are advised to consult *Sugar Beet and Beet Sugar*, by R. N. Dowling, N.D.A. (London: Ernest Benn & Co.) Much of the information given in this article has been obtained from this source and from Mr. Dowling's earlier book, *Sugar Beet from Field to Factory*. (2s. 6d. Published in 1925 by the same publishers.)

is desirable—the amount of summer rainfall required differing, of course, with the type of soil, heavy soils needing less than light soils.

Soil.—Sugar beet is being successfully grown on the large majority of soil types in this country, with the possible exception of very heavy clays. The ideal soil is a deep, friable, and free-working loam, free from stones, with a consistency neither too light for reliable cropping in a dry season nor too heavy to cause difficulty in a wet season. Under suitable soil conditions the beet grows a long tapering root without fangs; this is easy for lifting and the most suitable form for factory purposes, inasmuch as the maximum sugar extraction is secured.

Some of the more important characteristics that sugar beet does not like in soils are (1) the presence of a “pan” or hard, impenetrable condition under the plough depth; (2) excess of water in a badly drained soil; (3) an acid or sour soil suffering from a marked shortage of lime and the presence of an excess of organic matter; (4) any condition upsetting the natural supply of water from below, *e.g.*, a gravel subsoil. In regard to the first-named objection, there is evidence that the practice of subsoiling may overcome it and make the soil satisfactory, if otherwise suitable.

Rotation.—Sugar beet may be substituted for mangolds or swedes in any of the ordinary rotations practised in this country. It does well after cereals and it makes a good preparatory crop for winter wheat if it can be lifted soon enough. It is a splendid preparation for potatoes, and, in fact, for any crop requiring a deep rich tilth. Many farmers in this country have grown oats and barley after sugar beet with marked success. Although sugar beet generally replaces part of the root crop or potatoes on suitable land, it can be grown as required in odd fields irrespective of a definite rotation. It can be successfully grown for two or three or more years in succession on the same land, although this course is open to the grave risk of encouraging insect pests.

Seed per Acre.—At least 15 lb. per acre is required to be sown under the factory contracts, and in most cases this quantity could be increased with advantage. The ideal to be aimed at is the quantity of seed which, in an ordinary season, will provide, after singling, a regular plant without gaps. As transplanting is not done with beet, any blanks due to irregular seeding become a definite factor in determining the yield per acre. The seed is supplied by the factory, and although farmers are now being given a choice of varieties, little knowledge

exists as to their relative merits in this country. This question is now being investigated, and farmers would be well advised to pay attention to the point and also to note the name of the firm from which their seed is obtained, as knowledge of the behaviour of stocks would be of great value. At present the seed is as a rule obtained from the Continent, although the possibility of producing it in this country is being explored. Sowing is usually done on the flat, although some farmers favour ridges, which reduce cultivation costs. The width apart of the drills is a debated point. Continental experience favours a width of 15 in. between the rows, and a distance of 10 in. between the beets in each row. In this country, however, there is some evidence that a wider drill width, say from 18 to 22 in. on the flat, and 24 in. on the ridge, produces an equally good crop and considerably facilitates cultivation. Singling 8 to 10 in. between the beets according to the width of row is suitable—the wider the row, the closer the singling.

The time of drilling is important. If the crop is sown too soon, the early growth, if succeeded by a spell of cold weather, induces a tendency to “bolting.” Generally speaking, seeding time starts about the middle of April and goes on throughout May. The most suitable time is when the soil is in a free-working, moist condition and the temperature sufficiently high to promote quick germination and steady growth. Growers of large areas usually sow in sequence; this allows the various sowings to be singled with a smaller number of workers.

Preparation for Sowing.—The autumn cultivations are similar to those usually carried out for a mangold crop, except that, whereas the dressing of farmyard manure to the latter crop is sometimes applied in the spring, it should, in the case of sugar beet, always be applied in the autumn or winter and ploughed in. If beet is following a straw crop, it is an advantage for the cultivator to be at work on the stubbles as soon after harvest as possible, to clean the land before the dung is applied and ploughing takes place. Autumn cleaning should be followed by deep winter ploughing; where possible the depth should be 12 inches or even more. The first ploughing should not be left until the spring. In power ploughing, subsoiling tines may be used on the plough, thus moving the soil to a depth of 14 to 18 in. or more, where considered advisable.

The order and nature of the workings in preparation for a seed bed will necessarily vary under different conditions, but the object should be to obtain a fine tilth to a sufficient depth and with enough firmness to ensure close contact of the

soil with the seed. This is brought about by the judicious use of the cultivator, harrows and roller, preferably a ring roller, both before and after drilling. Too much stress cannot be laid on the importance of the roller on the lighter types of soil, not only to bring about close contact of soil and seed, but to promote the upward movement of water from the subsoil to the seed area. Skilful cultivation, accompanied by drilling the seed to a proper depth (not more than 1 in., and preferably less) in an even manner, will go a long way to ensure even and rapid germination and the establishment of a good stand of healthy young plants.

Manuring.—The dressing of farmyard manure, which should be applied in the autumn or winter, should not be more than 15 tons per acre on any soil, and if it is of good quality 12 tons should be sufficient. There is a danger of overfeeding the crop with organic matter, an excess of which tends to produce foliage at the expense of root. Although, therefore, from the point of view of the rotation and the following crop, the dung may be applied to the crop direct, this may be dispensed with in cases where a dressing of dung has been applied to the preceding crop and the soil is in good heart. In such circumstances successful crops of beet can be grown with the use of artificial manures alone.

The precise manurial treatment will vary in different localities according to the nature and condition of the land and the manuring of preceding crops. The experienced grower will manure his land according to his intimate knowledge of the farm, making comparative tests to secure the best results, and no two growers will be found to act exactly alike in this respect. The under-mentioned examples are given by Dowling as an approximate guide to the relative values of the different manures on various soils, the quantities in practice being increased or reduced according to the condition of the land and the nature of the soil. In each case it is assumed that farmyard manure (12 tons per acre) has been applied. Where no farmyard manure is used the dressings should be increased by about one-third.

Type of Soil	Super-phosphate 30 per cent. cwt.	Muriate or Sulphate of Potash cwt.	Sulphate of Ammonia cwt.
Good Sandy Loams	3	1½	1½
Poor Sands	3	2	2
Limestone Soils	3	1½	1½
Clay Loams	4	½ to 1	1 to 1½
Peaty Soils	4	1½	1
Fen Soils	6	½ to 1	1

Top Dressings.—There is evidence that a profitable increase in crop yield may be looked for by an application of one or two top dressings of a quick-acting nitrogenous manure at the rate of about 1 cwt. per acre for each dressing, due consideration being given to the natural fertility of the soil, previous or present applications of farmyard manure and the amount of nitrogen applied before drilling when deciding as to quantity and number of dressings. The dressing may take the form of any of the quick-acting fertilizers, such as nitrate of soda or nitrate of lime, the first dressing being applied at singling and the second two or three weeks later.

Experience, however, both on the Continent and in this country, is tending towards heavier applications of nitrogenous fertilizers—up to 3 cwt. per acre before drilling—followed by a top dressing of 1 cwt. nitrate of soda per acre immediately after singling.

On sandy loams the use of nitrate of soda as the only source of nitrogen applied before sowing the seed is recommended by some authorities. Calcium cyanamide can be used to replace sulphate of ammonia if desired, but it should be applied separately and some weeks in advance of the ordinary mixture. Where the soil is poor in lime, nitrate of soda, nitrate of lime or calcium cyanamide may be used as a source of nitrogen.

Potash.—On sandy and the lighter types of soils it is well to apply the potash dressings as kainit or potash salts, which should be broadcast earlier than the rest of the mixture, or it is a good plan to apply part as kainit or potash salts early and the remainder as muriate of potash with the mixture. If kainit (14 per cent.) is used nearly four times the quantities will be required as given above for muriate, which contains about 50 per cent. of potash, and if 20 per cent. or 30 per cent. potash salts are used the quantities should be increased in proportion to their decreased potash contents. The time for applying the mixture is when working the land down for drilling.

Drier for Mixtures.—The addition of steamed bone flour at the rate of 2 cwt. per ton of mixture will keep the latter in dry condition and assist the manures to run easily through the distributor.

Hoing and Singling.—It must be emphasized that success in sugar-beet cultivation depends very largely on adequate hoeing and early thinning of the crop, the object being to cause all the efforts of growth to be concentrated upon the best plants which are being isolated to create the sugar. The horse

hoe should be at work as soon as the plants are visible in the rows. It is advisable to have them fitted with protecting discs for the first early hoeing. Several such light draught horse hoes are now on the market capable of hoeing two or four rows at a time. The ordinary corn multiple hoe can easily be converted for sugar beet by fitting wider shares and disc coulter. The corn hoe should be run on the same breadth as the drill. In hoeing care should be taken not to damage the leaves or to draw away the soil from the roots. Hoeing must be maintained not only by the horse hoe between the rows but by the hand hoe between the plants in the row. This hand hoeing should also start early, and the plants should be struck out or bunched as soon as the second pair of leaves appears and when the plants are but 1 inch high. Hoes with 5 to 6 inch blades are generally used for singling the plants to a width of from 8 to 10 inches, care being taken that there are no doubles left in the row. Singling is done by hand on the Continent, and where possible this is much the better plan. The best plant in the bunch is selected; two fingers of the left hand are used to protect it, i.e., one on each side of the plant, with the back of the hand resting on the land. Then the other plants are pulled away with the right hand, and the soil pressed round the remaining plant by the two fingers of the left hand that are used to protect it.

Where the plants are first gapped, singling should follow immediately. This operation is often left too late, with consequent increase of costs and decrease of crop yield, and the importance of singling when the plants are really small cannot be too strongly emphasized. Farmers do not always realize how much damage is done by careless singling, careless hoeing, and by horses' feet during the operation of horse-hoeing; nor do they appreciate the fact that delay in thinning inevitably means reduced yield. Beet growing requires frequent cultivation of the land after singling until the leaves meet and prevent working without damage. It necessitates special attention to the loosening of the soil between the plants. This allows light and air to penetrate the soil to the benefit of the crop.

Harvesting.—Ripeness is indicated by drooping of the outer leaves and their changing to a yellowish-green colour. About three-quarters of the foliage should have wilted, but the central leaves should still be fresh and green. Unless only a small area is grown, which can be dealt with by a specially designed

spade or two-pronged fork, lifting should be carried out by a horse-drawn lifter, of which several simple and comparatively inexpensive types are on the market. This loosens the beets so that they can easily be pulled out by hand from the surrounding soil. They are then knocked together two at a time to remove as much soil as possible, and laid in rows. The roots should then be topped, which can best be done by one blow of a heavy knife as they lie in rows. Thereupon they are thrown into heaps; if not to be carted immediately, the heaps should be covered with tops.

The operation of topping requires care, inasmuch as the cut must be made at a point below the lowest leaf or bud so as to decapitate that part that was growing above the soil surface known as the crown. The crown is useless for sugar extraction and harmful to the manufacturing processes.

If the roots have to be kept for several weeks before the factory can take delivery, they should be topped and lightly covered, for example, with the tops and leaves. If a longer delay is involved, it is advisable to put the roots into clamps, which should not be too big, and should be first covered with soil, then with straw, and then with more soil, care being taken to ventilate them during the early period of clamping.

Delivery to the Factory.—The price paid by the factory is a delivered price per ton of washed and topped beets, and varies according to the sugar content of the crop as ascertained by the factory chemist. A calculation is made of the percentage of tare delivered by the grower in a fair sample, which is washed and retopped (if necessary). It is, therefore, to the grower's interest (a) to top correctly, and (b) to send the roots as free from dirt as possible, as otherwise he will be paying carriage upon weight for which he does not receive payment. The roots are washed at the factory and not by the grower. As the sugar content is ascertained from a sample of the roots in the form in which they enter the factory, and as the crown contains a relatively small amount of sugar, the grower who does not top properly will reduce the proportion which the sugar content bears to the weight of the whole root. This is important to him in its effect upon his price. If he fails to attend to the points set out above, he will reduce his profit per acre, as he is paid according to the actual net tonnage delivered. He should also fully load the railway trucks, as the carriage rate for beet is fixed upon a minimum load of six tons.

By-Products—(1) Sugar-Beet Tops.—It is computed that five tons or more of sugar-beet tops per acre, including about one ton of crowns, remain on the field after removal of the roots. These may be ploughed in or, as is the general practice on the Continent, used for feeding to stock. Although a watery food, containing no more than about 15 per cent. of dry matter, the latter is very rich in protein and carbohydrate, nearly one-quarter of the latter being present in the form of sugar. Broadly speaking, the chemical composition closely resembles that of other forms of succulent green forage. It is computed that the starch equivalent of the material is 54 lb. per 100 lb. of dry matter—a very satisfactory nutritive value, higher than that of the best quality meadow hay.

The tops are sometimes collected and carted for feeding to dairy cattle, but the simplest and most usual form of utilizing them consists in allowing sheep to eat them off the land. By this means the trouble and expense of carting are avoided, and the return of manurial residues to the soil is assured. In the eastern counties they have been found especially good food for the ewe flock.

An alternative method of feeding the tops is in the form of ensilage. On the Continent ensiling alternate layers of beet tops and wet pulp is a common practice; this method has been tested at Cambridge with good results. Clamp silage, another common Continental method, has also been successfully tried in this country. The whole subject of ensilage, however, requires further investigation.

(2) Sugar-Beet Pulp.—The grower is allowed, under the beet contract, to purchase from the factory up to 5 per cent. of the net weight of beet delivered in dried beet pulp at the special price stated in the contract. This dried pulp can be stored over long periods, and is a popular feed on the Continent and in America. It can be satisfactorily fed dry, but where large allowances are given in the rations the pulp should be soaked before feeding, in which process it takes up more than twice its weight of water. Satisfactory results are being obtained in this country from feeding to all classes of farm stock, including dairy, and all classes of cattle, sheep, pigs and poultry. With animals receiving heavy allowances of mixed protein concentrates a little pulp may be included in the ration with advantage, since it lightens the mass of concentrate and has a laxative effect, thus preventing digestive troubles. In regard to nutritive value 1 lb. of dried

pulp may be considered equal to about 8 lb. of mangolds. From $\frac{1}{2}$ lb. to 1 lb. may be fed to ewes with advantage when roots are not available. The use of the wet beet pulp is limited to farms in the vicinity of the factories, owing to the cost of transport. Dairy cows consume the wet pulp with relish and yield milk of good flavour provided it is fed in not too large quantities. The beet pulp should be balanced with hay and concentrates to compensate for its deficiencies in protein and mineral constituents, and, of course, roots should not be included in the ration. The wet pulp must be used with care, as it tends to spoil rapidly on exposure to air. For this reason it is frequently preserved in silos or pits with or without beet tops. On the Continent, molasses, a factory by-product, is mixed with wet or dry pulp and fed to stock.

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TRIALS OF MANGOLDS, SWEDES, AND MAIN CROP POTATOES, 1926

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THE following preliminary notes on yield and quality trials of mangolds and swedes, and yield and maturity trials of potatoes, are published as having immediate interest. In 1925 the National Institute of Agricultural Botany began three-year trials of mangolds and swedes, both at Cambridge and its sub-stations. The varying effects of seasonal factors make it necessary to defer definite recommendation until the trials are pleted; but brief progress reports after each year's trial will no doubt be of interest to farmers. Particulars of the 1925 trial are about to be published in the Institute's *Journal*, No. 6,* and the following notes provide a summary of the 1926 results.

Mangold Trials.—In the mangold trials, carried out at six stations in 1926, the following three varieties were under test at all centres: Yellow Globe, Golden Tankard, and Red Intermediate. New Century was tested at Norwich only. The yields of roots are given in Table I. Yellow Globe was used as the common standard against which each of the other varieties was tested. To facilitate comparison of the results, they are expressed in percentages, the yield of Yellow Globe being expressed as 100 per cent., and those of the other varieties as percentages thereof. For example, at Sprowston, Red Intermediate yielded 18.8 per cent. more than Yellow

* Obtainable from the Secretary, N.I.A.B., Huntingdon Road Cambridge, price 1s. 2d. post free.

TABLE I.—MANGOLD TRIALS, 1926: YIELD OF ROOTS PER ACRE.

	Cambridge	Sprowston, Norfolk	Long Sutton, Hampshire	Leegomery, Shropshire	Newton Abbot, Devon	Good Easter, Essex	Average
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Yellow Globe (Control)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Red Intermediate	94.2	118.8	111.8	93.1	99.0	101.7	103.1
Golden Tankard	89.1	71.4	81.2	83.0	78.5	84.7	78.0
New Century	—	92.8	—	—	—	—	92.8
Average yield of Yellow Globe in tons per acre	Tons 27.5	Tons 26.11	Tons 26.07	Tons 23.9	Tons 12.97	Tons 29.05	Tons 24.27

TABLE II.—MANGOLD TRIALS, 1926: YIELD OF DRY MATTER PER ACRE

	Cambridge	Sprowston, Norfolk	Long Sutton, Hampshire	Leegomery, Shropshire	Newton Abbot, Devon	Good Easter, Essex	Average
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Yellow Globe (Control)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Red Intermediate	105.4	130.0	112.8	90.5	109.2	116.0	110.7
Golden Tankard	93.5	92.8	94.5	103.6	103.7	105.8	99.0
New Century	—	96.0	—	—	—	—	96.0
Average yield of Yellow Globe in tons per acre	Tons 2.59	Tons 2.54	Tons 2.46	Tons 2.36	Tons 1.61	Tons 3.15	Tons 2.45

Globe, and Golden Tankard 28.6 per cent. less. In considering a single year's trial, little attention should be paid to differences of less than 10 per cent.

On these figures there is little to choose between Yellow Globe and Red Intermediate, except at Sprowston and Long Sutton. Golden Tankard, as was to be expected, gave a much lower yield than any of the other varieties.

Yield of roots, however, is not the only point to be considered; the farmer who grows roots for consumption on his own farm is also interested in the feeding value of the crop. It is usually held that dry matter and sugar content are the best indications of quality in this respect. These two features have been determined by laboratory analysis, and in Tables II and III are given the yields of dry matter and sugar per acre at every station, Yellow Globe again being taken as 100 per cent. in each case.

Red Intermediate proves superior in dry matter as in yield: at every station except Leegomery the dry matter per acre is greater than that of the other varieties. On this basis there is little to choose between the remainder, but it should be noted that the high quality of Golden Tankard largely compensates for its low yield of roots. As was to be expected, the quantity of sugar in the roots follows the dry matter. Red Intermediate is markedly above the remainder except at Leegomery.

It is interesting to note that at Leegomery Red Intermediate did badly both in yield and quality, and farmers in that area might be wise to await further trials before growing it. In the other districts Red Intermediate is the outstanding variety in the trial when yield and quality are considered together. For yield of roots alone Yellow Globe runs it very close, but if quality, rather than yield of roots, is the main consideration, Golden Tankard is at every station the best of these varieties to grow.

It must be pointed out that in these trials no account is taken of keeping quality, ease in lifting, or other features which, apart from yield and feeding value, must influence farmers in their decision as to what variety to grow.

Swede Trials.—The data from these trials have been dealt with in the same way as those of the mangold trials given above. Table IV gives the yields of roots per acre. The control—Round Purple Top—is represented as 100 per cent., and the other types are calculated as being so much per cent. better or worse than the control.

TABLE III.—MANGOLD TRIALS, 1926: YIELD OF SUGAR PER ACRE

	Cambridge	Sprowston, Norfolk	Long Sutton, Hampshire	Leegomery, Shropshire	Newton Abbot, Devon	Good Easter, Essex	Average
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Yellow Globe (Control)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Red Intermediate	104.4	128.3	122.1	94.6	129.8	116.1	115.9
Golden Tankard	86.1	92.3	110.1	105.4	117.4	106.8	103.0
New Century	—	107.6	—	—	—	—	107.6
Average yield of Yellow Globe in tons per acre	Tons 1.65	Tons 1.58	Tons 1.44	Tons 1.56	Tons 0.85	Tons 2.08	Tons 1.53

TABLE IV.—SWEDE TRIALS, 1926: YIELD OF ROOTS PER ACRE

	Cambridge	Sprowston, Norfolk	Long Sutton, Hampshire	Leegomery, Shropshire	Good Easter, Essex	Average
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Round Purple Top (Best of All) Control	107.0	100.0	100.0	107.0	100.0	107.0
Tankard Purple Top (Giant King)	95.4	96.0	102.0	86.8	105.5	97.1
Semi-Tankard Purple Top (Superlative)	119.0	109.0	103.3	106.1	108.9	109.3
Round Bronze Top (Gateacre)	111.1	107.0	107.5	107.8	113.0	109.3
Globe Green Top (Conqueror)	98.0	100.5	122.5	92.8	102.6	103.3
Smith's Green Top	84.4	94.7	120.6	94.0	90.2	96.8
Purdy's Swede	—	115.8	—	—	—	115.8
Average yield of Round Purple Top in tons per acre	Tons 13.12	Tons 13.64	Tons 7.66	Tons 19.09	Tons 21.73	Tons 15.05

It should be noted that at Long Sutton the yields (and as a consequence the accuracy of the trial) were so low that little attention can be paid to the results. At the other centres any differences of more than 8 per cent. may be regarded as of practical importance.

Purdy's Swede is a local production of Norfolk and is not on the market. This, combined with the fact that it was only tested at one station, makes its behaviour of little more than local interest for the present. Semi-Tankard Purple Top has shown consistently high yield, as was the case in the 1925 trials. Round Bronze Top has equalled it in the present year, thus improving on its behaviour in 1925. Smith's Green Top, which is also not yet on the market, gives a low total yield as in the previous year, except at Long Sutton.

In yield of dry matter, the differences between types are very small, except in the case of Purdy's Swede and Smith's Green Top. In most cases they reverse the 1925 results. Purdy's Swede owes its position at the head of the list to its high yield of roots, but Smith's Green Top comes up from last to second on account of its high content of dry matter.

In yield of sugar per acre Purdy's Swede is again top, but this is, as said before, only as a result of a single trial. Smith's Green Top comes second, again making up by its quality for its low yield of roots. Although it holds its high average position mainly as a result of its very good showing compared with the others at Long Sutton (where all types did badly) it did quite well at the other stations, and the two years' tests suggest that it may prove a useful type where farmers wish to grow small bulks of roots of consistently high quality for home consumption. Where greater bulk is desired, probably Round Bronze Top or Semi-Tankard Purple Top would be more satisfactory. When the 1927 trials are finished it is hoped to be able to decide how far these results hold good from year to year.

Main Crop Potatoes.—Following the practice adopted above in the case of roots, the ensuing tables give the main data of the Institute's potato trials in 1926. Both in this year and in 1925, varieties normally placed in the main crop group were under test. A full report of the 1925 trials is being published at an early date in the *Journal* of the Institute, No. 6, now in the hands of the printer, and a similar detailed report on the results now under review will be given in the same publication at a later date.

TABLE V.—SWEDE TRIALS, 1926: YIELD OF DRY MATTER PER ACRE

	Cambridge	Sprowston, Norfolk	Long Sutton, Hampshire	Leegomery, Shropshire	Good Easter, Essex	Average
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Round Purple Top (Best of All) Control	100.0	100.0	100.0	100.0	100.0	100.0
Tankard Purple Top (Giant King)	94.5	92.0	107.3	88.7	107.2	97.9
Semi-Tankard Purple Top (Superlative)	105.7	98.2	104.2	92.3	101.9	100.5
Round Bronze Top (Gateacre)	106.6	100.6	106.5	100.7	104.4	103.8
Globe Green Top (Conqueror)	98.5	100.7	113.8	84.3	102.8	100.0
Smith's Green Top	94.3	103.5	138.8	108.1	97.0	108.3
Purdy's Swede	—	113.8	—	—	—	113.8
Average yield of Round Purple Top in tons per acre	Tons 1.41	Tons 1.56	Tons 0.81	Tons 1.61	Tons 2.19	Tons 1.52

TABLE VI.—SWEDE TRIALS, 1926: YIELD OF SUGAR PER ACRE

	Cambridge	Sprowston, Norfolk	Long Sutton, Hampshire	Leegomery, Shropshire	Good Easter, Essex	Average
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Round Purple Top (Best of All) Control	100.0	100.0	100.0	100.0	100.0	100.0
Tankard Purple Top (Giant King)	87.5	89.6	100.0	79.1	102.6	91.8
Semi-Tankard Purple Top (Superlative)	111.7	98.6	102.8	97.3	107.1	103.5
Round Bronze Top (Gateacre)	116.3	102.7	107.5	111.5	100.0	107.2
Globe Green Top (Conqueror)	108.2	95.6	110.5	94.0	87.3	98.7
Smith's Green Top	95.2	98.5	129.3	114.0	104.5	108.3
Purdy's Swede	—	126.5	—	—	—	126.5
Average yield of Round Purple Top in tons per acre	Tons 0.65	Tons 0.71	Tons 0.37	Tons 0.67	Tons 1.13	Tons 1.01

For the sake of clarity in the present instance, the behaviour of each variety is compared with one of the included varieties (Kerr's Pink) which was represented in the trials at all stations. The trials were conducted in a similar manner to the potato trials carried out by the Institute in previous years. It will be seen that the yield results from the several stations vary considerably, and the amount of reliance to be placed in the average must be small. The trials, however, furnish some indication which may be of use to growers, though they are not in any way conclusive.

TABLE VII.—YIELD OF TUBERS PER ACRE

	Ormskirk, Lancs	Kirton, Lines	Truro, Cornwall	Average
	Per cent.	Per cent.	Per cent.	Per cent.
(1) Kerr's Pink	100.0	100.0	100.0	100.0
(2) Up-to-Date	—	107.0	86.6	96.8
(3) Majestic	97.0	100.2	85.5	94.2
(4) McGill and Smith's 8215	72.5	102.4	97.9	90.9
(5) Rhoderic Dhu	93.8	81.5	—	87.7
(6) Tinwald Perfection	77.5	83.5	101.8	87.6
(7) Arran Chief	—	91.4	83.4	87.4
(8) Arran Consul	85.2	73.5	95.6	84.8
(9) King Edward	—	75.9	91.2	83.6
(10) Ally	84.1	74.2	82.5	80.3
(11) Bishop	70.3	67.7	—	69.0
(12) Golden Wonder	51.0	—	—	51.0
(13) Field-Marshal	—	48.2	29.7	39.0
Yield of Kerr's Pink in tons per acre	Tons 13.48	Tons 13.70	Tons 9.74	Tons 12.31

It can definitely be stated that Kerr's Pink is one of the heaviest croppers in cultivation. The particular stock of Up-to-Date grown in this trial has done very well, but there are many stocks in the country which have lost their vigour through virus diseases, and the result in the case of this variety in the present trials must not be taken as a general estimate of its value. Majestic has behaved much more according to expectation than in 1925, when a weak stock was undoubtedly responsible for its poor showing. The remainder need little comment except for Field-Marshal. This variety was undoubtedly represented by an inferior stock, and the 1925 result is more likely to be reliable.

Saleable produce is all that fails to pass through a $1\frac{1}{4}$ in. riddle, i.e., "ware" plus "seed." Majestic (as was to be expected) and Arran Consul have done very well in this

TABLE VIII.—YIELD OF SALEABLE PRODUCE PER ACRE

	Ormskirk, Lancs	Kirton, Lincs	Truro, Cornwall	Average
	Per cent.	Per cent.	Per cent.	Per cent.
(1) Majestic	125.5	109.4	118.5	117.8
(2) Arran Consul	113.5	85.3	121.8	107.2
(3) Up-to-Date	—	110.9	90.1	100.5
(4) Kerr's Pink	100.0	100.0	100.0	100.0
(5) Tinwald Perfection	83.6	85.6	129.5	99.6
(6) Rhoderic Dhu	111.8	85.3	—	98.6
(7) McGill and Smith's 8215	67.2	103.1	119.0	96.4
(8) Ally	102.4	81.3	99.5	94.4
(9) King Edward	—	83.4	97.8	90.6
(10) Arran Chief	—	89.5	90.4	90.0
(11) Bishop	75.7	68.7	—	72.2
(12) Golden Wonder	42.1	—	—	42.1
(13) Field-Marshal	—	50.6	29.3	40.0
	Tons	Tons	Tons	Tons
Yield of Saleable produce of Kerr's Pink, per acre	7.86	10.58	5.73	8.06

respect, while 8215 did exceptionally badly at Ormskirk. This is not an isolated instance of the behaviour of 8215, for the same point was noticed in field crops of the variety at Cambridge, Barley (near Royston), and also in one instance in Scotland. The behaviour of the rest of the varieties needs no comment.

TABLE IX.—DAYS TO MATURE

	Ormskirk, Lancs	Kirton, Lincs	Truro, Cornwall	Average
	Per cent.	Per cent.	Per cent.	Per cent.
(1) King Edward	—	80.4	79.2	79.8
(2) Ally	80.1	79.7	84.0	81.3
(3) Bishop	83.0	82.9	—	83.0
(4) Golden Wonder	83.4	—	—	83.4
(5) Tinwald Perfection	82.7	83.1	85.4	83.7
(6) Field-Marshal	—	85.5	82.9	84.2
(7) Majestic	80.7	83.8	89.5	84.7
(8) Arran Consul	85.4	87.6	89.0	87.3
(9) McGill and Smith's 8215	83.6	88.1	91.4	87.7
(10) Up-to-Date	—	91.0	86.2	88.6
(11) Arran Chief	—	92.4	90.5	92.0
(12) Kerr's Pink	100.0	100.0	100.0	100.0
(13) Rhoderic Dhu	100.0	100.8	—	100.4
	Days	Days	Days	Days
No. of days taken by Kerr's Pink to mature	175.0	189.3	179.0	181.1

It is somewhat surprising that King Edward matured so early in these trials, which would suggest that it is earlier than Ally, which is classed by most experts as a second early. The maturity of Kerr's Pink and Rhoderic Dhu is extremely late. There is nothing notable concerning the behaviour of the remaining varieties.

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REPORT OF PROCEEDINGS UNDER THE TITHE ACTS DURING 1926

THE following Report deals with the business transacted in the Ministry under the Tithe Acts during the year 1926.

Total Amount of Tithe Rentcharge.—The total amount of tithe rentcharge charged on lands in England and Wales by the Tithe Act, 1836, and the amending Acts, was £4,054,405. It is estimated that, by the end of the year 1926, this sum had been reduced by redemption, merger and other means to about £3,249,000. There are no available statistics showing exactly what portion of this estimated sum of £3,249,000 was payable to incumbents of benefices, but the amount was probably about £1,889,000. It may further be estimated that about £273,000 was owned by the Ecclesiastical Commissioners, £96,000 belonged to ecclesiastical corporations, and £209,000 was owned by the Welsh Church Commissioners, the balance of £782,000 being held by various schools, colleges, charities and individual lay owners.

Redemption of Tithe Rentcharge.—The number of redemption cases completed in 1926 was 1,795, of which 281 were "compulsory" and 1,514 "voluntary," but in several cases rentcharges owned by two or more different titheowners were separately redeemed by these proceedings, and the total number of separate redemptions effected was 2,157.

At the end of the year 1926, the number of compulsory redemptions in progress was 674, comprising areas owned by many thousands of small property owners.

The total amount of consideration money and expenses, collected by the Ministry in connexion with compulsory redemptions in 1926, was £69,700, and the number of property owners affected by these proceedings was 27,970.

Altered Apportionment of Tithe Rentcharge.—The number of cases completed during the year was 527, of which 370 were voluntary and 157 compulsory. In the latter cases, tithe rentcharges, amounting to £6,326 and charged on 31,823 acres, were re-apportioned among 1,006 landowners. The total of the expenses assessed upon these landowners was £2,413, the average cost being 1s. 6d. per acre, £2 8s. 0d. per landowner, and £15 7s. 7d. per case.

Merger of Tithe Rentcharge.—The total number of declarations confirmed by the Minister during 1926 was 177, and the amount of tithe rentcharge thus extinguished was £3,589 12s. 1½d.

Corn Rents.—During the past year, redemptions of corn rents, rentcharges and money payments payable out of, or charged on lands in lieu of tithes, by virtue of any local Inclosure Act or other local Act of Parliament, amounting to £403 14s. 11½d. were completed, all of which were redeemed by cash payments. The total consideration for these redemptions was £6,785 15s. 11d. Last year three altered apportionments of corn rents were completed.

Other Transactions.—Other transactions effected during the year 1926, under the Tithe Acts and other Acts affecting tithe payments, included 18 redemptions and 17 altered apportionments of extraordinary rentcharge; 8 cases of redemption under the London (City) Tithe Act, 1879, of tithe rate payable in the City of London; and 1 redemption under the Vicar's Rate in Halifax Act, 1877, affecting property in Halifax. There were also completed, two exchanges of glebe for other lands under the Tithe Acts. The number of cases of apportionment of annuities completed during the year under the Tithe Annuities Apportionment Act, 1921, was 34, and 3 cases under Section 191 of the Law of Property Act, 1925. One order was issued releasing an Order for the redemption of tithe rentcharge by annuity from the direction that a certain part of the annuity should be accumulated by investment in trust funds.

In one case a consent was issued authorizing trustees, appointed by the Ministry to receive consideration money for the redemption of tithe rentcharge, to employ the same for the acquisition of lands, etc.

APPENDIX II
SUMMARY OF TITHE RENTCHARGE REDEMPTION PROCEEDINGS COMPLETED DURING 1926

Tithe Rentcharges payable to	Number of separate redemptions completed	Amount of Tithe Rentcharge redeemed			Consideration money for redemption			Redemption Annuities imposed	
		Compulsorily by cash payment	Voluntarily by cash payment	Voluntarily by annuity	Total	Paid in cash	Being paid by Annuity	Total	Total Amount
Incumbents of Benefices	1,410	£ 842	£ 6,568	£ 410	£ 7,820	£ 153,823	£ 8,866	£ 162,689	£ 495
Welsh Church Commissioners	49	25	252	—	277	4,975	—	4,975	—
Ecclesiastical Corporations	78	47	522	—	569	10,032	—	10,032	—
Ecclesiastical Commissioners	177	131	694	97	922	14,065	1,691	15,756	95
Other owners	443	297	2,187	352	2,836	41,154	5,993	47,147	345
TOTAL	2,157	1,342	10,223	859	12,424	224,049	16,550	240,599	935

APPENDIX I

TITHE ACTS 1836 TO 1925

TRANSACTIONS COMPLETED UNDER THE TITHE ACTS, 1836 TO 1925, AND CERTAIN OTHER ACTS

Period	Tithe Rentcharge						Extraordinary Tithe Rentcharge						Corn Rents					Number of Awards of Exchange of Glebe lands, etc.	Redemptions under the Vicar's Rate in Halifax Act, 1877		Redemptions of Tithe Rate under London (City) Tithe Acts		Period														
	Redemptions			Mergers			Altered Apportionments	Redemptions		Exonerations		Altered Apportionments	Redemptions		Conversions		No.		Amount of Rate	No.	Amount of Tithe Rate																
	No.	Amount of Rentcharge		No.	Amount of Rentcharge			No.	Amount of Rentcharge		No.		Area exonerated	No.	Amount of Rentcharge							No.		Amount of Rentcharge													
		£	s.	d.		£	s.	d.			£	s.	d.			a.	r.	p.			£	s.	d.			£	s.	d.			£	s.	d.				
1838 to 1914	19,641	69,470	6	11	17,790	151,433	5	10½	12,205	376	1,535	7	9	5	145	3	8	149	393	1,638	7	5½	24	6,921	10	5	85	1,543	289	142	3	10½	139	1,491	1	4½	1838 to 1914
1915	255	831	18	2½	90	3,022	15	1	282	4	4	4	10	—	—	—	—	7	7	19	16	9½	—	—	—	6	5	1	0	6	10	3	9	7	9	1915	
1916	257	1,158	7	7	62	1,271	16	9½	212	4	2	5	2	1	3	1	17	6	10	79	16	5½	—	—	—	2	4	3	7	14	9½	5	52	2	2	1916	
1917	157	1,053	4	11½	89	1,138	11	2½	135	2	0	11	5	—	—	—	—	8	3	1	1	2½	—	—	—	—	1	3	2	3	5	7	29	13	2	1917	
1918	213	1,065	16	7½	131	3,463	13	8	119	7	18	6	4	—	—	—	—	12	6	50	1	5½	—	—	—	1	2	—	—	—	1	1	19	0	1918		
1919	744	8,442	4	0½	262	4,268	12	6½	208	9	40	7	3	—	—	—	—	8	13	332	18	7½	2	1,150	13	2	2	4	1	0	6	4½	—	—	—	1919	
1920	2,213	41,344	0	4	367	4,967	7	3½	771	30	53	12	7	—	—	—	—	6	16	220	1	4	5	1,298	5	5½	3	4	—	—	—	12	43	15	11½	1920	
1921	4,151	96,195	2	4½	270	4,625	10	7½	575	39	79	18	11	—	—	—	—	18	17	314	13	9	2	810	2	2	1	5	4	1	5	9	1	29	3	1½	1921
1922	4,466	125,260	1	10½	167	3,210	3	1	679	24	68	15	2	—	—	—	—	10	40	1,324	5	7½	2	373	3	8	3	3	5	2	4	3½	4	14	14	9	1922
1923	2,990	64,788	4	9	252	5,523	7	8½	746	14	24	14	9	—	—	—	—	26	18	353	19	6	—	—	—	11	1	2	0	10	2½	7	96	14	0	1923	
1924	2,208	27,130	16	8½	156	4,851	10	8½	607	15	59	4	3	—	—	—	—	21	52	450	15	9½	—	—	—	3	2	3	0	15	0	7	62	2	7	1924	
1925	1,854	18,007	14	2	158	4,121	10	6½	561	14	51	5	2	—	—	—	—	5	42	287	14	2	—	—	—	7	2	2	1	10	7½	7	108	2	4	1925	
1926	1,795	12,424	0	9½	177	3,589	12	1½	527	18	43	0	0	—	—	—	—	17	36	403	14	11½	—	—	—	3	2	1	0	3	3	8	104	4	2	1926	
Totals	40,944	467,171	19	5*	19,971	195,487	17	2½†	17,627	556	1,981	13	7	6	149	0	25	293	653	5,477	7	1	35	10,553	14	10½	127	1,578	314	159	4	4½	201	2,043	0	4½	Totals

* This sum includes £667 15s. 10½d. unapportioned rentcharge and £466,504 3s. 6½d. apportioned rentcharge.

† This sum includes £46,559 0s. 4½d. unapportioned rentcharge and £148,928 16s. 10½d. apportioned rentcharge.

The fees and charges paid to the Ministry during the year ended December 31, 1926, in connexion with the work under the Tithe Acts and other incidental business were as follows :—

	£	s.	d.
Office fees	19,013	6	3
Inspection fees	403	10	0
Search charges	151	18	9
Charges for copies of, or extracts from, documents and tracings from the relative maps	1,196	9	1
	£20,765	4	1

* * * * *

FOOT-AND-MOUTH DISEASE RESEARCH COMMITTEE: SECOND PROGRESS REPORT

THE Second Progress Report of the above committee, which has now been issued,* deals with the work carried out during the past year or so. The causal microbe, or virus, of foot-and-mouth disease cannot be seen by the most powerful microscope and it passes the finest bacterial filter. It can only be recognized by its effects upon a susceptible animal; so that, to discover its presence and activity, all experiments involve tests by inoculation. Research into the disease is, therefore, peculiarly tedious and discovery necessarily slow. Farm animals need a good deal of room, individual attention, and must be securely isolated from each other. These points present difficulties in the carrying out of experimental work. As such animals are also costly, the research worker has been compelled to use other animals for experimental purposes. Where experiments can be carried out with animals, such as guinea-pigs, it is best to utilize them.

Previous experience as to the regularity with which guinea pigs can be infected with very small doses of virus has been confirmed. Size, cheapness, and other advantageous characteristics of guinea-pigs make it possible to carry out experiments with them in sufficient numbers to draw safe conclusions. When definite indications in any direction have been obtained by working with guinea-pigs, the experiment has, whenever possible, been repeated on a smaller scale with large animals. In spite of difficulties involved in changing the habitat of the virus from one kind of animal to another,

* Published by H.M. Stationery Office. Price 3s., post free 2s. 2d.

several observations, made from work on the guinea pig, have been confirmed by subsequent experiments on cattle. The principal lines of investigation are described briefly under the nine heads below.

(1) **Further Attempts to Propagate the Virus Outside the Bodies of Animals.**—The propagation of the virus outside the bodies of animals would be of so much assistance in almost every department of investigation into foot-and-mouth disease that prolonged attempts to cultivate the virus on a number of different artificial media have been continued by the Committee's workers, but no success has been attained, although the virus was found to survive for considerable periods in media containing pieces of animal and vegetable tissue.

(2) **The Search for a Satisfactory Source from Animals of Virus of Uniform Activity, and the Best Conditions for its Maintenance with a Minimum Loss of Potency.**—Until the virus can be propagated on artificial media, recourse must be had to material derived from an infected animal, and the amount of this is limited. By successive passage through guinea-pigs, virus of very high potency can be obtained and maintained for long periods. Several samples of vesicle fluid have been infective for guinea-pigs when diluted to one in 10 million. Virus is very sensitive to either small alkalinity or acidity of the medium containing it, and kept best when the alkalinity was about the same as that of the blood and tissues of animals. Two samples of virus, suspended in appropriate mixtures of phosphates of soda and kept in a refrigerating room, have survived for 413 and 433 days respectively.

(3) **Determination of the Time the Virus Survives upon Glass, Hair, Fodder, Carcasses, etc.**—When dried rapidly on glass slides the virus does not usually survive the drying process, but if dried slowly and then kept chemically dry it has survived for six months; when kept in a moist atmosphere the virus is inactive after two days. These experiments did not suggest that under ordinary conditions of the atmosphere virus dried on inanimate objects which chanced to receive it would survive for long and serve to pass on the infection.

When dried on silk and woollen fabrics the virus survived from 7 to 14 days; on hay at least 15 weeks; on bran at least 20 weeks; on flour 7 weeks; on cow's hair 4 weeks; on sand 2 weeks; and mixed with salted butter

2 weeks. When mixed with an extract of hay and dried at ordinary temperatures, the virus was found to be active after 15 days; in a control, using distilled water instead of hay extract, the period of survival was 4 days. An experiment carried out at the Experimental Station showed that it was possible to infect farm animals by feeding with dry fodder which had been sprayed a month previously with diluted infective saliva.

It has been found that tissues from the bodies of guinea-pigs, killed when the blood was infective, remain virulent for considerable periods in cold store: the blood was virulent after 36 days and the bone marrow up to 96 days. Epithelium from the lesions was infective after 102 days. In the carcasses of cattle and pigs slaughtered in the early stages of foot-and-mouth disease and kept under ordinary cold storage conditions, virus has remained active for 40 days in the blood and 76 days in the bone marrow. After dry or wet salting, the virus was recovered from the bone marrow after 42 days. The disease was readily conveyed to pigs by feeding them upon crushed bones from frozen carcasses containing infected marrow. Imported carcasses of pigs with lesions of foot-and-mouth disease on them were proved to contain the virus by infection of cattle at the Experimental Station with material from the foot lesions.

Burial of the carcasses with lime did not shorten the period of infectivity. In some of the brine mixtures ordinarily used by the trade the virus was not recovered from the feet after five days, but in others it was present after a month.

(4) Effect of Heat, Light, and Various Chemical Agents upon the Survival of the Virus.—Virus kept at a favourable degree of alkalinity at a temperature of 37° C. survived for 3 to 4 days, but when kept at a temperature of 55° C. it only survived from 15 to 40 minutes. Direct sunlight in August killed the virus in an hour, and even winter sunlight passing through window glass shortens the survival of dried virus on glass slides by some days: a similar adverse effect was observed on virus dried on hay.

The action of a number of chemical substances on the virus has been tested with a view to preparing an innocuous but effective vaccine and to furnish information as to the best means of disinfection. Glycerine has little action upon the virus, and the same may be said of sodium chloride, sodium sulphate, and magnesium sulphate. The virus also

resists the action of sodium fluoride, phenol, toluol, lysol, hydrogen peroxide, chlorine, iodine, chloropicrin, and acetone in concentrations which rapidly destroy ordinary bacteria. The resistance of the virus to formalin (40 per cent. formaldehyde) has been tested with special care since this disinfectant was chosen to kill the virus in the preparation of a "dead" vaccine.

(5) Plurality of Types of Virus.—The observations of Vallée that there are two types of foot-and-mouth disease, called "A" and "O," which are indistinguishable clinically have been confirmed. Twenty strains have been examined, 17 of which came from outbreaks in this country. Of the latter only one was of the "A" type, all the others being "O" type. Both types of virus have been passaged through species of animals other than that from which they were originally maintained, but there was no indication that either type had undergone any modification.

(6) Experimental Infection of Animals not Readily Susceptible to the Disease.—Attempts have been made to infect rodents, cats, dogs, and birds, and when this has been successful the disease has been studied in them, particularly with regard to its contagiousness and the possible influence on the virus of sojourn in the bodies of animals which are not its usual habitat. The virus can be maintained in rodents, but the disease hardly ever passes from one to another by natural means. Neither dogs nor cats were readily infected, but cats appear to be more susceptible than dogs. A number of birds (including 34 fowls) were inoculated with guinea-pig virus, but no evidence of infection resulted. Attempts to infect calves with the excreta of fowls and sea gulls which were being fed on virulent material were unsuccessful, although occasionally the virus was recovered from fowls fed on massive doses of material containing virus.

(7) Cross Infection Experiments between Cattle and Guinea-Pigs.—Attempts were made to infect cattle experimentally by contact with guinea pigs suffering from foot-and-mouth disease at an early stage. Only once did infection of cattle result, an experiment in which the vesicles on the guinea-pigs' feet were opened and allowed to discharge. The converse experiment, in which guinea-pigs were kept in the stalls with infected cattle was also made, but the guinea-pigs did not contract the disease.

(8) **Immunity.**—The study of artificially produced immunity to foot-and-mouth disease in guinea-pigs has been undertaken with a view to finding a satisfactory way of protecting farm animals from infection. When guinea pigs have passed through an attack of the disease they remain resistant for a variable period, usually three to four months, occasionally longer. The degree of immunity in different guinea-pigs as the result of an attack is variable. Eight guinea-pigs were tested by intra-dermal inoculation at periods varying between 105 and 113 days after recovery: seven were unaffected and the other showed a small transient local vesicle.

The duration of acquired immunity in cattle is being tested at the Experimental Station. So far, resistance to an intra-muscular inoculation has been found 13½ months after an attack.

(9) **Conclusions.**—In concluding the Report, the Committee state that their workers have considerably extended the knowledge of the virus of foot-and-mouth disease in many important directions. They have explored the susceptibility of various small animals which might contribute to the spread of the disease. They have defined some of the conditions under which the virus may survive upon inanimate objects, fodder, and carcasses. The facts they have brought to light are of great epizootological importance. The susceptibility of the virus to various chemical substances has been determined, and the strength in which these may be suitably employed as disinfectants under various conditions ascertained. Lastly, their observations on natural and acquired immunity to the disease suggest possibilities for the ultimate protection of farm animals, which are at least encouraging, and which are being pursued.

The expenditure of the Committee during the financial year 1925 amounted to £9,476 and the total expenditure to the end of March, 1926, was just over £16,000.

A PLEA FOR POULTRY COURSES ON FARMS

F. W. PARTON,

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TWENTY-FIVE years ago, the writer acted as assistant at the first itinerant poultry courses held in Great Britain. In the following years there were a few spasmodic repetitions of these courses; but recently this method of instruction has been revived in Yorkshire, and is now being taken up again

in other counties. It is with experience of such courses over an extended period of years, and, with a knowledge of the results obtained, that the writer would wish to make a plea for their more general adoption. They have proved an excellent means of demonstrating to the rank and file in the poultry industry the accepted methods of poultry management, methods which have been put to the test by many years of experiment and patient investigation.

Considerations of time and money make it impossible for the majority of boys and girls, who are looking after poultry on farms, to take a course of instruction in poultry management at an agricultural college or farm institute. Such persons form a numerous and distinct class, to which more attention might well be paid by those engaged in providing instruction in poultry-keeping. It is for their benefit that what may be called an organized day course in poultry-keeping has been primarily designed.

Instruction of this description as a rule extends over a period of three weeks, with six meetings each week. The course may be longer, but the three weeks' period has been found to serve best. The meeting place may be a barn or large outhouse which, along with the poultry equipment of the farm, has been placed by a sympathetic farmer at the instructor's disposal for the time being. Three hours a day are devoted to the work, the time being arranged to meet the convenience of the pupils. Each day's programme includes a lecture of one hour, whilst the remaining time is occupied in practical work.

Certain appliances should always be included in the equipment and demonstrated during the course, as, for example, incubators of two types, hot water and hot air; brooders of one or more kinds; coops; nest-boxes; models of poultry houses. Samples of different kinds and qualities of poultry food should also be shown.

The spring is the best time for an organized day course, because the important work of hatching and rearing can then be thoroughly taught. When the class is of three weeks' duration, it is a good plan to start incubating the eggs a week or more before the class commences; students are thus able to see actual hatching and can take part in the first week's rearing. If incubation is not started till the first day of the course, the eggs will not be hatched out till the last day, and those who have looked after the incubator for three weeks and have become thoroughly interested, suffer considerable disappointment in not being able to take any further part in the rearing of the chicks.

One great advantage of classes of this kind is that teaching matter of immediate local interest can be selected, and the local practices and conditions of the poultry industry explained; for example, if the district in which the course is held be high and exposed, special consideration can be given to the breeds and management suitable for such conditions. The local colour thus given to the instruction has a powerful influence in establishing confidence between teacher and student.

The following is an outline syllabus of a course on the lines indicated above, conducted in 1925, at Walkington, in the East Riding of Yorkshire, a district where poultry keepers specialize in egg production, the farm at which the course was conducted being well equipped for this purpose:—

Breeds and their characteristics; selection of laying and breeding stock; hatching and rearing—natural and artificial; foods and methods of feeding; housing; ducks—breeds and management; geese—breeds and management; turkeys—breeds and management; diseases—prevention and cure.

* * * * *

APRIL ON THE FARM

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Seasonal Notes.—The Anglo-Saxons called this Oster-Monath, i.e., Easter Month, not because of the prevalence of east winds which are characteristic of April, but in allusion to the Saxon goddess Eostre. The name April comes from the Roman calendar, and is commonly regarded as being derived from the Latin *aperire*, “to open,” in allusion to the opening of buds, which is one of the natural features of this month.

The date at which trees and shrubs begin to put out their green foliage, and herbage begins to freshen, varies considerably from season to season, and, of course, some districts are earlier than others. Last year we had an early spring, apples being in full blossom by the middle of the month, where normally only plums are in bloom at that time. Grass was so forward and grazing conditions so good that some farmers had all their cattle out of doors both night and day in the middle of April, although in ordinary years the transfer is not completed until May 12.

On the average of many years, April is, taking all England and Wales, the driest month in the year. Generally it is a period when the land dries appreciably and when the pro-

verbial showers help rather than hinder tilth-forming operations. Occasionally, however, as in 1920, this may be a very wet month, and such conditions seriously delay spring cleaning and sowing operations on heavy arable land. Apart from that, a rainy April is proverbially beneficial to farmers; even a cold, wet April is credited with filling the barn; and a flood of the river Dove (between Derbyshire and Staffordshire) is said to be “worth a king’s good.”

Soil Cultivation.—Weed eradication and the relative economy of different methods of soil preparation are questions of importance to the practical farmer; a third question of no less importance is that of the influence of tillage on productivity of the soil. The kind of information given in text-books on soils does not help us much on this point; and it is not easy to give scientific explanations for the general superiority of the tilth obtained by means of spade and fork methods over that produced by horse-drawn field implements. The depth of working may be the same; the field tilth may be as fine as that of the garden. Frequently, however, the gardener’s tilth is superior to that of the farmer in respect of moisture content and looseness of texture. It is difficult when working by ordinary field methods to obtain a satisfactory degree of fineness and looseness on the top soil, without making the tilth too dry in the upper layers and too solid underneath. As a general rule, the best results on heavy soils are obtained when the desired degree of fineness and looseness are produced with the minimum of compression by implements and horses’ feet.

For spring cultivations, the work of the rotary-tilling machine is commendable. Not only does it save labour and time—and therefore moisture—but evidence is accumulating that the tilth produced by rotary methods is more favourable to crop growth than that obtained by the plough and the tine implements. In this connexion, the results of a beet-growing trial in 1924, carried out at the Vienna Agricultural High School, are worthy of mention. A field that had grown potatoes in 1923 was autumn ploughed 6 in. deep, and in December a dressing of 8 tons of yard manure was spread on the back of the furrow. On April 19, 1924, part of the field was ploughed 8 in. deep and, near the end of the month, harrowed, spike-rolled and again harrowed; it was flat-rolled on May 2 and the next day drilled with sugar beet in rows 17 in. apart. The remainder of the field was not ploughed but rotary-tilled

to a depth of 6 in. on April 26, then harrowed; on May 2, it was flat-rolled and drilled next day with the first part of the field. The yields obtained from the two methods of seed-bed preparation were as follows:—

	Yields per acre	
	Ploughed part. Tons	Rotary- tilled. Tons
Roots	9.9	12.0
Leaves and tops	8.7	7.2
Dry substances in roots	1.7	2.1
Dry substances in leaves and tops	1.3	1.1

The remarkable feature of the results of the above trial is the difference in the ratio of root to leaf in the two sets of plots. The experimenter suggests that the more intensive loosening of the soil by the rotary machine brings about a more rapid decay of the organic matter in the soil than does ploughing. This would provide a stronger stream of carbon dioxide and enable the plant to satisfy its needs for carbonic acid by means of a smaller leaf surface. This theory—the influence of the supply of carbon dioxide—has not yet been generally accepted, however.

Finger-and-Toe.—The disease known as *finger-and-toe* in turnips, and as *club root* in cabbages, is caused by a microscopic parasite, classified as a fungus, which lies dormant in the soil when there is no cruciferous crop plant or weed—such as charlock—within its reach. Soils that are deficient in lime are well known to be more commonly infected than those which are not sour; and there is ample experimental evidence that the timely application of lime to infected soils considerably reduces the proportion of diseased roots. Frequently, however, cruciferous crops have to be grown on infected land that has not received a timely and adequate application of lime. In these circumstances, advantage should be taken of additional precautionary measures against severe attack.

Fertilizers which tend to aggravate soil sourness—such as sulphate of ammonia, and compound manures containing acid ingredients, should be replaced by fertilizers that are functionally basic, such as nitrate of lime, nitrate of soda, and basic slag. Excess of potash manures should not be used. Calcium cyanamide is reported to have given excellent results in Danish experiments on this disease, but, as explained by Mr. Garner,* this fertilizer should be applied some time before the crop is drilled or planted.

* This JOURNAL, October, 1926, p. 663.

A number of official trials have demonstrated that varieties of swede differ considerably in their susceptibility to attack. In an experiment, recently carried out in East Devon, the proportion of diseased roots varied from more than 85 per cent. in the case of four varieties to 15, 25, 34, and 40 per cent. in the varieties Incomparable, Eclipse, Defiance, and Tipperary respectively. Among common turnips, green globe varieties, and a special disease-resisting purple top, showed least susceptibility to finger-and-toe. Marrow-stem kale and kohlrabi are not immune from the disease but they are not very susceptible, and the injury caused by the attack does not, as in the case of turnips, extend to the edible parts of the plant.

The Dairy Herd.—Milk producers who farm in the Midlands and the Northern counties often criticize milk contracts in which April is grouped with the summer months. In this season's London agreement, the price falls from 16½d. per gallon in March to 12d. per gallon in April, although, in the counties indicated, costs of production remain the same, or, according to local belief, increase in April. There can be little profit on April milk at these prices, not to mention the possibility of profit where the actual net price received by the producer is only 8½d. The price of milk, however, is ruled by the law of supply and demand, and the supply is increased by the growth of the grass in the earlier districts and by the number of cows that calve about this time of the year.

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NOTES ON MANURES FOR APRIL

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Manures for Roots.—April is a period of great activity in the application of manures. Quite apart from spring corn, three exhaustive crops are sown during the month, each receiving farmyard manure and a good dressing of artificials in addition. In 1926, potatoes occupied 500,000 acres, mangolds 338,000 acres, and sugar beet 126,000 acres; and if we assume that the very moderate dressing of 4 cwt. of fertilizers per acre was, on the average, given to these crops, the total of 964,000 acres would account for nearly 200,000 tons of artificials, or about one-sixth of the quantity used for all purposes during the year.

Requirements from the Soil.—The above three crops have several points of similarity. In the first place, each makes considerable claim on the stores of plant food in the soil, and potash, in particular, is required in large amounts. Moreover, only part of the crop is removed from the field on which it grows, and the quantities of plant food restored to the soil through the leaves, in the case of mangolds and beets, is considerable. The nutrient content of the dead potato haulm is probably not large, for, in the process of dying down and decay, much of the mineral and nitrogenous matter originally contained will find its way back to the soil. Since the actual quantity of haulm and its condition at harvest time are so variable, average estimates of the nutrient content could have little value. The following figures enable the root crops to be compared with a typical grain crop in respect of the nutrients per acre required from the soil to grow the crop, the amounts which are returned to the soil direct or by way of the manure heap, and the quantity of nutrients which leave the farm as potatoes or washed beet.

Crop per acre	Nutrients, lb. per acre			Remarks
	Nitrogen	Phosphoric Acid	Potash	
19 tons Mangolds (roots & leaves)	119	46	260	Nutrients required from the soil. No data for potato haulm.
8 tons Beet (roots & leaves)	71	34	128	
6 tons Potatoes	47	22	77	
30 Bu. Wheat (grain & straw)	48	21	29	
Mangold Leaves	44	14	67	Ploughed in.
Beet Leaves	44	16	65	
Mangold Roots	75	32	193	To the dung heap, where about $\frac{1}{2}$ N $\frac{1}{4}$ P ₂ O ₅ , and $\frac{1}{4}$ K ₂ O are lost.
Wheat Straw	15	7	20	
Washed Beet	27	18	63	Sold off
Potatoes	47	22	77	
Wheat Grain	33	14	9	

The figures show that an average root crop requires considerably more from the soil than an average crop of wheat, and, in the case of mangolds, the potash removed is nine times as great. The residues, left as leaves, contain nearly as much plant food as a full crop of wheat. The addition to the dung heap by feeding roots is considerable, and is specially valuable from the point of view of the potash supply. On the other hand, the sale of beet or potatoes is a greater drain on the farm supplies of potash than the sale of grain.

Farmyard Manure.—The next outstanding point is the value of farmyard manure. Dung has many useful physical effects, but, in addition, the nutritive effect goes a long way towards explaining the good results of farmyard manure for these crops. An ordinary dressing of 10 tons of dung not only gives a complete and considerable supply of plant food, but also provides the rich source of potash (about 150 lb. in 10 tons) which is highly desirable for roots. There is a great body of experimental evidence to show that a heavy dressing of dung is not necessary, but that a lighter dressing, helped out by a complete mixture of artificials, is equally satisfactory. The extensive experiments, conducted in Ireland, on potatoes, at 353 centres in 11 seasons (1901-11), may be mentioned in this connexion.

AVERAGE YIELDS OF POTATOES. ALL SOILS AND SEASONS.

AVERAGE YIELDS OF POTATOES. ALL SOILS AND SEASONS.									
Treatment									Tons per acre
No Manure	..	..	..	..	..	..	..	..	4.0
15 tons dung alone	..	..	..	..	..	..	..	..	8.2
20 "	"	"	..	..	..	..	..	..	9.1
15 "	"	"	+ 1 cwt. Sulphate Ammonia	..	..	..	..	..	9.1
15 "	"	"	+ 1 cwt. Sulphate Ammonia, + 4 cwt. Super.	..	..	..	..	..	9.95
15 "	"	"	+ 1 cwt. Sulphate Ammonia, + 4 cwt. Super. + 1 cwt. Mur. Potash	..	..	..	..	..	10.85

Similar experience has been recorded for mangolds and sugar beet, and, provided that they are grown on light to medium soils, they, like potatoes, usually do best with a complete artificial mixture in addition to the dung. There is some evidence that on rich clay soils the potash may be reduced.

The Nitrogen Supply.—Only on rich fen soils will roots be commonly grown without any nitrogen beyond that provided in the farmyard manure. In other cases, sulphate of ammonia up to 2 cwt. per acre may be used in the drills for the potatoes ; and for mangolds and beet, 1 cwt. of sulphate of ammonia in the seed bed and up to 2 cwt. of nitrate of soda in two top dressings. Since beet is at present worth more per acre than

mangolds, the higher rate of manuring might be reserved for this crop. With regard to the effects of nitrogenous top dressings on the sugar content of the beets, continental experience seems to show that, if the dressings are kept within some such limits as have been mentioned above, the depression in sugar content is trifling, and is more than outbalanced by the increased yield. Late top dressings, i.e., after the end of June, are not recommended, as they prolong the growing period and thus lead to the harvesting of unripe beets.

The Phosphate Supply.—The need of phosphate varies considerably with the nature of the soil, but there will be few circumstances in which no phosphate will be needed for the root crops. The chief function of phosphatic fertilizers is to give the young plants an early start, and for this reason a supply of readily available phosphate in the neighbourhood of the young seeds is desirable. Where soil conditions allow, superphosphate should have the preference for spring sowing, but good grade basic slag is frequently used with success. Recent work at Kirton, Lincs, has shown that, under the conditions there prevailing, the customary heavy dressings of superphosphate used on potatoes could be reduced without detriment to the crop. This result is significant, and it remains to be seen how far these conclusions will be confirmed under other conditions. On ordinary soils, 3-4 cwt. of superphosphate, in addition to dung, would be a normal dressing for potatoes, mangolds or sugar beet; but under special conditions, such as in the fen district or on poor clays, these amounts are considerably exceeded. With the possible exception that, on light soils in an early ripening season, the crop may mature so quickly that the yield suffers, no harm is to be feared by using more phosphate than the plant requires. The excess of phosphate may be recovered in part in subsequent crops. On the other hand, in late districts, a good dressing of phosphate is of value in hastening the maturity of beet and potatoes.

The Potash Supply.—As already pointed out, the crops under consideration require considerable amounts of potash, of which the farmyard manure provides a large part. We must also bear in mind that heavy soils are usually able to meet some of the needs of the crop in this respect. Cereals, for example, rarely require additional potash on clay soils, and root crops show less need of outside supplies. Taking all this into account we can reckon that, where farmyard manure is used, about 1 cwt. of muriate of potash, or its equivalent, should be

allowed per acre of the above crops, the quantity being somewhat increased on the light soils and reduced on rich clays. The form of potash used is worthy of attention. Potatoes do best with high grade salts, such as the sulphate or muriate of potash, while beet and mangolds sometimes benefit from the salt which is contained in the lower grade manures, such as kainit of 20 per cent. or 30 per cent. potash salts. On soils which tend to run together with agricultural salt, the high grade muriate of potash is to be preferred. Like other fertilizers, potash is more effective in some seasons than others, as shown by the following results on potatoes at Rothamsted, obtained on different fields of the farm each year, but on soil of essentially the same type:—

INCREASE DUE TO SULPHATE OF POTASH* IN PRESENCE OF NITROGEN AND PHOSPHATE

Tons per acre

	1921		1922		1923		1924		Average
	Actual	Per cent.	Actual	Per cent.	Actual	Per cent.	Actual	Per cent.	Actual
With dung	·46	13	1·52	19	·79	7	—·36	—4	·6
No Dung	2·41	179	5·83	236	2·53	26	1·08	17	2·96

* 1½ cwt. per acre in presence of dung; 2 cwt. without dung.

Taking the results over a series of years, the addition of potash to farmyard manure produces a slight advantage even on the heavy soil at Rothamsted. In the absence of dung, the effect of the potash is much more marked. The year 1922 showed great responses to potash at this centre, while in 1924 potash fertilizers produced no effect where dung was used.

Lime.—In their sensitiveness to lime deficiency, the three root crops show decided differences. Sugar beet and mangolds are distinctly damaged by soil acidity, and failures from this cause are quite common. The remedy is a suitable dressing of lime, chalk, or ground limestone; but, before any action is taken, the need should be definitely proved by analysis, and the approximate lime requirement ascertained by consulting the local advisory service. Potatoes are less sensitive to soil acidity, and can be grown quite well on land where the other crops would suffer. If lime is required for the rest of the rotation it may be applied after the potatoes have been removed.

No Dung.—If no dung is available, all the above crops may be grown fairly successfully if the dressing of artificials is increased all round by about 50 per cent. On light soils, however, crops thus grown may receive a heavy check in a droughty period. On heavy land, worked with skill to obtain the necessary tilth, this risk is considerably diminished. Nevertheless, except on a few soil-types of excellent physical

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named and are net cash for prompt delivery.

Description	Average price per ton during week ending March 9				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½%) ..	13 15	13 15	13 10	13 12	17 7
" " Lime (N. 13%) ..	..	..	..	11 12	17 10
Sulphate of ammonia :—					
Neutral (N. 20.6%) ..	12 6*	12 6*	12 6*	12 6*	11 11
Calcium cyanamide (N. 19%) ..	9 16*	9 16*	9 16*	9 16*	10 4
Kainit (Pot. 14%) ..	3 2	2 17	2 17	2 15	3 11
Potash salts (Pot. 30%) ..	4 17	3 2	..	4 10	3 0
" (Pot. 20%) ..	3 12	3 2	3 9	3 2	3 1
Muriate of potash (Pot. 50.53½%) ..	9 10	8 5	8 13	9 7	3 6
Sulphate " (Pot. 48.51½%) ..	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 30%) ..	..	3 2s	3 1s	..	..
" (T.P. 28%) ..	..	2 11s	2 10s	..	..
" (T.P. 26%) ..	..	2 7s	2 6s	..	..
" (T.P. 24%) ..	..	2 2s	..	..	..
Ground rock phosphate (T.P. 58%)					
Very fine grade ¶ ..	2 15	..	..	2 15d	0 11
Fine grade ¶ ..	2 10	..	..	2 12d	0 11
Superphosphate (S.P. 35%) ..	3 9	..	3 12	3 10	2 0
" (S.P. 33%) ..	..	..	3 9	..	..
" (S.P. 30%) ..	3 2	2 15	3 5	3 3	2 1
Bone meal (N. 3½%, T.P. 45%) ..	8 15	8 5	8 10	8 0	..
Steamed bone flour (N. 4%, T.P. 60.65%) ..	6 0†	6 10†	6 5	5 15	..
Burnt lump lime ..	2 0	1 12a	2 0b	2 1c	..
Ground lime ..	2 7	2 1a	2 9b	1 15c	..
" limestone ..	..	..	1 10b	..	..
" chalk ..	..	1 9	..	1 5c	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

¶ Fineness 80% through standard screen of 14,400 holes to the square inch (120 mesh sieve).

|| Fineness 80% through standard screen of 10,000 holes to the square inch (100 mesh sieve).

a Delivered to Hull.

b Delivered to Liverpool area.

c Delivered in 4-ton lots to London.

d Price for 4-ton lots f.o.r. at Northern London Stations. At G.W.R. and S.E. London Stations the cost to purchasers is 2s. 6d. per ton extra.

condition, the growing of roots without organic manure is regarded as a makeshift. If, for some reason, two root crops are taken in succession, as, for example, beet following potatoes which have been well dunged, the second crop of roots may well be grown on artificials only.

Further Work.—Of the three crops dealt with, the treatment of mangolds has probably been worked out most completely, for here the question of quality, though undoubtedly worthy of attention, does not react on the returns as much in the case of potatoes or beet. Most of our information with regard to the manuring of beet comes from continental countries, and, until English experiments have progressed further, nothing better can be done than to accept the main findings of this work. Since our farmers enjoy a much bigger price margin for their product than the continental growers, this serves to mitigate the effects of any lack of precision in manurial treatment. At present manurial experiments centre round two problems :—

- (1) The effect of nitrogenous top dressings in their relation to yield and quality.
- (2) The extent of the need for potash and the relative effectiveness of low grade and high grade potash manures.

It is realized, however, that the working out of cultivation methods most suited to English conditions will be the main factor in improving the sugar beet crop; experiments directed to this end are in hand at many centres and their results are awaited with interest.

Potatoes have had their requirements worked out on broad lines, and also the general effect in quality of some of the various grades of potash fertilizers. Interest is now shifting to the question of the "balance" or relative proportion of the ingredients in mixtures for potatoes. The interesting work of J. C. Wallace at Kirton has been mentioned; and a start has been made at Rothamsted on the balance of nitrogen and potash in presence of constant amounts of phosphate.

NOTES ON FEEDING STUFFS

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The Principles of Meat Production.—In the production of meat for human consumption, the farmer's skill is chiefly directed towards feeding his animals in such a way that they appeal to the butcher. His interest in this direction is to a

certain extent a commercial one, since an animal finished so that it "is ripe for the butcher" will command a better price than a half-finished animal. Many factors are involved in the commercial process of meat production, some of which are under the control of the feeder, and some outside his influence. The two main physiological processes governing meat production are growth and fattening. The growth processes are inherent to the individual and cannot be influenced, except in a detrimental sense, by feeding; the fattening processes, on the other hand, can be directly controlled by the feeder. In the fattening of the young animal, both growth and fattening are involved, whereas, in the adult, the growth processes have ceased. The fattening of calves, lambs, and pigs is therefore a different problem to fattening adult sheep and bullocks, and is generally recognized as such by all stockfeeders. Similarly, it must be recognized that the methods required to produce baby beef at 21 months are far different to those which suffice for fattening 2½-year old steers. It has already been mentioned that the growth processes are inherent to the individual. During growth active bone formation, and protein storage, in the shape of muscle, occurs, and the feeder is chiefly concerned in purchasing animals in which these processes are most rapid, i.e., he requires animals which show early maturity. Similarly, he requires an animal which, when killed, yields a carcass which conforms to a particular type, especially so in the case of, say, the bacon pig; length of back, size of ham, width of shoulder, and fineness of bone are all characteristics of growth that are outside the control of the feeder, but fortunately they are the points to which the breeder has given attention.

One has only to compare the modern breeds with their ancestral types to realize the extent to which the breeders have improved their meat-yielding capacity, and the breed societies' standards are so formed as to encourage not only a better type of carcass, but also to increase the proportion of the better quality joints. With regard to early maturity, however, apart from the pig, little exact work has been carried out, since it is only in recent years that much attention has been paid to the early production of beef. The existence of "good" and "bad doers" in animals has led to much speculation among feeders as to the reason for such variation in the growth response of animals to similar diets. Among the varying causes assigned as responsible for such differences are variation in digestive powers of individuals and varying capacity in conversion of digested food to fat and meat. With regard to "digestive power," tests on

"good" and "bad doers" have shown that "bad doers" are equally efficient as "good doers" in the capacity to digest food; so variation in digestive power may be ruled out as a possible cause of such variation in growth response. Similarly, such experiments as have been conducted on the "assimilative power" of animals in the conversion of food to milk, fat and work have shown little variation among individuals. The explanation of such differences in growth response as undoubtedly do exist must, then, be sought for in other direc-

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations are as follow:—

					Starch	Protein	Per ton
					equivalent	equivalent	
					Per cent.	Per cent.	£ s.
Barley (Imported) ..	..	..	..	..	71	6.2	9 15
Maize ..	..	..	..	..	81	6.8	7 12
Decorticated ground nut cake ..	..	..	..	..	73	41.0	11 15
" cotton cake ..	..	..	..	..	71	34.0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2.27 shillings, and per unit protein equivalent, 1.71 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS					Starch	Protein	Food value
					equivalent	equivalent	per ton, on
					Per cent.	Per cent.	farm
							£ s.
Wheat ..	..	..	..	..	72	9.6	9 0
Oats ..	..	..	..	..	60	7.6	7 9
Barley ..	..	..	..	..	71	6.2	8 12
Potatoes ..	..	..	..	..	18	0.6	2 2
Swedes ..	..	..	..	..	7	0.7	0 17
Mangolds ..	..	..	..	..	7	0.4	0 17
Beans ..	..	..	..	..	66	20.0	9 4
Good meadow hay ..	..	..	..	..	31	4.6	3 18
Good oat straw ..	..	..	..	..	17	0.9	2 0
Good clover hay ..	..	..	..	..	32	7.0	4 5
Vetch and oat silage ..	..	..	..	..	13	1.6	1 12
Barley straw ..	..	..	..	..	19	0.7	2 4
Wheat straw ..	..	..	..	..	11	0.1	1 5
Bean straw ..	..	..	..	..	19	1.7	2 6

DESCRIPTION	Price per qr.		Price per ton	Manu-rial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Pro-tein equiv. %
	s. d.	lb.	£ s.	£ s.	£ s.		s. d.	d.	
Wheat, British ..	—	—	12 2	0 14	11 8	72	3 2	1.70	9.6
Barley, British feeding ..	—	—	9 15	0 11	9 4	71	2 7	1.38	6.2
" Canadian No. 3 Western ..	35 9	400	10 0†	0 11	9 9	71	2 8	1.43	6.2
" Argentine ..	35 0	"	9 17	0 11	9 6	71	2 7	1.38	6.2
" Danubian ..	34 3	"	9 12*	0 11	9 1	71	2 7	1.38	6.2
" Persian ..	33 0	"	9 5	0 11	8 14	71	2 5	1.29	6.2
" Russian ..	36 6	"	10 5	0 11	9 14	71	2 9	1.47	6.2
Oats, English, white ..	—	—	9 7	0 12	8 15	60	2 11	1.56	7.6
" " black and grey ..	—	—	9 0	0 12	8 8	60	2 10	1.52	7.6
" Scotch white ..	—	—	10 0	0 12	9 8	60	3 2	1.70	7.6
" Irish black ..	—	—	8 15	0 12	8 3	60	2 9	1.47	7.6
" " white ..	—	—	9 7	0 12	8 15	60	2 11	1.56	7.6
" Canadian feed ..	24 0	320	8 9*	0 12	7 17	60	2 7	1.38	7.6
" American ..	21 9	"	7 12†	0 12	7 0	60	2 4	1.25	7.6
" Argentine ..	24 0	"	8 9	0 12	7 17	60	2 7	1.38	7.6
" Chilean ..	23 0	"	8 2‡	0 12	7 10	60	2 6	1.34	7.6
Maize, Argentine ..	32 6	480	7 12	0 11	7 1	81	1 9	0.94	6.8
Beans, English winter ..	—	—	10 13	1 10	9 3	68	2 9	1.47	20
Peas, English blue ..	—	—	17 0*	1 6	15 14	69	4 7	2.45	18
" Japanese ..	—	—	28 10	1 6	27 4	69	7 11	4.24	18
Dari, Bombay ..	—	—	12 5	0 14	11 11	74	3 1	1.65	7.2
Millers' offals—									
Bran, British ..	—	—	7 17	1 5	6 12	42	3 2	1.70	10
" broad ..	—	—	8 17	1 5	7 12	42	3 7	1.92	10
Middlings, fine, imported ..	—	—	10 0	1 0	9 0	69	2 7	1.33	12
" coarse, British ..	—	—	8 0	1 0	7 0	58	2 5	1.29	11
Pollards, imported ..	—	—	7 6	1 5	6 1	60	2 0	1.07	11
Meal, barley ..	—	—	11 0	0 11	10 9	71	2 11	1.56	6.2
" maize ..	—	—	9 5	0 11	8 14	81	2 2	1.16	6.8
" " germ ..	—	—	8 15	0 18	7 17	85	1 10	0.93	10
" " gluten feed ..	—	—	8 15	1 5	7 10	76	2 0	1.07	19
" locust bean ..	—	—	8 10	0 9	8 1	71	2 3	1.20	3.6
" bean ..	—	—	12 10	1 10	11 0	66	3 4	1.78	20
" fish ..	—	—	22 0	3 18	18 2	53	6 10	3.66	48
Maize, cooked flaked ..	—	—	10 10	0 11	9 19	85	2 4	1.25	8.6
Oilcakes—									
Linseed cake, English 12% oil ..	—	—	13 0	1 15	11 5	74	3 0	1.61	25
" " 10% " ..	—	—	12 12	1 15	10 17	74	2 11	1.56	25
" " 9% " ..	—	—	12 7	1 15	10 12	74	2 10	1.52	25
Soya bean, " 6% " ..	—	—	11 10*	2 9	9 1	69	2 7	1.38	36
Cottonseed cake, English, 5 1/2% " ..	—	—	7 0	1 12	5 8	42	2 7	1.38	17
" " Egyptian, 5 1/4% " ..	—	—	6 15	1 12	5 3	42	2 5	1.29	17
Decorticated cottonseed meal, 7% oil ..	—	—	10 0	2 9	7 11	74	2 0	1.07	35
Coconut cake, 6% oil ..	—	—	9 0	1 9	7 11	79	1 11	1.03	16
Ground-nut cake, 6% oil ..	—	—	8 2	1 13	6 9	57	2 3	1.20	27
Decorticated ground-nut cake, 7% oil ..	—	—	11 15*	2 11	9 4	73	2 6	1.34	41
Palm kernel cake, 6% oil ..	—	—	7 17‡	1 1	6 16	75	1 10	0.98	17
" " meal, 6% oil ..	—	—	10 0†	1 1	8 19	75	2 5	1.29	17
Feeding treacle ..	—	—	6 5	0 9	5 16	51	2 3	1.20	2.7
Brewers' grains, Dried ale ..	—	—	7 10	1 2	6 8	49	2 7	1.38	13
" " porter ..	—	—	7 0	1 2	5 18	49	2 5	1.29	13
" " Wet ale ..	—	—	1 7	0 8	0 19	15	1 3	0.67	4.8
" " porter ..	—	—	1 2	0 8	0 14	15	0 11	0.49	4.8
Malt culms ..	—	—	7 0‡	1 12	5 8	43	2 6	1.34	16

Prices at London except where otherwise stated.

† At Bristol.

* At Hull.

‡ At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of February and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 6d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 11s. 8d. P₂O₅, 8s. 8d.; K₂O, 3s. 0d.

1927.]

MISCELLANEOUS NOTES.

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tions. Such possible factors are variation in maintenance requirement, variation in feed consumption and variation in muscular movement. With regard to variation in maintenance requirement, the skin temperature experiments of Wood and Hill are significant. These workers obtained evidence that the skin temperatures of bullocks varied, the "good doers" showing a lower skin temperature than the "bad doers," indicating that the feed requirement of the "bad doers" for maintenance was distinctly higher than the "good doers." Thus on equal feed consumption, the "good doers" would store a relatively greater amount of food as fat or meat than the "bad doers." Similarly, excessive muscular exercise would constitute a drain on the available food supply, the very active animal tending to fatten less rapidly in consequence than the animal of lethargic temperament. Another factor that cannot be ignored as a possible cause of variation in rapidity of fattening, is the variable capacity of individuals to consume food. It is obvious that, of two individuals, the individual which can consume the greater amount of food per diem will have a greater margin of food available for carcass formation, and such an individual will produce more meat than his less fortunate brethren in the same interval of time; not because he makes more efficient use of the productive portion of his ration, but simply because he actually consumes more in the same interval of time.

* * * * *

MISCELLANEOUS NOTES

THE following note has been communicated to the Ministry by Mr. John Watson, of Kendal: The Ministry is drawing attention to experiments directed to finding out which are the best meat-producing fowls and their general table qualities. This side of the poultry industry

has in recent years somehow fallen behind owing to the attention paid to that of egg production. After experimenting over a series of years, I have come to the conclusion that there is no *best breed* for producing meat. The ideal fowl should carry the maximum of meat and the minimum of offal. The meat should be carried on a full, square breast to such an extent as almost to conceal the breast-bone. The flesh should be white (not yellow) and the bone fine. It must, in addition, have a gamey flavour and be fine in texture.

The production of this type of fowl was the aim of these experiments. I have kept most of the heavy breeds, including White Wyandottes, White Orpingtons, White and Salmon Faverolles, Houdans and all the varieties of Sussex, but none of these has been satisfactory. Hens of the above breeds were next crossed with Old English Game cocks, and it was only then, in my opinion, that the perfect meat fowl was obtained. The increase in weight, more especially in the cockerels, averaged from 50 to 100 per cent.

The difficulty experienced by breeders of White Leghorns, and the lighter breeds generally, in disposing of their surplus cockerels, on account of the small amount of meat they carry, suggested the trial of the Old English Game cross in this direction, and an Old English stag was put with half a dozen Leghorn hens. At three months old the cross-bred chickens were double the weight of pure-bred ones, carried 50 per cent. more flesh, were hardier, and the pullets subsequently laid more eggs than either of the parent breeds. This cross should enable breeders in many cases to avoid rearing light-breed cockerels at a loss.

My people and I have bred Old English Game fowls for several generations, and this breed, crossed with practically any other, especially with Sussex, produces an amount of meat of beautiful texture that will prove a revelation to those who have not previously tried it.

* * * * *

A SPECIAL course on Milk Recording will be held at the Midland Agricultural and Dairy College, Sutton Bonington, Loughborough, from Monday, April 25, to Saturday, May 14, 1927. Applications for admission to the course should be addressed to the Principal. The course is being held for Milk Recorders and others who intend to take up the work of recording. Students will travel to Sutton Bonington on Monday, April 25, and tuition will begin on the following day. Each day's instruction will embrace :—

(a) At least two hours' theoretical teaching.

(b) Practical work in weighing, sampling, testing and keeping of records.

At the conclusion of the course the College will notify, in writing, those students who have satisfied their instructors as to their industry and general ability, and have passed the theoretical and practical examination held during the closing days.

THE experimental scheme of scholarships for the sons and daughters of agricultural workmen and others, which was approved in 1922 for a period of five

Scholarships for years, was concluded last year, and
Agricultural a record of the working of this experi-
Workers ment will shortly be published by
 H.M. Stationery Office (*Report of the*

Central Scholarships Committee of the Ministry of Agriculture and Fisheries).

The Government have decided to continue the scheme in a slightly modified form as recommended by the Central Committee, and the first awards under the revised scheme will be made this year. There are two main grades of scholarship: namely, junior scholarships for short courses in agriculture, horticulture, dairying, or poultry-keeping, at farm institutes; and senior scholarships for diploma or degree courses in an agricultural or allied subject at agricultural colleges or universities, or for courses in veterinary science at veterinary colleges. The normal avenue to the senior grade is through the junior grade, but an exception is made in the case of candidates who have passed a higher school certificate examination before the age of 17 or a higher school certificate examination with distinction in at least one subject before the age of 18. Such candidates may apply for senior scholarships (honours degree courses) without passing through the junior grade.

Candidates must be (a) sons or daughters of agricultural workmen, or of working bailiffs and small-holders whose means are comparable with those of agricultural workmen; (b) bona-fide workers in agriculture; (c) sons or daughters of rural workers whose means and method of livelihood are comparable with those of agricultural workmen. The value of the scholarship is such as will enable students to attend the courses without cost to their parents. Provided a sufficient number of suitable applicants is forthcoming, there will be awarded this year about 120 junior scholarships, 10 extended junior scholarships (for well-qualified candidates who have held Class III scholarships under the experimental scheme), and 10 senior scholarships. The closing date for the receipt of applications is April 30, 1927.

Forms of application and full particulars may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1, or locally from the offices of county councils.

SINCE 1924, a scheme has been in operation under which a limited number of young agriculturists from Denmark are afforded facilities to live and work on farms in this country in order to study, at first hand, the methods and practice of British agriculture; while an equal number of British agricultural students have opportunities of working for a few months on selected Danish farms. The students are required to pay all their own travelling expenses and to undertake regular work on a farm, for a period of from three to twelve months, in return for free board and lodging, no money being paid to them for their services. The National Farmers' Union assists in the selection of farms on which the Danish students can be placed, and also helps to obtain suitable British applicants for work and study on Danish farms.

In Denmark, the scheme is worked by a Bureau of Agricultural Travels under the Royal Agricultural Society of Denmark. This Bureau has organized, with the assistance of the Danish Foreign Office and the Legations in Copenhagen of the various countries concerned, a series of similar exchanges with other countries; and the Bureau each year places a number of agricultural students of different nationalities with Danish farmers of high standing, on whose farms dairy farming in general; scientific economic feeding of dairy cattle; rational breeding of dairy cattle (with particular reference to the influence of the bull in the yield of the offspring); general co-operation in production, buying, and selling; and so forth, may be studied. In England those who wish to take advantage of the scheme should make application through the Principal of a college or farm institute (if they have attended either of such institutions) or through the agricultural organizer of the county in which they are resident. It is hoped that during the present year British students will take fuller advantage of the scheme.

THE reproduction on the opposite page is of a poster, recently prepared by the Ministry, setting out points that should be observed in the marketing of

Egg Marketing eggs. With the suggestion that it might
Poster be displayed in a prominent place in the market, copies of this poster have been

sent to every auctioneer who is known to handle eggs and to the Market Authority of every country market in England and Wales at which eggs are known to be sold,

EGGS

MARKET REQUIREMENTS

EGGS MUST BE NEW-LAID

Collect eggs once a day.
Keep them in a clean, cool and dry place.
Market weekly; more frequently if possible.

NEVER HOLD EGGS

Treat your market fairly.
Always candle eggs from "stolen nests."
Infertile eggs from incubators are not New-Laid.

EGGS MUST BE CLEAN

Don't wash hen eggs; use a damp cloth if necessary.

DIRT IS A POOR TRADE MARK

Keep stained eggs at home.

EGGS MUST BE UNIFORM

Don't mix hen and duck eggs.
Don't mix large and small.

GOOD APPEARANCE ATTRACTS BUYERS

You are better placed for supplying new laid eggs than the foreigner; don't fritter this advantage away.

The response has been remarkable. The poster has been welcomed as filling a long-felt need ; applications for additional copies are numerous. One prominent auctioneer says, " I am glad to have the opportunity of displaying this poster, as it is just the type of plain speech and clear instruction that the country people round here understand and pay heed to." Another auctioneer says that where producers have followed similar advice which he, himself, has tendered, improved prices have been obtained for their eggs.

It is hoped that the few simple points noted on the poster will receive attention and so help to place English eggs on our markets in a condition and manner worthy of their quality and of the home country.

* * * * *

THE general index number of the prices of agricultural produce fell four points in February and at 45 per cent. above pre-war was one point lower than in

The Agricultural Index Number December last and at the lowest level of recent years. A similar sharp decline in the index number occurred in February, 1926. Price changes in the case of most commodities were very small on the month and the fall in the general index number is due principally to lower index numbers for fat stock.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1922 :—

			Percentage Increase compared with the Average of the corresponding month in 1911-13					
Month	1922	1923	1924	1925	1926	1927		
January	71	67	60	71	58	49		
February	75	63	61	69	53	45		
March	73	59	57	66	49	—		
April	66	54	53	59	52	—		
May	69	54	57	57	50	—		
June	64	49	56	53	48	—		
July	67	50	53	49	48	—		
August	68	52	57	54	49	—		
September	59	52	61	55	55	—		
October	61	50	66	53	48	—		
November	63	51	66	54	48	—		
December	61	55	65	54	46	—		

Grain

Wheat was unaltered on the month at an average of 11s. 10d. per cwt., and the index figure declined one point to the level of 60 per cent. above pre-war. Barley advanced by 2d. and oats by 1d. per cwt., the relative index figures moving upwards by

one point in the case of barley to 37 per cent. above the base years and downwards by 4 points to 16 per cent. in the case of oats. The decline in the latter instance is due to the relatively greater increase in the price of oats in the corresponding months of the base years 1911-13.

Live Stock

A fall of 6d. per live cwt. in the price of fat cattle was recorded in February and, aided by a rise of 5d. per live cwt. in February, 1911-13, caused the index figure to fall three points to the level of 30 per cent. above pre-war as compared with 47 per cent. a year earlier and 53 per cent. in February, 1925. The price of fat sheep declined by $\frac{1}{4}$ d. per lb. and with a rise of $\frac{1}{4}$ d. in the base years the index figure was 13 points below the January figure of 57 per cent. above pre-war. Both bacon pigs and porkers were reduced in price by about 2d. per 14 lb. stone, estimated dressed carcass weight, and the corresponding index figures were seven points lower in each case at 63 per cent. and 75 per cent. respectively above 1911-13. Dairy cattle showed a further decline of 13s. per head and were thus only 26 per cent. dearer than pre-war, while store cattle improved a little to 30 per cent. above the level of the base years. Store sheep and store pigs appreciated somewhat in price during February, but there was a relatively greater increase in the corresponding period of 1911-13 and the index figures are, therefore, somewhat lower at 48 per cent. and 125 per cent. respectively above pre-war.

Dairy and Poultry Produce

Butter and cheese were unchanged in price on the month, but changes in the base prices in February, 1911-13, caused the index figures to vary a few points, butter moving from 37 to 40 per cent. and cheese declining from 38 to 36 per cent. above the pre-war level. The average price of milk sold under contract in the Manchester area was somewhat lower than in January and as a result a fall of three points is recorded in the index figure for milk. Eggs were almost the same price as in the previous month, but a considerable decrease in price occurred in February of the base years and the index figure shows a sharp rise of 16 points to a level of 62 per cent. above pre-war ; at this figure eggs were 10 points lower than a year earlier. Poultry were little altered at 39 per cent. above the base years 1911-13.

Other Commodities

The prices of potatoes and hay were practically the same as in January, and a fall of one point in the index figure brought potatoes to 94 per cent. above pre-war prices as compared with 49 per cent. a year ago. Hay was actually cheaper than in 1911-13. Vegetables were a little cheaper on the month at 41 per cent. above the level of the base years, or six points lower than in the previous month. Wool remained 32 per cent. dearer than pre-war, the slight increase in price in February being proportional to the increase in the corresponding period of 1911-13.

Index numbers of different commodities during recent months and in February, 1925 and 1926, are shown below :—

Percentage Increase as compared with the Average
Prices ruling in the corresponding months of
1911-13

Commodity	1925	1926			1927	
	Feb.	Feb.	Nov.	Dec.	Jan.	Feb.
Wheat	83	60	66	61	61	60
Barley	59	19	35	31	36	37
Oats	42	27	20	17	20	16
Fat cattle ..	53	47	31	28	33	30
Fat sheep ..	100	50	43	44	57	44
Bacon pigs ..	62	89	71	63	70	63
Pork pigs ..	60	89	76	72	82	75
Dairy cows ..	50	40	34	30	28	26
Store cattle ..	46	37	22	21	29	30
Store sheep ..	100	53	42	41	55	48
Store pigs ..	48	121	135	115	135	125
Eggs	62	72	60	46	46	62
Poultry	56	50	49	49	38	39
Milk	84	74	64	65	65	62
Butter	62	47	47	40	37	40
Cheese	50	78	28	28	38	36
Potatoes	144	49	113	110	95	94
Hay	—	4	4	2	—1*	—2*
Wool	119	45	31	29	32	32

* Decrease.

THE scheme operated by the Ministry and the British Goat Society, with the object of enabling goat-keepers of the small-holder and cottager class to secure the services of first-grade stud goats, for breeding purposes, at a maximum fee of 5s., will be continued in 1927. Persons desirous of entering their stud goats under the scheme should apply to the Honorary Secretary of the British

Goat Society, 10 Lloyd's Avenue, E.C. 3, who will be pleased to furnish full information. Entries will not be considered after June 1, on, and subsequent to, which date the goat submitted for approval must be at the centre in which it is proposed to stand at stud, so that the animal may be available for inspection. A goat accepted must remain at the approved centre, unless permission for its removal (under the same ownership) to another centre be granted by the Society. Applications for registration are invited from any owners of eligible stud goats, whether members of the Society or not.

* * * * *

PARTICULARS have been issued by the Colonial Office, the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland and the Empire Cotton Growing Corporation of the following post-graduate scholarships which they will award during the current year, and which will be tenable from October 1

next for one, two, or three years, as the case may be :—

Colonial Office.—It is intended to award from 16 to 18 post-graduate scholarships in agriculture and agricultural science, at any rate until the year 1933 inclusive, provided that a suitable number of candidates present themselves. The question of the continuance of the scheme will be examined in 1932. The object of these scholarships is to create a pool of properly qualified candidates from which vacancies in the Colonial Agricultural Departments can be filled. Candidates should, if applying for a research or specialist scholarship, hold an honours degree in pure science of a standard not lower than Part II of the Cambridge Natural Sciences Tripos; or, if applying for a general agricultural scholarship, hold a degree or diploma in agriculture or natural sciences (of which botany must be one) entailing not less than a three-years' course of study at a university or agricultural college. A candidate may apply before taking his final examination.

A scholarship will usually be tenable for two years, the first being spent in this country and the second at the Imperial College of Tropical Agriculture, Trinidad, or at some similar institution abroad; but scholarships for one year only may be granted at the discretion of the Secretary of State. The value of a scholarship is £250 per annum, from which the fees of training institutions must be paid. Passage expenses overseas are provided in addition to the scholarship, together with the cost of travelling, if required, whilst abroad, and of approved

books. Inquiries for fuller particulars and for forms of application should be addressed in writing to the Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W. 1. Completed applications should be received by the Private Secretary before June 15, 1927.

Ministry of Agriculture and Fisheries and Board of Agriculture for Scotland.—(1) *General Agricultural Scholarships.*—Five of these scholarships will be awarded. Their object is to train agricultural students who propose to take up posts in this country as agricultural organizers, teachers or lecturers in agriculture (agriculture includes horticulture, dairying, poultry work, etc.). Candidates must be British born, and should be graduates of a university or be otherwise qualified and must have some experience of practical farming. Candidates may apply before taking their degree or diploma examination. The value of the scholarships is normally £200 per annum, and expenses of travelling, laboratory fees, etc., are met. The scholarship is awarded for one year in the first instance, renewable for a second year on satisfactory reports on the scholar being received. The first year is normally spent in this country and the second year abroad. The amount of the scholarship maintenance allowance is increased in the second year where necessary.

No guarantee of employment at the conclusion of the scholarship can be given, but agricultural colleges and county councils in filling vacancies on their staffs may be expected to give preference to those who have held these scholarships.

(2) *Agricultural and Veterinary Research Scholarships.*—Seven of these scholarships will be awarded. Their object is to train students for a career as agricultural research or advisory worker. Candidates must be graduates with honours in science of a British university or equivalent qualifications. The value of the scholarships is £200 per annum; they are tenable for three years, one of which is usually spent abroad, in which case the maintenance allowance is increased, if necessary, and expenses of travelling, laboratory fees, etc., are met. No guarantee of employment at the conclusion of the scholarship can be given, but it is usual for agricultural research institutes and advisory centres to fill any vacancies occurring in their junior staff from among these scholars.

Forms of application for general agricultural scholarships and agricultural and veterinary research scholarships may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1, or from the

Secretary, Board of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh, according to the country in which the candidate resides. Completed applications should be received on or before June 30, 1927.

Empire Cotton Growing Corporation.—*Post-Graduate Studentships.*—The Corporation intend to award in July next not more than 12 studentships tenable for one year, each of the value of £250, with certain additional allowances for travelling expenses, lecture fees and books. The studentships are intended to provide opportunity either for additional training in research methods in, or for the advanced study of, plant physiology, genetics, mycology, entomology and other allied subjects which relate to the utilization of the soil and thus to improve the qualifications of those who are likely to seek employment in cotton-growing countries, either as botanists or in other specialized work or in agricultural administration or inspection.

Candidates must be men of British nationality. Applicants for senior studentships must be graduates who since taking their degree have had at least a year's training in research methods, or have done a year's post-graduate work in agriculture, or taken other advanced post-graduate course. Junior studentships are intended to assist men who as a rule should have passed all examinations for, and be otherwise qualified to take, a degree, but are unable without financial assistance to fulfil the post-graduate requirements for senior studentships.

All candidates must pass a medical examination, and candidates for senior studentships must be prepared to spend their studentship year at some institution abroad.

Particulars and forms of application may be obtained from the Secretary, Empire Cotton Growing Corporation, Millbank House, Millbank, London, S.W. 1. All letters should state whether the inquiry relates to a junior or a senior studentship. Forms of application must be returned so as to reach the Secretary not later than June 21, 1927.

* * * * *

Travelling Research Fellowships

THE Ministry has awarded the following travelling research fellowships to agricultural research workers in the financial year 1927:—

(1) A Fellowship of £250 to Mr. E. T. Halnan, of the Cambridge Animal Nutrition Institute, to enable him to attend the World's Poultry Congress at Ottawa and to visit Nutrition Research Centres in the United States.

(2) A Fellowship of £80 to Mr. T. J. Jenkin, of the Welsh Plant Breeding Station, Aberystwyth, for a visit to Norway and Sweden to study plant breeding methods and technique.

(3) A Fellowship of £40 to Mr. H. G. Sanders, of the Cambridge Animal Nutrition Institute, for a visit to Denmark and Sweden to study Live Stock Improvement Schemes, especially in regard to dairy cattle.

* * * * *

THE Ministry has awarded the following grants to enable the workers mentioned to attend at the following conferences:—

Grants for Attendance at International Conferences

(1) First International Congress of Soil Science, Ithaca, U.S.A., June 13 to July 22, 1927. Grants of £55 to—

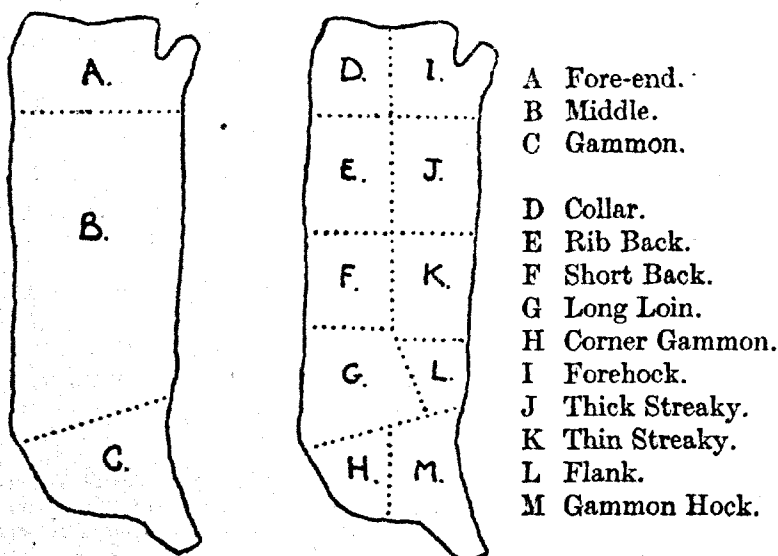
Prof. N. M. Comber, Department of Agriculture, Leeds University
Dr. E. M. Crowther, Rothamsted Experimental Station.
Dr. B. A. Keen, Rothamsted Experimental Station.
Mr. H. J. Page, Rothamsted Experimental Station.
Prof. G. W. Robinson, University College of N. Wales, Bangor.

(2) Fifth International Conference on Genetics, Berlin, September 11 to 18, 1927. Grants of £30 to—

Mr. H. Hunter, Cambridge Plant Breeding Institute.
Mr. A. E. Watkin, Cambridge Plant Breeding Institute.

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In the printing of the article on "Pig Carcasses for Wiltshire Bacon," in the March issue of the JOURNAL, the key to the diagram, shown in Fig. 1 (p. 1096), was omitted. The diagram and key are reproduced below:—



Farm Workers' Minimum Wages.—A meeting of the Agricultural Wages Board was held on February 21, at 7 Whitehall Place, S.W. 1, the chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions:—

Bedfordshire and Huntingdonshire.—An Order continuing from March 1 until further notice the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers. The rates in question are in the case of male workers of 21 years of age and over 30s. 6d. per week of 48 hours in winter and 50 hours in summer, with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays, and in the case of female workers of 18 years of age and over 6d. per hour for all time worked.

Berkshire.—An Order varying, as from February 28, the overtime rates of wages for male workers of 17 years of age and over, the rate in the case of workers of 21 years of age and over being increased from 8d. to 8½d. per hour. The Order also continues the general minimum rates unchanged until October 11, 1927 (the rate for male workers of 21 years of age and over being 30s. for a week of 50 hours).

Cambridgeshire and Isle of Ely.—An Order continuing from March 1 (when the existing rates are due to expire) until October 31, 1927, the existing minimum and overtime rates of wages for male and female workers, with amendments in the case of male workers under 19 years of age. The minimum rate in the case of male workers of 21 years of age and over employed wholly or mainly as horsemen, cowmen or shepherds, is 37s. per week of the hours necessary for the performance of the customary duties of workers so employed, and in the case of other male workers of 21 years of age and over 30s. per week of 51 hours, with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays, Christmas Day, and Good Friday. In the case of female workers of 18 years of age and over the minimum rate is 5½d. per hour, with overtime at 7d. per hour.

Dorset.—An Order continuing as from February 27 until August 27, 1927, the existing minimum and overtime rates of wages for male and female workers. In the case of male workers of 21 years of age and over the minimum rate is 30s. per week of 51 hours in summer and 48 hours in winter, with overtime at 8d. per hour, and in the case of female workers of 15 years of age and over 5d. per hour, with overtime at 6d. per hour.

Kent.—An Order continuing as from March 2 for a period of 12 months the existing minimum and overtime rates of wages for male and female workers. The minimum rate, in the case of male workers of 21 years of age and over, employed wholly or mainly as horsemen, stockmen, or shepherds, is 33s. per week of 52 hours, and in addition 8d. per hour for all employment on customary duties in excess of 52 hours but not exceeding 60 hours in any week, with overtime for employment on customary duties at 9d. per hour and when employed on other duties 9d. per hour on weekdays and 10d. per hour on Sundays. In the case of other male workers of 21 years of age and over the minimum rate is 32s. 6d. per week of 52 hours in summer and 48 hours in winter, with overtime at 9d. per hour on weekdays and 10d. per hour on Sundays, and in the case of female workers of 18 years of age and over 5½d. per hour, with overtime at 6½d. per hour on weekdays and 7d. per hour on Sundays.

Lincolnshire, Kesteven and Lindsey Divisions.—An Order continuing as from March 7 until March 4, 1928, the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers. The minimum rate, in the case of male workers of 21 years of age and over employed wholly or mainly as waggoners, is 39s. per week of 52 hours in summer and 48 hours in winter, and such additional hours as may be required for the performance of customary duties in connexion with the care of horses up to 61 hours from October 15 to May 13 and up to 58 hours during the remainder of the year. In the case of male workers of 21 years of age and over, employed wholly or mainly as shepherds, the minimum rate is 37s. per week of 52 hours in summer and 48 hours in winter, and such additional hours as may be required for the performance of customary duties in connexion with the care of sheep up to 55 hours in summer and 56 hours in winter. Additional payments are to be made in respect of the lambing season. In the case of male workers of 21 years of age and over, employed wholly or mainly as stockmen, the minimum rate is 38s. per week of 52 hours in summer and 48 hours in winter, and such additional hours as may be required for the performance of customary duties in connexion with the care of stock up to 56 hours in summer and 58 hours in winter. The minimum rate in the case of other male workers of 21 years of age and over is 32s. per week of 48 hours in winter and 52 hours in summer, with overtime in the case of all classes of male workers at 9½d. per hour on weekdays and 11½d. per hour on Sundays. In the case of female workers of 17 years of age and over the minimum rate is 5½d. per hour for all time worked.

Monmouthshire.—An Order continuing as from March 16 for a period of 12 months the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers. The rates in question are—in the case of male workers of 21 years of age and over, 32s. per week of 48 hours in winter and 50 hours in summer, with overtime at 9½d. per hour on weekdays and 11½d. per hour on Sundays, and in the case of female workers of 17 years of age and over, 6d. per hour for all time worked.

Northumberland.—An Order to come into operation at noon on May 13 (when the existing rates are due to expire) and to continue in force until noon on May 13, 1928, fixing minimum and overtime rates of wages for male and female workers. The minimum rates in question are in the case of male workers of 21 years of age and over employed wholly or mainly as stewards, horsemen, cattlemen, stockmen, or shepherds and hired by the week or longer period, 39s. for householders and 36s. for workers who are not householders (instead of 40s. and 37s., respectively, as at present), and in the case of other classes of male workers (other than casual workers), 32s. (instead of 33s. as at present) per week of 48 hours in winter and 52½ hours in summer, with overtime for all classes above mentioned at one and a-quarter times the general minimum time rate on weekdays, and one and a-half times the general minimum time rate on Sundays. The minimum rate for casual male workers of 18 years of age and over is 7½d. per hour. In the case of female workers of 18 years of age and over the minimum rate is 5d. per hour, except in the case of casual workers, where the minimum rate is 3d. per hour, the overtime rate in each case being 1d. per hour above the general minimum time rate otherwise applicable.

Worcestershire.—An Order continuing as from March 6 until March 5, 1928, the existing minimum and overtime rates of wages for male and female workers. The minimum rates are in the case of male workers of 21 years of age and over, 30s. per week of 50 hours in summer and 48 hours in winter, with overtime for stockmen, shepherds, and waggoners at 7d. per hour up to 53 hours in summer and 51 hours in winter, and 9d. per hour in excess of those hours, and for other male workers, 9d. per hour for all overtime employment. In the case of female workers of 18 years of age and over, the minimum rate is 4½d. per hour, with overtime at 5½d. per hour.

Glamorganshire.—An Order to come into operation on March 2 (when the existing rates are due to expire) and to continue in force until March 1, 1928, fixing minimum and overtime rates of wages for male and female workers. The minimum rates in the case of male workers of 21 years of age and over are 40s. per week of 60 hours for workers employed wholly or mainly as stockmen, cattlemen, cowmen, horsemen, shepherds, or bailiffs, with overtime at 11d. per hour, and in the case of other male workers, 36s. per week of 52 hours in summer and 48 hours in winter (instead of 50 and 48 hours respectively, as at present), with overtime at 10d. per hour on weekdays and 11d. per hour on Sundays. In the case of female workers of 18 years of age and over the minimum rate is 6d. per hour, with overtime at 7d. per hour on weekdays and 7½d. per hour on Sundays.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

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Enforcement of Minimum Rates of Wages.—During the month ending March 15, legal proceedings were instituted against eight employers for failure to pay minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers in agriculture. Particulars of the cases are as follows:—

County	Court	Fines			Costs			Arrears of wages			Workers concerned
		£	s.	d.	£	s.	d.	£	s.	d.	
Hereford ..	Hay ..	—	—	—	3	18	0	4	13	0	1
Monmouth	Abergavenny	0	6	0	—	—	—	49	11	6	3
"	Monmouth ..	1	4	0	3	2	6	77	16	0	5
Devon ..	Holsworthy ..	0	5	0	0	5	0	33	17	8	1
"	" ..	0	5	0	0	5	0	25	18	0	1
"	" ..	0	5	0	0	5	0	50	12	0	1
Hants ..	Basingstoke ..	6	0	0	9	9	0	18	14	0	2
Suffolk ..	Framlingham	2	0	0	0	5	7	12	10	0	1

In regard to the case heard at Monmouth, an inspector visited the employer concerned in February, 1926, and explained that the Monmouthshire Agricultural Wages Committee had prohibited the reckoning of any benefit or advantage as part payment of minimum rates of wages, and that if a worker was provided, for instance, with board and lodging, the matter must be treated as a separate transaction, as no deduction on that account could be made from payment of wages. A recent re-inspection revealed the fact that, for the first week after the inspector's visit, wages were paid in accordance with the Orders, but that subsequently the employer reverted to his former method of payment, which resulted in an infringement of the Act, inasmuch as, even if a reasonable allowance could have been legally made for benefits provided, the workers would still have received less than the equivalent of the minimum wage.

Foot-and-Mouth Disease.—No fresh centre of disease has been discovered since the issue of the March number of the JOURNAL; but two further outbreaks have been confirmed in existing infected areas. The first was confirmed at Tamworth, Staffs, on February 24; and the other at Little Tey, Colchester, Essex on the March 4.

Twenty-one outbreaks have been confirmed in all since January 1 last, involving eight counties, and the slaughter of 1,004 cattle, 565 sheep, and 348 pigs.

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Failure to Render Agricultural Returns.—As a result of the passing of the Agricultural Returns Act, 1925, the annual agricultural returns of the acreage of crops and number of live stock became compulsory. Comparatively few occupiers failed to render their returns in 1926, but proceedings were taken against four occupiers, and fines varying from £1 to £3 were imposed in each case.

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Leaflets Issued by the Ministry.—Since the date of the list given in the March (1927) issue of this JOURNAL, p. 1162, the following leaflets have been issued:—

Rewritten:—

No. 16. Apple Sucker.

Revised:—

No. 308. Plum Aphides.

Amended:—

No. 279. Technical Advice for Farmers.

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NOTICES OF BOOKS

Inorganic Plant Poisons and Stimulants. By Winifred E. Brenchley, D.Sc., F.L.S. (Cambridge: The University Press. Price 10s. 6d. net.)

It is becoming increasingly evident that the reactions of animals and plants to chemical reagents and to physical conditions may be very pronounced, even when the reagents are present in extremely dilute solutions, or the differences in physical conditions are only measurable by most exact methods. The reaction of plants to minute traces of such mineral elements as occur exceptionally in quantity in natural soils has been investigated by many research workers with varying results. In 1914, Dr. Brenchley published a concise account of the work done up to that date, and a second edition of her book has just appeared in which new results are incorporated, especially those concerning Manganese and Boron. The methods employed can be classified under the four headings of water cultures, sand cultures, soil cultures in pots, and field experiments. It is doubtful if sufficient is yet known to justify the use in practical agriculture of any of the inorganic substances investigated. With copper compounds, stimulation may be manifest at low concentrations and poisoning at higher concentrations. With zinc compounds, it appears that stimulation occurs in some species of higher plants in soil but not in water cultures. No definite evidence of stimulation has yet been obtained with any arsenic compound, however great the dilution at which it was applied. Boron, below a certain limit of concentration, exercises a favourable influence upon plant growth, and for some species, especially of the pea family, small quantities of Boron appear to be as essential for healthy development as any of the more abundant elements generally regarded as nutritive in function. The concentrations of Boron which cause stimula-

tion are remarkably low. Thus, with peas, concentrations from 1/100,000 downwards to 1/20,000,000 caused improvement in growth. Manganese, again, exerts a toxic influence on plants if it is available in too great amount, but small quantities appear to cause a very general stimulation of growth. It is probable that researches with Boron and Manganese are most likely to yield practical results, although the technique of applying to economic farming the favourable results obtained under easily controlled laboratory conditions has still to be found.

Rainfall Atlas of the British Isles. (Published by the Royal Meteorological Society, 49 Cromwell Road, London, S.W. 7. Price 15s. net.)

No apology is needed for the review in this JOURNAL of a book dealing with rainfall. The importance of accurate rainfall data, both in the practical business of farming and in scientific research in agriculture, needs little stress. Different crops require different amounts of moisture at their various growth stages; rainfall at certain times of the year may hinder farming operations, such as ploughing, seeding and harvesting, and may spoil a crop after harvesting; and rainfall has an influence on the prevalence of pests and diseases of crops and on the action of manures.

The volume under review is exceedingly well produced, and will be valuable in any general surveys of the effect of rainfall on the agriculture of the country, and in the first stages of any detailed surveys on the subject. Three full-page maps show the rainfall distribution in the "average" year, in a very wet year (1872), and in a very dry year (1887). A series of 56 half-page maps show, for each year from 1868 to 1923, the distribution of rainfall expressed as a percentage of the average; 12 full-page maps show the distribution of average rainfall for each month of the year. An introduction, by Dr. H. R. Mill, gives a history of the British Rainfall Organization, and an account of the methods used in the construction of the maps. The atlas shows that rainfall increases from east to west, and is highest in the neighbourhood of the highest land. The normal annual rainfall for England and Wales is 35.23 inches; but in the Snowdon district an average of over 200 inches is reached, and in Borrowdale an average of over 180 inches; the average falls to 20 inches in the south-east of Essex and the north-east of Kent. In the wet year of 1872, the rainfall for England and Wales was 50.8 inches, and in the dry year of 1887, 26.1 inches. In the former year a fall of 244 inches was reached in Cumberland, and in the latter year the fall for the Thames estuary was less than 15 inches. The sequence of wet and dry years is very irregular; thus from 1868 onwards there were two wet years, two dry, one very wet, two rather dry, nine consecutive wet, two dry, etc.

The normal rainfall of every month is distributed in substantially the same way as the normal rainfall of the year. For the east and south the rainiest month is October; for the west and north December or January; for the whole of England and Wales the driest month is April (followed closely by May and June), and the wettest October (followed closely by December).

Politics and the Land. By C. Dampier-Whetham, M.A., F.R.S. (Cambridge University Press. Price 6s. net.)

In this little book of 200 pages, the chief results of recent inquiry regarding the state of agriculture and the future of the land are brought under review. The author, impressed by the fact that there is no general understanding of the economic conditions which determine the methods of British farming, or of the causes which produce agricultural prosperity or adversity, makes his own attempt to understand

these conditions and causes, and sets out in the clearest possible style the facts and inferences which have helped him in his study.

Regarding agricultural depression, he shows that, when the general price level is falling, depression is inevitable. Neither skilful cultivation, co-operative marketing, nor import duties can prevent it, though they may mitigate its effects. The farmers' troubles, he concludes, are caused by unremunerative prices, as has been consistently and continually pointed out by the National Farmers' Union.

"The only complete cure would be a stabilization of the general price level, for the chief cause of depression is not agricultural or economic, but monetary." The author does not decry partial remedies; indeed, he thinks that alleviation may be all that is possible "until Nature in the form of a new goldfield or Man in the form of a refusal to produce enough food at present rates" effects a radical cure.

He points out that the farmer is less able to bear a continued fall in prices than other producers because of the length of time his operations take. His costs begin months before he sells his produce; consequently falling prices mean adversity. It is only when prices are rising that a farmer can look for prosperity.

On a grass dairy farm the economic lag is only about seven months, as compared with double that time on an arable farm. Hence is seen the sound economic reason which underlies the general opinion that grass land is safer than arable land.

The book can be recommended with confidence to all interested in agriculture.

The Principles of Dairy-Farming. By G. H. Garrad, N.D.A., *Farmer and Stockbreeder Manuals*. (London: Ernest Benn, Ltd. Price 7s. 6d. net.)

This handbook of 200 pages is a concise review of the chief factors which influence success in modern dairy-farming. The suitability of a farm for milk production, and the breeding and management of young stock, is shown in a practical manner: the chief aspects, also, of milk production and the feeding of dairy cows are brought up-to-date, supported by reference to recent experiments and publications on the subject. The author comments on many controversial matters, e.g., the use of roots, milking thrice daily, breeding and the use of minerals, whilst the significance of clean milk production and its influence on consumption by the public is discussed. The book should be of service to milk producers and students, also members of the general public who may wish to gain an insight into the many aspects of this branch of agriculture.

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ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Duhamel du Monceau.—A Practical Treatise of Husbandry: Wherein are contained many useful and valuable experiments and observations in the New Husbandry, collected during a series of years. Also the most approved Practice of the best English Farmers in the Old Method of Husbandry. (491 pp.) London, 1759. [63 (022); 63 (42).]

King, F. H.—Farmers of Forty Centuries, or Permanent Agriculture in China, Korea and Japan. (379 pp.) London: Jonathan Cape, 1926, 12s. 6d. [63 (5).]

Fitzrandolph, Helen E., and Hay, M. Doriel.—The Rural Industries of England and Wales: A Survey made on behalf of the Agricultural Economics Research Institute, Oxford. Vol. II.—

Osier Growing and Basketry and Some Rural Factories. (159 pp. + 12 pl.) London: Oxford University Press, 1926, 5s. [63.193; 63.3412.]

Russell, Sir E. J.—Soil Conditions and Plant Growth (5th Edition). The Rothamsted Monographs on Agricultural Science. (516 pp.) London: Longmans, Green & Co., 1927, 18s. [63.115; 63.161.]

Brenchley, W. E.—Inorganic Plant Poisons and Stimulants. (2nd Edition.) (134 pp.) Cambridge University Press, 1927, 10s. 6d. [58.11; 63.168.]

Cave, H.—Fertilizers: Their Sources, Manufacture and Uses. (116 pp.) London: Pitman, 1926, 3s. [63.16.]

Culler, D. Ward.—Evolution, Heredity, and Variation. (147 pp.) London: Christophers, 1925, 4s. [575.1.]

Royal Meteorological Society.—Rainfall Atlas of the British Isles. (12 pp. + 44 pl.) Published by the Society at 49, Cromwell Road, South Kensington, S.W. 7, 1926, 15s. [912; 551.5.]

Horticulture and Fruit

Watson, Margaret J. M.—The Home Preservation of Fruit and Vegetables. (142 pp. + 12 pl.) Oxford University Press; London: Humphrey Milford, 1926, 6s. [664.84; 664.85.]

Department of Scientific and Industrial Research.—Food Investigation Special Report No. 27: Temperature Conditions in Refrigerated Holds carrying Apples. By A. J. M. Smith. (52 pp.) London: H.M. Stationery Office, 1926, 1s. 6d. [664.8.]

Department of Scientific and Industrial Research.—Food Investigation Special Report No. 29: Temperature Conditions in Small Cold Storage Chambers containing Fruit. By A. J. M. Smith. (37 pp.) London: H.M. Stationery Office, 1926, 1s. [664.8.]

Thomas, H. H.—Pruning made Easy: How to Prune Rose Trees, Fruit Trees and Ornamental Trees and Shrubs. (184 pp. + 8 pl.) London: Cassell & Co., 1927, 2s. 6d. [63.41-195; 63.524; 63.522.]

Thomas, H. H.—Home-Grown Vegetables: The Amateur's Guide to Their Cultivation. (184 pp. + 8 pl.) London: Cassell & Co., 1927, 2s. 6d. [63.511.]

Thomas, H. H.—An Easy Guide to Gardening. (184 pp. + 8 pl.) London: Cassell & Co., 1927, 2s. 6d. [63.5.]

Thomas, H. H.—Rock Gardening for Beginners. (184 pp. + 8 pl.) London: Cassell & Co., 1927, 2s. 6d. [63.52.]

Lambert, N., and Thomas, H. H.—Sweet Peas for Amateurs. (184 pp. + 8 pl.) London: Cassell & Co., 1927, 2s. 6d. [63.522.]

Thomas, H. H.—500 Popular Flowers and How to Grow Them. (184 pp. + 8 pl.) London: Cassell & Co., 1927, 2s. 6d. [63.522.]

Plant Pests and Diseases

South-Eastern Agricultural College, Wye.—Bulletin No. 5: Some Soil Insects and Their Treatment. By F. V. Theobald. (6 pp.) Wye, 1927, 6d. [63.27.]

Appel, Dr. Otto.—Taschenatlas der Krankheiten der Zucherrübe. (22 pp. + 20 pl.) Berlin: Paul Parey, 1926. [63.24-33; 63.27-33.]

Wardlaw, C. W.—Lanarkshire Strawberry Disease: A Report for the Use of Growers. (38 pp. + 4 pl.) University of Glasgow, 1926, 2s. [63.24-41; 63.41 (c).]

Department of Scientific and Industrial Research.—Food Investigation Special Report No. 28: Bitter Pit in Apples. A Review of the Problem. By A. J. M. Smith. (24 pp. + 2 pl.) London: H.M. Stationery Office, 1926, 1s. [63.21.]

Iowa Agricultural Experiment Station.—Research Bulletin No. 96 :
The Extent to which Weeds Modify the Transpiration of Cereals.
(pp. 209-240.) Ames, 1926. [63.259.]

Live Stock

Staffordshire Farm Institute, Penkridge.—Iodine in Animal Nutrition : A Three Years' Trial. (7 pp.) 1926. [612.394 ; 63.60432.]

Ohio Agricultural Experiment Station.—Bulletin No. 395 : Mineral and Vitamin Requirements of Pigs, with Special Reference to the Effect of Diet on Bone Development. (229 pp.) Wooster, 1926. [612.394 ; 63.64 : 043.]

Iowa Agricultural Experiment Station.—Research Bulletin No. 94 : The Salt Consumption of Sheep : Fattening Lambs. (pp. 129 176.) Ames, 1926. [63.631 : 043.]

Dairying

Prewett, F. J.—The Marketing of Farm Produce. Part II : Milk. (84 pp.) Oxford : at the Clarendon Press, 1927, 3s. 6d. [381 ; 63.70 : 38 ; 63.716.]

Palmer, Leroy S.—Laboratory Experiments in Dairy Chemistry. (84 pp.) New York : John Wiley ; London : Chapman & Hall, 1926, 4s. 6d. [54 ; 543.2.]

Iowa Agricultural Experiment Station.—Research Bulletin No. 95 : Influence of Carbon Dioxide upon Quality and Keeping Properties of Butter and Ice Cream. (pp. 177-208.) Ames, 1926. [63.721 ; 63.715 ; 63.725.]

Veterinary Science

Ministry of Agriculture and Fisheries.—Second Progress Report of the Foot-and-Mouth Disease Research Committee. (117 pp.) London : H.M. Stationery Office, 1927, 3s. [619.2 (d).]

Poultry

United States Department of Agriculture.—Farmers' Bulletin 1508 : Poultry Keeping in Back Yards. (28 pp.) Washington, 1926. [63.651.]

Economics

Cambridge School of Agriculture, Farm Economics Branch.—Report No. 5 (February, 1927) : A Successful Norfolk Poultry Farm, 1922-26. R. McG. Carslaw. (19 pp.) Cambridge : School of Agriculture, 1927, 1s. (post free). [63.65 (42).]

Scotland, Board of Agriculture.—Report of Committee on Questions of Farm Accounting and Economics. (34 pp.) Edinburgh : H.M. Stationery Office, 1926, 9d. [657.]

Dampier-Whetham, C.—Politics and the Land. (215 pp.) Cambridge : University Press, 1927, 6s. [338.1.]

Lerner, F. M.—Financing the Live Stock Industry. (327 pp.) New York : Macmillan, \$2.50 ; London : Allen & Unwin, 1926, 10s. [332.71 (73) ; 63.6 (73).]

Prohl, Dr. Hans.—Die Deutsche Rentenbank-Kreditanstalt (Landwirtschaftliche Zentralbank) ihr aufbau und ihre Funktionen. (208 pp.) Berlin : Robert Gürgens, 1926. [332.71 (43).]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXXIV. No. 2.

MAY, 1927.

NOTES FOR THE MONTH

THE Linlithgow Committee, after surveying the whole marketing field, made the following recommendation in its final report* :—

Markets and Fairs in England and Wales

" During the course of our inquiry we have been struck by the lack of readily available information regarding the markets of the country. This

appears to be due to the fact that there is no general body of legislation on the subject ; many markets owe their origin to early charters, others are controlled by local authorities under private Acts of Parliament, while others have been established under the general powers of the Public Health and other Acts. As a result, there is no Government Department which is concerned to consider the relation of local markets to the food supply of the country, their influence on prices, or their general suitability from the point of view either of the consumer or the producer. The Ministry of Health in England and Wales and the Department of Health in Scotland only come into the picture, we understand, in connexion with the powers of local authorities (mainly in regard to sanitation and finance) as prescribed by certain Acts of Parliament, and cannot deal in any way with the wider aspect of the question to which we have referred above. As a preliminary step to the further consideration of this question, we think it desirable that the Government Departments concerned should collect and publish information as to the control and ownership of markets and any relative information likely to be useful."

* *Departmental Committee on Distribution and Prices of Agricultural Produce : Final Report*, p. 41. [Cmd. 2008.] H.M. Stationery Office, Price 1s. net.

In furtherance of this recommendation, a survey of the agricultural markets and fairs in England and Wales has been undertaken by the Ministry in connexion with, and complementary to, its investigations into marketing. Sufficient progress has been made with this survey to enable a preliminary report to be prepared.* This presents a general view of markets and market conditions in this country and is intended to serve as a background to later and more detailed reports on this subject.

In the introductory chapter of this first report the historical and legal foundations of markets and fairs, and the statutes and regulations affecting their administration and control, are briefly reviewed. Since 1847, no general enactment regulating markets has been made; it is not surprising, therefore, that little uniformity, and much that is anomalous, is present in the mass of laws and statutes which govern the markets of to-day.

In subsequent chapters, the markets are classified according to the commodities sold and the methods of sale. Wholesale markets are divided, broadly, into markets in producing areas and markets in consuming centres. The former are subdivided into (a) fruit and vegetable markets, (b) egg and poultry markets, (c) cheese and butter markets, (d) corn and provender markets, and (e) wool auctions. The latter are resolved into three main classes: (a) fruit, flower and vegetable markets, (b) fish and poultry markets, and (c) meat markets. From views expressed by competent authorities, the chief features to be considered in the provision of wholesale market facilities are summarized.

Live-stock markets, on account of their outstanding importance to the farming community, are considered in greater detail. Private treaty is still the main method of business in a few large fat-stock markets, which are mainly dealers' clearing-houses, and also in the large store-stock markets, especially those to which large numbers of Irish cattle are consigned. Four kinds of live-stock auctions are distinguished according to their size and location, and the superiority of large over small markets from the standpoint of equipment and competitive sale is stressed. The desirable features of a well-planned live-stock market are indicated, and the case for the abolition of live-stock street markets, where they exist, is stated. The powers of control exercised by public authorities and private

* *Markets and Fairs in England and Wales (Part I).* Economic Series, No. 13. H.M. Stationery Office. Price 6d. net.

owners over auction markets are discussed, and it is shown that the powers of local authorities are often restricted and may lead both to an excessive number of auctioneers and to a clashing of sales.

Since the main weakness of the present system in England is the unnecessary number of small separate auctions, whether for the sale of live stock, eggs, poultry or wool, the suggestion is put forward that the four parties mainly concerned—namely, farmers, auctioneers, buyers and market owners—should get together and form district committees for the purpose of examining the markets in their respective areas and agreeing on some rearrangement which will have the effect of eliminating the smaller markets and strengthening the larger. The suggestion is also made that there would appear to be a reasonable case for the greater exercise of central, i.e., national, authority in regard to market problems of more than local significance, including the economic development of markets generally.

The importance of markets, not only for their functions in the marketing system, but equally for their reactions on agriculture, is emphasized in the concluding chapter of the Report. Markets are institutions of great antiquity, but they have still a large part to play in the vast trade in agricultural products which is transacted in this country.

With the aid of the grant recently made to the Ministry by the Empire Marketing Board, the report is being issued at the nominal price of 6d. net. It is freely illustrated, and should be of service not only to all concerned with the control and administration of markets, but to producers, distributors and others interested in agricultural marketing. A knowledge of the markets of the country is essential if the methods of marketing agricultural produce are to be fully understood.

A description of Dresden markets, which are generally quoted on the Continent as the embodiment of all that is best in live-stock markets and abattoir construction and design, and interesting notes on markets in other countries are contained in an appendix to the report.

ANOTHER of the well-known periodical conferences was held at the Rothamsted Experimental Station on March 22, the subject on this occasion being cultivation.

Rothamsted Conference on Cultivation Sir Daniel Hall occupied the chair in the absence, through illness, of the Rt. Hon. Lord Bledisloe. In his introductory remarks, the CHAIRMAN compared the present monetary relationship between wheat and wages with that of pre-war days. The problem before the farmer was to adjust the methods of the farm to a period of dear labour and comparatively low returns for his produce.

Dr. B. A. KEEN defined the objects of cultivation as (1) the elimination of weeds, (2) the control of moisture, and (3) the formation of tilth. Tillage was the most costly item of farm expenditure, and the surest way to reduce it was by means of labour-saving implements and machinery. Rotary cultivation was recently compared at Rothamsted with flat and ridge cultivation in the growing of swedes. The stubbles were ploughed in the autumn in the ordinary way. In spring, the portions intended for flat and ridge work were cross-ploughed and subsequently worked down to the requisite tilth. In the case of the other portion, cross-ploughing was omitted, a seed bed being formed at one operation by a rotary tiller.

The rotary tiller left the soil in a finely comminuted state, puffy and spongy. After a roller had been passed over the ground, the seed was sown at an even depth. Germination and early growth were good, and, for some time, this plot promised best of all. Then, suddenly, the ground set hard; growth was checked; and the final crop was inferior to that obtained by ordinary methods.

No farmyard manure was used in the trial. It is possible, therefore, that the state of fineness reached was too extreme for a naturally sticky soil, deficient in organic matter. It might be that the sort of tilth required in the conditions indicated was one of superficial fineness, super-imposed upon a somewhat lumpy and firmer stratum of soil.

Mr. H. DREWITT (Chichester) followed with a description of farming on brick-earth soil in Sussex. Perhaps the most noteworthy feature is the number of ploughings—at least three—still considered necessary in the preparation of a seed bed for roots. Formerly, the number of workings was even greater, but a saving in this respect has been brought about by the use of disc implements and spring tooth harrows.

Ploughing, pressing and broadcasting are still the recognized routine for wheat.

Mr. J. JOYCE (Taunton) dealt with practice in Somerset. The basic implement of cultivation is a one-way plough, fitted with a digger breast and skim coulter. The last-named attachment is invaluable for burying vegetation of all kinds, whether weeds or catch-crops. Mr. Joyce emphasized the importance of timely work and of taking special pains to secure a satisfactory seed bed, more particularly on land in poor heart. In the case of spring cereals, the tilth should be such that one can easily drag one's toe along in the soil nearly up to the instep.

Well-farmed land, where roots have been folded, should be ploughed 7 or 8 in. deep. Land previously impoverished will give a better return if ploughed with a lighter furrow. Mangolds and sugar beet should be grown, preferably, in fields abutting on a good highway. Mr. Joyce generally took the format after a catch-crop of trifolium and vetches, folded off in April. As the fold is moved on, farmyard manure is applied and turned in with the one-way plough.

Generally, Mr. Joyce advocated deep ploughing, followed by stirring, which gradually diminishes in depth, to finally shallow harrowing and rolling.

Mr. J. STEEL (Rochford) dealt with cultivation in South-East Essex, in a climate with an average rainfall of about 20 in. Here potatoes are extensively grown. About 15 loads of dung are ploughed down in autumn, followed by steam ploughing and subsoiling before spring.

Later operations are disc harrowing, cultivating, harrowing, and opening by a combined double-row ridger and manure drill. Eight women plant the potatoes, which are covered by a single baulker doing 4 acres per day. Rye, sown after early potatoes, is 1 ft. high in February, when it is fed off by ewes and lambs.

Plumage Archer barley, drilled in October or November, yields from six to eight quarters per acre, and is, in every way, superior to that sown in spring. Mangolds for milk production were given up in favour of water bowls and a somewhat bigger ration of cake and meal.

As a result of changing to chilled digging ploughs, with reversible shares, Mr. Steel reduced the smith's bill from 5s. per acre to a few pence. Of particular interest was his account of how man, horse and mechanical power can be combined economically in farm work.

Mr. SPILLMAN recounted the methods adopted on the large farms of the Yorkshire wolds, where a farmer may have from 600 to 1,000 acres under the plough. In general, a four-course rotation is followed—namely, roots, barley, seeds, corn—the last-named consisting partly of wheat and partly of oats.

Sheep, at the rate of one per acre, have been considered indispensable on this class of farm, but the recent fall in prices, coupled with the high cost of growing roots, is operating seriously against financial success. Some farmers are beginning to look to temporary leys and kale as a way out of their difficulties.

As a means of saving labour, the use of the double-furrow plough is rapidly gaining in favour. It is interesting to note that in this high-lying part of Yorkshire two of the most successful cereals are Little Joss wheat and Goldfinder oats. The latter, however, must be got in early.

A useful discussion followed, after which Sir JOHN RUSSELL briefly summed up the chief points of the papers.

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THE International Institute of Agriculture at Rome, which is referred to from time to time in these pages, is an organization of an official character established by an international treaty or convention in 1905 to which some 70 different countries have now adhered. The expenses of the Institute are shared by these countries on a scale divided into five classes, the contribution of each country being determined by the class in which it is enrolled. The total expenditure of the Institute for 1927 and 1928 has been fixed at 5,260,000 lire, or about £50,000, but there is in addition certain expenditure covered by voluntary contributions which are made from time to time for special purposes either by Governments or by private organizations.

The work of the Institute has in the past been mainly directed to the collection and publication of information relating to agriculture, the most important being perhaps the issue of international statistics of the production of crops, though in addition the Institute has maintained since its foundation the regular publication of technical and economic intelligence. Recently an endeavour has been made to expand the activities of the Institute in various directions, and to bring it more directly in touch with scientific experts on the

one hand, and with agricultural associations on the other. With this end in view, it is in process of establishing a Scientific Council of eminent men in different countries, who can be consulted from time to time either by correspondence or at meetings to be held in Rome. In the same way a scheme has been devised whereby the principal agricultural associations of the different countries will be invited to nominate representatives who will be available for consultation, and thus advise and keep the Institute informed of the views and opinions of practical agriculturists.

The management of the Institute is entrusted by the terms of the treaty to a Permanent Committee, on which each adhering Government has a right to be represented by one member. For a number of years Great Britain was represented by the late Sir Thomas Elliott, who resided in Rome for that purpose. Since the death of Sir Thomas Elliott it has been decided for the present to discontinue the practice of having a resident representative, and Mr. R. J. Thompson, C.B., O.B.E., the Assistant Secretary in charge of the Economics Division of the Ministry, has been appointed as the representative of Great Britain and Northern Ireland on the Permanent Committee of the Institute. Mr. Thompson has also been appointed by the respective Governments as the representative of Australia, Canada, India and New Zealand, on the Permanent Committee.

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THE Ministry's annual report on the acreage of crops and grass, the production of the principal crops, the number of live stock, the number of agricultural holdings, and the number of agricultural workers employed thereon in England and Wales in 1926 has now been issued.

The report discusses the method employed by the Ministry in estimating production of crops, the chief changes in the statistics generally as compared with 1925, the increase in the acreage of sugar beet and the quantities of this crop dealt with at the various factories, and the number of poultry on agricultural holdings.

The tables attached to the report contain detailed figures of the acreage under each crop, of the numbers of each class of live stock, and of the yields per acre of the chief crops in each county of England and Wales, together with summaries

for Great Britain and Ireland over the last 10 years. This year, information which for a number of years past has been published separately as Parts I and II of the *Agricultural Statistics* has been combined in a single volume, with the object of bringing together, for the greater convenience of readers, matter which is very closely related.

This combined report now forms Part I of the *Agricultural Statistics of England and Wales*, 1926, and may be obtained through any bookseller, or direct from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, price 1s. 3d. net or 1s. 4d. post free.

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THE experimental period for which the scheme of scholarships for the sons and daughters of agricultural workmen and others

was approved, ended on March 31, 1927.

Scholarships for Agricultural Workers

There were three grades of scholarship: Class I, for courses of three or four years at universities or veterinary colleges for degrees in agriculture, horticulture, or veterinary science; Class II, for two-year diploma courses at agricultural colleges; Class III, for short courses at farm institutes and similar institutions. During the experimental period, 612 scholarships were awarded, 49 in Class I, 55 in Class II, and 508 in Class III.

A report on the working of the experiment has now been issued by the Ministry (Report of the Central Scholarships Committee published by H.M. Stationery Office, price 1s. 3d. net). Generally, the progress made by the scholars has been noteworthy and some have done exceptionally well. Among the small number of Class I scholars who have completed their courses, one obtained the degree of M.Sc.; two that of B.A. with honours; one, B.Sc. with honours, and two, B.A. with post-graduate diplomas. A few have won university prizes, one veterinary student gaining the gold medal for his class two years in succession. In Class II, the educational progress made by the majority of the scholars was distinctly good; most of them obtained National Diplomas in addition to College Diplomas. The positions taken at farm institutes by Class III scholars, bearing in mind their earlier educational handicaps, exceeded all expectations. At the date of the Committee's Report, 355 Class III students had completed their courses, of whom 294 gained the certificates or diplomas issued by the institutes, 102 obtaining first-class certificates or certi-

ificates with distinction, and no fewer than 28 of the students securing first places in the courses. There were five gold medallists, one silver medallist, and a number of other prize winners.

The ultimate aim of the scheme is to benefit the agricultural industry as a whole. The Committee state: "In land work, success depends largely on the efficiency and skill of the persons engaged in production; any measures which tend to maintain and increase the efficiency and skill of selected workers, and also to enable them in later life, as bailiffs, foremen, dairy managers and otherwise, to direct the details of the industry, must have an important effect on the development of agriculture." At the same time, there must be prizes in the industry to be won if applicants for scholarships are to be forthcoming.

So far as Class I is concerned, opportunities for testing the effects of training have largely been absent, as only 9 out of 49 scholars have, as yet, completed their courses of study. Much interesting information is, however, given in the Committee's Report as to the subsequent progress of the Class II and Class III scholars. With exceedingly few exceptions, these students have returned to farm work, and some of them, particularly the older students, have already substantially improved their positions. Within the limits of this note, it is impossible to enumerate all the later life successes of scholars, but a few examples are given. One Class II student, formerly a milk recorder, is now manager of a group of farms totalling over 1,000 acres; another, formerly a farm worker, is now manager of a well-known experimental farm; a third, formerly a dairymaid, is now an assistant dairy instructress; a fourth, formerly a farm worker, is tillage foreman on an estate of 1,000 acres; a fifth, formerly a working gardener, is an horticultural instructor, and a sixth, another working gardener, is head gardener and gardening instructor at a farm institute. Two of the Class III scholars are now farm bailiffs, five are foremen, four are head stockmen, fifteen are working at farm institutes or research stations, one is an assistant horticultural instructor, and another is an assistant poultry instructress. Among other posts secured by ex-Class III students are managers (and manageresses) of dairies, cheese factories and poultry farms.

In view of the satisfactory results of the experimental scheme, the Government have decided to continue the scholarships in a slightly modified form, as recommended by the Committee. Particulars of the continuing scheme were given on p. 79 of last month's (April) issue of this JOURNAL.

THE NEED FOR IMPROVED METHODS OF SELLING AGRICULTURAL PRODUCE

R. J. THOMPSON, C.B., O.B.E.,

Assistant Secretary, Ministry of Agriculture and Fisheries.

BRITISH farm produce is meeting with a rapidly growing competition from all parts of the world; and this competition is remarkable for the extent to which it is made up of produce of the highest class. At one time, most imported produce (apart from certain luxury articles, such as early fruits) was, on the average, inferior, and British produce could hold its own by reason of freshness or nearness to market. In recent years, the standard of imported produce has been so raised that much of it competes very closely with the best English produce. In all cases, imported produce is in a superior position as a commercial product on account of regularity of supply, evenness of quality and other considerations which admit of goods being dealt with on a large scale. The result is that, with many commodities, wholesale merchants find it more convenient and advantageous to handle imported goods, and English farm produce is being gradually pushed off the wholesale market.

There are naturally many reasons which have led to this change in position, such, for example, as the development of refrigeration, but, in essence, standardization appears to be the real secret of the commercial success of imported produce on our home markets. The classification of the produce into grades according to quality, and the observance of absolute uniformity in the grades, enables the purchaser to get exactly what he wants; wholesale trading is facilitated, distribution is made more elastic and less costly, sales can be made on description only, credit can be obtained from banks, and business, instead of being conducted on retail lines where each consignment differs from the next, is put on a commercial footing. Standardization is, of course, much more easily applied to some articles than to others, but it is questionable if there is any article on the wholesale imported food market which is not standardized to some extent. There is, therefore, an urgent need for the application of standardization to English produce, so that it may be put more on a footing with imported goods. Apart from purely commercial advantages, the classification of produce into quality grades results in higher relative prices to the producer for the top grades, and thus encourages and stimulates the production of the better

qualities. Indeed, one remedy for agricultural depression is to be found in raising the average quality of the output, so that a larger proportion is really of first quality and realizes first quality prices.

No doubt standardization begins on the farm, but, from a marketing standpoint, grading may be regarded as the first stage in standardization, and the first step towards effective grading is the definition of standard grades for the different commodities. Another phase of standardization lies in the selection and fixation of the most advantageous form of package—its dimensions and capacity, its construction and cost—so that the uniformity in quality secured by grades is supported and aided by uniformity in the package, the two taken forming a unit understood and recognized in the trade. To secure uniformity by these means presupposes some measure of agreement among all concerned, both producers and distributors, so that they all work along the same lines.

It is here that our competitors have such an enormous advantage. The fact that the goods exported to this country have, of necessity, to be concentrated in a limited number of channels and dealt with in large consignments of a wholesale character, naturally, and almost inevitably, leads to a certain uniformity. The trade falls into the hands of large co-operative societies or other trading organizations, which adopt measures of this sort, in the first instance, for their own convenience and for the furtherance of business. A further stage, which is becoming increasingly common, is for Governments to control by regulation the quality of the goods exported, and to insist on the adoption of standard grades. These methods cannot easily be applied in this country. Even in the "exporting areas" of England and Wales, there is no "bottle neck," such as a port, through which goods have to pass and at which their quality can be controlled, while the voluntary control of production and trade by large co-operative organizations, which is so successful on the Continent and in the United States, does not offer very favourable prospects owing to the limited extent to which co-operative principles have been applied by producers to the sale of agricultural produce in this country.

It is necessary, therefore, to consider how the principles involved and the objects aimed at can be secured by means suited to our special conditions. An essential preliminary is the close investigation of the circumstances of the trade in each commodity. This is being carried out by the Ministry, and the results are being published in the Reports in the Economic

Series. As regards standard grades, the Ministry is putting forward proposals and suggestions setting out exactly the classes into which each commodity might be divided on a weight and quality basis. These are only put forward, in the first instance, in a tentative manner, and it is for the trades concerned to consider how far these grades are suitable to their particular circumstances, or what modification of them is desirable. In order, however, that the proposals may be judged by actual examples, demonstrations of these grades as applied to eggs, poultry, fruit and pigs will be on view at a number of agricultural shows during the coming summer.

The best form of package is, perhaps, more difficult to determine than the grades of quality, but the advantages and disadvantages of the different types are being discussed in the same way. In the Fruit Report, a complete set of standard packages is put forward for consideration. In the case of poultry and eggs, a Committee representative of all sections of the industry is, at the invitation of the Ministry, considering the types of packages which can best be recommended. When this Committee has reported, specimens of the packages recommended will be shown at the Demonstrations at Agricultural Shows referred to above.

The determination of grades and the selection of packages is one stage on the road, but it does not solve the question how they are to be made effective and brought into common use. Looking at the matter from a broad point of view, there seem to be certain lines of action which deserve consideration. In the first place, it must be recognized that only those producers whose output is large can themselves perform the services of grading and packing economically and efficiently. As a general rule, in areas of surplus production, the output of many producers needs to be brought together and dealt with on a sufficiently large scale to spread the cost of handling and to secure the highest efficiency. This concentration and bulk handling of produce can be done by producers' co-operative societies, or, alternatively, by traders who buy up the produce and themselves prepare it for market, or, again, by organizations which act as agents for producers and may be financed by them.

The problem is to bring the various interests together and secure agreement as to common action; no single system will meet all circumstances, but it may be useful to consider some of the principal alternatives. It is possible to have a purely voluntary system, or a compulsory system, or a combination

of both, that is to say, a voluntary system, under which those who elect to come within its operation accept certain legal obligations.

A voluntary system, which would be suitable for certain commodities, can be suggested on the following lines, viz., the formation of a union or association of persons engaged in the sale of some particular agricultural product in an "exporting area" with a view to their agreeing mutually and jointly to adopt a definite system of grading and packing. By the phrase "exporting area" is meant an area where the bulk of the output is regularly sent in wholesale quantities elsewhere. In so far as produce is already collected and graded by distributors rather than by producers, it would be a case of uniting these distributors for joint action on the lines suggested. Alternatively, if the existing agencies were few or inefficient, the most effective method would be for producers to set up such collecting or packing centres as were needed to deal with the output. In any case, the object would be to secure that sales and deliveries of a wholesale character (i.e., above a prescribed quantity) should be made only on the basis of the agreed grades and in the prescribed packages.

An additional strength would be given to such an association by the use of a trade mark or brand to be applied only to produce of a defined quality or grade. The members of the association would agree on a system of voluntary control whereby a brand—signifying excellence of quality—was used, and exclusively used, for produce which fulfilled certain requirements. To make such a trade mark or brand of real value, a good deal of advertising would be necessary, and the brand would need to be used not only in the wholesale but in the retail trade. The difficulty, of course, is to ensure that the control by the association is sufficiently strong and effective to prevent the brand from being improperly used. This involves not only inspection of consignments, but power to enable the association to take action against defaulting members and to impose a substantial penalty.

An experiment somewhat on these lines was made, as regards fruit, by the Federation of British Growers in 1920-21, but was not successful, mainly owing to the difficulties mentioned. In any case, it was national and not local in its conception and administration. On the other hand, the scheme of the British Glasshouse Produce Marketing Association, which is mainly applied to the output of the Lea Valley and Worthing areas, and includes standard grades and packages, a registered

trade mark, an advertising campaign, and other features, has been in operation since 1922. The marketing scheme, now being attempted by producers of Cheshire cheese, is somewhat similar. No doubt there are many practical difficulties, but it is conceivable that a group of producers and distributors united together in an "exporting area," grading and packing their products on an agreed system, and reinforced by a trade mark or brand, could build up an extensive trade, which would have the effect of stimulating the production and sale of first-class produce. If it were possible to organize associations of this type in exporting areas, it would have the effect of putting such exporting areas in a similar position to individual countries exporting to the British market. Producers in such areas could set up any packing stations or collecting centres that they considered necessary, either as co-operative societies or as limited companies financed by producers, but it would be desirable that existing traders, engaged in a similar business in the area, should form an integral part of the scheme, so that all dispatching centres should be conducted on uniform lines as regards grades, packages, and the use of a common trade mark or brand. Whether an association of producers and distributors is a practical proposition can only be settled by those concerned, but it should be borne in mind that combination for a common object is one of the methods by which our competitors have obtained their present hold on the British market.

If a number of such local associations could be formed, then the next stage would obviously be the federation of these Associations in a national organization, all the units of which used the same grades and the same trade mark.

The difficulty in any purely voluntary scheme, such as the above, lies in securing the use of the quality grades, and the trade mark, in a uniform manner by all the members of the association, and it is in this respect that some Government support seems likely to be required. It is conceivable that this might be given in two ways without in any way destroying the voluntary nature of the scheme, *viz.*, by the establishment of a Government brand, and by the legalization of standard grades.

The use of a Government brand or trade mark might be authorized in respect of commodities reaching a certain standard of quality and complying with certain conditions. In such a case, it would probably be necessary to license or register traders entitled to use the trade mark, to arrange

for sampling and inspection of consignments, and for penalties for misuse. The use of the trade mark, however, would remain entirely voluntary, and only those who wished to take advantage of it would be subject to the conditions necessary to ensure that the mark was really a guarantee of quality. The value of a Government mark might prove quite considerable, and, whilst the mark would require advertising, it would also provide a subject which could definitely be advertised.

Two examples of Government marks may be mentioned. One is the "Kangaroo" Brand of Australian butter; all butter exported from Australia is graded, and the butter classed as "choicest" is branded with a kangaroo to denote that such butter is Australia's best quality. Another is the official Danish mark known as the "Lur Brand," which is applied to butter and bacon. This started in a voluntary manner by the registration of a trade mark and the formation of an association of co-operative and private creameries which agreed to adopt the mark. Subsequently, the Government was invited to make the mark obligatory on all butter exported from Denmark, and a mark was also adopted for bacon. In the case of butter, a certain quality standard is required, and the brand can be used only by approved and registered creameries, but, in the case of bacon and pig products, the mark is intended more as a guarantee of freedom from disease. In both cases, the use of the Government mark has proved a very valuable asset to the Danish trade.

The second method which would be of considerable assistance would be to legalize approved and agreed grades and packages as definite standards of quality and quantity. This would enable certain goods to be dealt in on description in the same way as a simple weight or measure, *i.e.*, just as a sale of a cwt. implies and requires the delivery of a weight of 112 lb., so the sale of a specified grade or package would require the delivery of an article of a prescribed quality or quantity. This again would be legislation of a permissive or voluntary character, as it would only apply to sales made in this way. It could, however, be connected up with both the ideas mentioned above. The legalization of a standard grade for first quality might provide the basis for a standard to which the suggested Government mark could be applied, while voluntary associations of the kind already indicated would certainly be much assisted in the conduct of their business by the existence of approved and recognized standards.

The above are examples of voluntary or semi-voluntary methods which seem worth consideration. There remains the question whether, in the case of certain commodities, the use of prescribed grades and, if need be, prescribed packages, should not be made compulsory by law, at any rate in wholesale transactions.

The compulsory use of prescribed grades is the method most commonly adopted by our competitors, but it is usually only applied to produce for export. Its application is thus relatively easy, as the produce, having to pass through a port, can be inspected and tested to see that it complies with the conditions prescribed by law. The adoption of any similar system in this country is made correspondingly difficult by the absence of any central point at which produce can conveniently be inspected. Nevertheless, the fact that so much of the produce put upon our markets is compulsorily graded, and is inspected and supervised before export to this country, is a very serious matter for agricultural producers in this country, and, unless some other system can be devised and brought into operation at an early date, it may be doubted whether the mere difficulty of compulsory grading will constitute a sufficient justification for neglecting to put home agricultural produce in a position to compete with imported goods.

In any attempt at compulsory grading, different commodities would present different problems which would call for different treatment. Broadly, however, the need would be, in the main, to regulate the sale of wholesale quantities, and this could probably be most conveniently done by legislation requiring packers and wholesale distributors to comply with certain conditions. Obviously, the consent and co-operation of a majority of the persons concerned would be required, but it is a remarkable and noteworthy fact that there is a growing tendency in practically all exporting countries in the direction of legislation regulating trade in one form or another, and that this legislation is proposed and passed at the request of the persons or organizations concerned, and with their entire approval and support.

In any case, an immediate and rapid improvement in methods of marketing agricultural produce in England and Wales is needed. The problem is to induce producers and traders to recognize that it is in their own interest, as well as in the interest of agriculture and of the country at large, to adopt methods which will encourage and reward the production of

produce of first quality, and thus open the way to a united effort to restore home produce to the position it should hold by right on the home market.

Closely connected with the problem of improved methods of marketing is the question of advertising. Except in the case of one or two commodities, advertisement has not been much used as a means of increasing the sale of home produce, and where it has been adopted the difficulties met with have not been small. Taking advertisements in the broad sense as including all kinds of publicity, whether by means of advertisements in newspapers or by posters, publications, etc., or by means of exhibitions such as the British Industries Fair or the Imperial Fruit Show, there are two main objects which may be attained—first, the maintenance of the general sentiment in favour of home produce and; second, the creation of a demand for particular products. An example of advertising of the first kind is afforded by the general scheme of the Empire Marketing Board, which is aimed at encouraging purchasers to demand and to obtain produce from the Empire, both home and overseas. In this connexion, the existence of a patriotic desire to support home industries is a valuable asset to the home grower, and one of which he should take full advantage.

The creation of an additional demand for particular products presents more difficulty. It is first of all necessary that a supply should be forthcoming to meet the demand which the advertisement is hoped to create. If the supply is not there to meet the demand, not only is the advertisement wasted, but it may well be that the demand is diverted into other channels and cannot subsequently be recovered. Further, if the advertisement is to succeed, there must be means of identifying the produce both as being of British origin and of first-class quality. It is here that prescribed grades or standards of quality, supported by a national trade mark or brand, become of importance. If only these two ideas could be put into operation, advertising of particular products would become practicable and valuable. All that would then be necessary would be to adjust the scope of the advertisement to the available supply in such a way as to create a corresponding demand, but if advertisement is to be used effectively to enlarge the market, and hence to stimulate production, it needs to be based on a guaranteed standard of quality, supported by a national trade mark or brand, and accompanied by an efficient marketing system.

RURAL CONTINUATION CLASSES

Circular Letter to Local Education Authorities.—The following circular letter, upon the subject of Rural Continuation Classes, has been forwarded, jointly, from the Ministry of Agriculture and Fisheries and the Board of Education to Local Education Authorities :—

We are directed to refer to the letter of November 25, 1925 (T.E. 3618/C.L.), issued by the Ministry of Agriculture and Fisheries to County Agricultural Education Authorities, and circulated by the Board of Education to the Education Committees which do not deal with agricultural education. That letter notified the revised arrangements made by the two departments in regard to part-time instruction for students between the ages of 14 and 16, and, in pursuance of the last paragraph, of the letter we are now able to lay before Authorities suggestions for the conduct of Continuation Classes for students of the ages in question. These suggestions, which are incorporated in the enclosed Memorandum, have been formulated by the Inter-Departmental Committee of the two Departments. It is believed that they are applicable to all rural continuation courses which include both a general and a technical agricultural element, even though, according to the preponderance of one or other of these elements, some of these courses, under the revised Regulations shown in the Appendix to this circular, may be aidable by the Board and others may be aidable by the Ministry.

The Committee have pointed out that over 60,000 boys and girls between the ages of 15 and 16 were employed as wage-earners in agriculture at the time of the 1921 Census, and that, if regard be also had to those who are not in actual employment in a wage-earning capacity, or who are engaged in rural pursuits not definitely agricultural, it will be apparent that there is much scope for the provision of classes designed to stimulate or maintain the interest of these young persons in an agricultural career. It is suggested that County Authorities should provide organized courses on the lines set forth in the Memorandum. The instruction should include subjects of general education for both sexes; with the addition, for boys, of such subjects as rural science, carpentry, and manual processes, and for girls, of dairying, poultry-keeping, horticulture and domestic subjects. In particular circumstances, instruction in such a subject as

dairying, poultry-keeping or horticulture will be suitable also for boys. In courses of domestic science for girls, it is important to include instruction dealing with the use and conservation of home-grown produce and with labour-saving methods.

A few authorities have included in their programmes, submitted to the Board in pursuance of Circular 1358, proposals for some expansion of the continuation school system, and it is known that in some areas the question of making provision, for students between 14 and 16, under the Regulations of the Ministry has been under consideration. In these cases, it is hoped that the Inter-Departmental Committee's suggestions will be useful in the working out of schemes of instruction.

The position in regard to the aiding of expenditure on instruction of the nature referred to in the Memorandum is fully set forth in the letter of November 25, 1925. The Ministry, however, desires again to emphasize the suggestion made in the last sentence of that letter, viz., that in Counties where agricultural education is dealt with by the Agricultural Committee of the County, that Committee should consult with the Education Committee if it proposes to provide part-time instruction for students under the age of 16.

Appendix.—EXTRACT FROM THE REGULATIONS OF THE MINISTRY OF AGRICULTURE AND FISHERIES FOR GRANTS IN AID OF AGRICULTURAL EDUCATION PROVIDED BY LOCAL EDUCATION AUTHORITIES IN ENGLAND AND WALES.

11.—(i) Except as indicated in (ii) below the Ministry will recognize and aid the following types of instruction :—

(a) All instruction given as part of his staff work by a teacher recognized by the Ministry as a member of a County Agricultural Education Staff or of the staff of an Agricultural College.*

(b) All courses in which instruction given is wholly or mainly in technical agricultural subjects.†‡ Instruction

* A member of a County Agricultural Education Staff whose time is spent partly on work relating to School Gardens and/or Teachers' Classes will not be recognized by the Ministry in respect of such work, and an apportionment of his salary in this connexion will be required.

† In counties where agricultural education has been transferred to the Agricultural Committee, such courses, if intended primarily for students under 16, should be arranged in consultation with the Education Committee.

‡ The arrangement of day and evening part-time courses, including instruction in both agricultural and general subjects, will be encouraged by the Ministry and by the Board of Education. Where a course of

in Gardening or the care of Small Live Stock will not normally be regarded as instruction in a technical agricultural subject, if it is given by a person who is employed as a full-time teacher in schools or classes recognized by the Board of Education.

(ii) The following forms of instruction will not be recognized or aided by the Ministry :—

(a) Education provided in or as part of the curriculum of Elementary or Secondary Schools.

(b) Instruction recognized by the Board of Education under their regulations[§] for Technical Schools, etc. (See note (†) on previous page.)

(c) Courses for the training of teachers employed, or students intending to obtain employment as teachers, in schools or classes recognized by the Board of Education.

Memorandum.—The following is the Memorandum referred to in paragraph 1 of the above letter :—

Summary of the Recommendations of the Inter-Departmental Committee.—The witnesses examined by the Committee were unanimous in regretting the lack of educational provision for young persons in rural districts who have just left the elementary school, and were convinced of the need for classes which will bridge the period between leaving the elementary school and the age when the boy or girl becomes old enough to profit by the instruction organized for those of sixteen years of age and over, by the County Agricultural Staff, at a farm institute or elsewhere.

The Committee believe that Young Farmers' Clubs are a great asset in fostering an interest in general and technical education, and that this movement should be extended.

The main difficulty, in connection with the proposed classes, is of an economic nature. Prospective students would be drawn from homes which could ill afford that members of the family should lose wages in consequence of attendance at day classes, and it appears doubtful whether, in the present condition of agriculture, farmers would be willing to pay an employee in

this nature is primarily agricultural it will be aided by the Ministry. Where the elements of general instruction predominate, it will be aided by the Board. If a teacher recognized by one Department is employed, during the time for which he is paid a salary, on a course recognized by the other Department, no apportionment of his salary will be required. Additional expenses, however, such as overtime charges, or travelling and subsistence allowances, will be aided by the Department recognizing the course.

§ Now the regulations for Further Education (Grant Regulations,

respect of the time spent in class work. Girls would be more likely to take advantage of the opportunities offered, as the majority of them seem to be retained for work at home.

It is considered that the aim in such instruction should be to combine some practical training with the continuance, to an appreciable extent, of the general education of the student. It is suggested that Local Authorities in considering the matter should give special attention to

(a) The general circumstances of the students, and the relation of training to local agricultural occupations.

(b) The selection of suitable centres, in order to bring instruction within the reach of the small number of rather sparsely distributed students.

(c) The selection of suitable teachers.

With regard to (a), a class arranged in a district of small farms would differ from one in a small-holdings area, or in a locality where large farms predominate. In any case, however, it is most desirable that neither the syllabus nor the method of teaching should give pupils the impression that they are merely "going back to school." The club spirit should be fostered, and students invited to express a voice in the arrangement of classes, the selection of subjects and the general conduct of the course. English, arithmetic, rural and domestic science should all be taught in close relationship to the outdoor occupations which students are likely to pursue, such as the care of live stock, dairying, poultry-keeping, bee-keeping and gardening, and the cultivation, marketing and preservation of fruit and vegetables. Every course should include practical work as well as theoretical instruction; neither branch should be taken for long without some demonstration of its connexion with the other.

Four to six hours of instruction a week would be desirable, and, while local conditions must determine the number of hours, the Committee suggest five possible methods of arranging the meetings :—

(1) Two evenings a week for two hours each. (This arrangement would obviate any difficulty about payment for broken time; but there may be difficulties about evening attendance and it makes no provision for systematic instruction in practical work out-of-doors.)

(2) The afternoon and evening of one day. (This method is the more equitable arrangement as between employer and employee. Difficulties of travel are minimized, and practical work is made possible; but arrangements to enable students to have a meal may be necessary.)

(3) Two afternoons per week. (If employers were willing to release their young workers twice a week, this would appear to be

(4) A whole-time course of two to six weeks' duration. An effort should be made to organize an experimental course of this type (non-residential) in suitable counties, at any rate for girls.

(5) Attendance on one day a week for a period of, say, twelve weeks.

The Committee consider it important that the boys and girls who have attended these continuation classes should have a reasonable chance of obtaining further education, and they suggest that provision should be made for scholarships which would enable promising students who have attended at least one continuation course to proceed to a farm institute.

(b) The difficulty of arranging suitable centres for the instruction of children, who will probably be widely scattered over the countryside, might be overcome by arranging for the classes to be held at a limited number of centres, easily accessible by rail or omnibus, or to which students might be brought by the provision of motor transport—a method which has proved economical and successful in at least one English county. Centres should be selected where facilities would be available for taking the boys on to farms and, if possible, into rural workshops; and for taking both boys and girls into dairies, poultry yards, gardens, etc.

(c) Local circumstances must determine the method of selecting the teachers. The instruction in agricultural subjects may be given by members of the county agricultural staff. In appointing teachers in these subjects, consideration should be given to the advantages of selecting those who have had training and experience in the art of teaching pupils under sixteen years of age.

If local authorities are unwilling to make special provision for this kind of instruction until they are in a better position to judge of the demand for it, the Committee suggest that it would be helpful if in every county at least one class were organized at a suitable centre, in order to test experimentally the demand.

Curriculum.—It is assumed that the intention of the course will be, on the one hand, to provide some definitely vocational training, and, on the other, to enlarge the information of the students and their stock of ideas, to help them to express themselves in speech and writing with reasonable freedom and accuracy, to give them further instruction and practice in calculations, to develop their reasoning powers, and to encourage, judiciously, the habit of reading both as a means of acquiring information and as a source of rational enjoyment.

Teachers should be encouraged to think of the definite ends which may be reached under the actual conditions, and to consider for themselves how they can best make the discipline and experience, which the course will supply, effective for its purpose. The course, including the practical work, should be regarded as a whole, and if two or more teachers take part in it they should consult before finally settling the syllabuses for their respective shares of it. The teacher should arrange his instruction by a more or less definite plan, which might need modification in the light of experience. It should be understood that visiting inspectors would encourage such departures from the scheme when sound reasons can be adduced.

It is not proposed that the whole of the subjects dealt with in the following outline of a course should be taught in any one school. At the majority of centres a selection from each of the four groups of subjects will be desirable. The course might extend over two or more winters, and a cyclic arrangement in the treatment of the subjects should be adopted. This would overcome the difficulty of arranging first and second year courses at any one centre.

The suggestions as to English, mathematics and science are applicable to young persons of either sex.

ENGLISH SUBJECTS. Group 1.—In the treatment of English subjects, the course might include literature and composition, history, geography, and rural economy. Students might be encouraged to consult books of reference and to read works in English literature which have a bearing on rural life.*

For the purpose of providing training in the power of expression, oral discussion and the writing of essays on the books studied and on rural matters are of primary importance. The writing of business letters and exercises in the keeping of simple records, suitable for rural conditions, should not be neglected. The students should be encouraged to write occasional essays during the summer period.

The history course might deal with topics drawn from social as well as industrial and political history or such aspects of the subject as the local systems of land tenure, the progress of agriculture and developments of rural conditions and co-operative enterprise.

* In certain counties in Wales, what is here said with reference to English literature will apply to Welsh and Welsh literature.

In geography it will not be difficult to discover aspects of particular interest in rural districts and to treat them with considerable fullness. It will be possible to give attention to climatic conditions (temperature, rainfall, winds, etc.) and their influence on natural products; the distribution of arable and pasture land, and of different types of farming, and the causes which influence it; agricultural imports and the conditions under which they are produced.

In connexion with rural economy, it will be possible to deal in an elementary way with such matters as Acts of Parliament, Local Government, Government Orders and Forms, local bye-laws, methods of co-operative trading and co-operative enterprise applicable to rural districts.

MATHEMATICS. Group 2.—In dealing with calculations, the application of arithmetical principles to rural problems should be kept in view, and the instruction should be of a decidedly practical character. Students ought to have practice not only in dealing with figures, but in making measurements, and otherwise securing the data upon which their calculations are based. The course might include farm book-keeping of an elementary character and some simple surveying and levelling.

In this connexion, it may be noted that farmers often employ their daughters as secretaries, so that instruction in arithmetic, in the form of keeping farm accounts, is needed for girls as well as for boys.

SCIENCE. Group 3.—In the teaching of science, adequate attention should be given to experimental work. The course might embrace an elementary study of air, water and soil, and of plant and animal life, with such further work as will give the student some understanding of the nature, composition, and action of manures and foods. Some study of heat and of mechanical powers might also be included.

CRAFTSMANSHIP. Group 4.—For the younger students, training in the use of ordinary hand implements might prove of considerable assistance if they were taught to conserve their strength, and to adopt methods which would secure speed combined with efficiency. Physical exercises directed to this end might be of considerable value.

Instruction in farm processes should aim at informing the student of the why and the wherefore of the process, and demonstrations should be consistently used for this purpose. Where boys are concerned, a selection of processes suitable to

the district should be made from such operations as ploughing, hedging, draining, stacking, thatching, planting and pruning fruit trees, spraying of crops, care of farm animals and dairy work. Students should become acquainted with the working of the main agricultural machines, including some form of prime mover.

Woodwork should embrace instruction in the use and care of tools, the recognition of various timbers, their properties and uses, the preservation of materials, and the making and repairing of various tools and appliances for rural use. Independence, originality and resourcefulness ought to be encouraged.

For girls, instruction might be provided in such subjects as care of live stock, dairying, poultry-keeping, horticulture, bee-keeping, laundry work, housewifery, cookery (with special reference to fruit preservation, bacon curing, and the general utilization of home-produced food). Some of these subjects are, of course, suitable for boys.

* * * * *

ELECTRICITY IN AGRICULTURE.—I

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The Supply of Energy.—There are two points of view from which the question of electricity in agriculture may be considered: that of the consumer—the farmer; and that of the supplier—corporation or private company. As regards the consumer, there are, at the present time, many farmers in this country whose farms are within convenient and accessible distance of an adequate supply of energy, and who are duly taking advantage of the fact. If not all of them are doing so, it is either because they are not yet fully assured that it would, in their particular circumstances, be to their benefit, or because they have not yet given the question much consideration. It is here that the dissemination of well-considered information, educative rather than propagandist, would serve a very useful purpose, and it is hoped in the second article of this series to offer some contribution in this direction. But there is a less fortunate class of farmers who, however they might wish to employ electricity, cannot do so, for the simple reason that they have no supply available. For these it may be useful to

know something of the conditions which govern the distribution of electricity; such a knowledge will help them to meet, as it were, half-way any steps that may be taken to offer them a service. They should, in other words, be able to appreciate the point of view of the supplier.

It may be taken for granted that any supply company or corporation is only too willing to undertake the supply of power in any area if it is going to pay to do so—that is to say, if the revenue produced by the sale of energy covers expenses and leaves a sufficient margin of profit. It is obviously theoretically possible to secure this by charging a sufficiently high rate per unit of energy delivered, but electrical energy, like any other commodity, must be sold at a price at which the consumer can use it profitably.

Extension of Supply to New Districts.—In the case we are considering, of the extension of electrical supply to new districts, it is scarcely worth while suggesting the idea of a subsidy. Facilities for credit exist in various forms and should be sufficient to meet the case. And a possibility, worth a passing notice, is that of a moderately large town, in the centre of a large farming district, with its prosperity, to a considerable degree, dependent on the prosperity of the farmers, who make it their centre. It might be good policy on the part of a corporation electricity department to extend its supply area to these farms and to sell energy at no immediate profit, trusting thereby to promote eventually a general rise in the prosperity of the district and consequently of their own undertaking. But in the development of any undertaking there are certain economic facts to be met and faced, and it will be well to consider the special features which these present in connexion with the distribution of electricity to farmers.

There are several considerations which confront the engineer who is contemplating the extension of his supply lines into any given rural area. What is probably most important to him—and what will certainly weigh most heavily with the committee, or board, for which he is acting—is the fact that the supply system must work at a profit, and any part or extension of that system must also work at a profit. Now a profit is made, on the year's working, only if the revenue from the sale of energy is greater in amount than $A + B$. A represents the annual charges due to capital sunk in generating plant, transmission lines and the various distributing lines and equipment; these charges may generally be taken as propor-

tional to the capital cost of all the constructional work. B represents the running costs—i.e., cost of fuel, water, labour—and may be taken, nearly enough for the purpose of illustration, as being proportional to the number of the units of energy actually sold, though this is not strictly true. For a given supply system, A is fixed irrespective of the number of units generated and supplied; and since this charge, A , must be covered by the revenue from energy sold, the first charge on each unit sold is $\frac{A}{n}$, where n is the number of units sold in the year. In

addition there is the second charge on each unit of $\frac{B}{n}$, to cover the actual running costs; but as B , as has been observed, is proportional to n , this charge may be regarded as remaining fairly constant per unit, subject only to such variations as may be due to the cost, mainly, of coal and labour.

We see, then, that in a given supply system the cheapest price per unit is obtained when n , the number of units generated annually, is a maximum; this happens when the demand on the power station is such as to keep it running at steady full output day and night. The same applies to each transmission line: to secure most profitable working it should be kept fully loaded all the time. This is a condition which is rarely obtained in practice—and never on general supply systems; it is, nevertheless, the end to which the engineer is striving. A system on which the full load was obtained for, say, one hour per day, and which was idle for 23 hours, would be of no use to him. The standing charges (A) would fall so heavily on the units generated during that hour as to make their price absolutely prohibitive.

Thus, then, the engineer, prospecting the area, is faced with the problem of getting a maximum load for the minimum of erectional and constructional work. Let us suppose that the question of generating plant does not arise, since the existing plant may have a big enough margin for a considerable extra load. Consequently, the constructional work required to serve the new area would be confined solely to the erection of main transmission lines, sub-stations and secondary distribution lines, and the engineer has only one thing to consider; whether the revenue necessary to cover the standing charges on these lines, plus a reasonable share of the existing standing charges on the station, can be obtained without unduly high tariffs. The running cost charge per unit of energy supplied is really

only small, so the difficulty lies mainly in getting the standing charge per unit down to a reasonable figure.

It may be taken that, within limits, the erection charges for a transmission and distribution system for a given load increase with the length of lines necessary. That is to say, to supply energy at the rate of 10 kw., for instance, to a farm one mile away costs half as much as to supply a similar load to a farm two miles away. It is also, approximately, true to say that the cost of line depends on the *rate* of delivering energy; it does not increase in direct proportion, but as the rate of using energy increases, heavier, and therefore more expensive, wire is necessary. Thus, if two farmers are prepared to use, say, 24 units each per day, but one wishes to use his whole supply in two hours, at the rate of 12 units per hour, while the other is prepared to spread his supply over 12 hours, using only two units per hour, it will cost more, distances being equal, to erect a line for the former than for the latter. Thus the latter would deserve, and under some tariffs obtain, his power more cheaply.*

Requirements of an Ideal Supply System.—The requirements of an ideal transmission and distribution system are, therefore, a maximum total consumption of energy at the minimum rate over the minimum distance. Recognizing the impossibility of such attainment, the engineer is left to weigh up the position to see how closely he can approach it, and whether he is justified in taking steps to provide the service.

It must be recognized that the supply company requires some guarantee that their outlay in erecting supply lines will be covered by the revenue, and most tariffs are framed with this idea in mind. This guaranteed revenue is usually obtained by fixing a minimum charge which must be paid irrespective of the amount of energy consumed. There are many different tariff systems in use, but a method which is fairly popular is to make a fixed charge, proportionate to the rateable value of the farms or other premises, and, in addition, a charge per unit of energy consumed. The fixed charge ensures a certain revenue to the company in return for the outlay in making the service

* It may be pointed out that the rate of using energy, or the rate of working, is given in electrical units as kilowatts—kw.—and the number of units of energy used over a given time is the product of the rate of working and the time in hours, giving kilowatt-hours—kw.h. A motor working at the rate of 1 kw. for 1 hour or $\frac{1}{2}$ kw. for 2 hours, uses 1 unit, and so on. 1 kw. is approximately equivalent to $1\frac{1}{2}$ h.p.

connexion, and protects them from people who would use little or no energy after the connexion was made. The unit charge may be on a sliding scale, decreasing after a certain number of units are used; this encourages the consumer to make a liberal use of the energy and so get the advantage of the cheaper rates. Such a tariff rate might be as follows: a fixed charge of 3s. per £1 per annum of annual rateable value of the consumer's premises, and a unit charge of 2d. per unit for the first five units for every £1 of annual rateable value, together with a unit charge of $1\frac{1}{2}$ d. per unit for any further units. That is to say, for a farm with an annual rateable value of, say, £200, the fixed charge would be £30; the first 1,000 units used would be charged at the rate of 2d. per unit, and any further units at the rate of $1\frac{1}{2}$ d. per unit.

Uncertainty of the Farming Load.—It must be recognized that the farming load is to most engineers in this country a more or less unknown quantity; the circumstances in which power has hitherto been used on farms have not resulted in much detailed information being collected as to the actual requirements of the various operations. Few farmers, therefore, would be in a position to estimate the amount and the nature of the load they could offer to the supply company.

The domestic load, however, is less of an unknown quantity, and the fact that a farmer was prepared to make a considerable use of electrical appliances in the ordinary work of the home would offer the engineer, always faced with the problem of at least paying interest on the cost of erecting the necessary lines, an element of security to set off the uncertainty of the untried farming load proper.

Nor will the engineer leave out of sight the question of village supply, if villages be conveniently situated in the district of which he is considering the electrification. Here again, the load will, in the first instance, be mainly domestic, but the possibility of the supply of power to rural industries will not be neglected. In some parts of the Continent, a considerable amount of power is now absorbed by small manufacturers, rural more in the fact that they are carried on in the villages than that they have any real connexion with rural life. Such development of village and rural industry supply may be slow, but, in the electrification of the countryside, the engineer will not be indifferent to anything that may help to secure a full and evenly distributed load.

COUNTY SCHEMES OF AGRICULTURAL EDUCATION: I.—HERTFORDSHIRE

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Introduction.—The Scheme of Agricultural Education in Hertfordshire falls into four sections:—

The Residential Farm Institute.
The County Demonstration Farm.
Adult Education in the County.
Rural Education.

Each of these sections might be organized independently, but there are certain advantages in combining them. The success of any one section makes for the success of the others. For example, the published balance sheets of the Demonstration Farm have been a potent factor in securing the goodwill of farmers; without that goodwill students for the Institute could not be obtained, and farmers would not so readily take advantage of the advisory facilities.

Undoubtedly the best basis for training a young man in farming is a well-managed successful commercial farm. This type of education is preferred by farmers to that of an institution where the teaching is mainly theoretical, no matter how sound the theory may be. In the past, the majority of young farmers have received their training on their fathers' farms, while a number are sent away from home, for a year or two, to get additional experience with relatives, neighbours, or on more distant farms. Always an impelling motive is to keep the lads at work and to avoid any "kid-glove" period. Herein lies the special value of Farm Institutes, as the training they give meets both the practical ideas of the farmer and the growing need for a knowledge and appreciation of science.

There is still one factor which militates against the free and abundant use of schemes for the training of farmers; this is the fact that success in farming is so generally linked with individual shrewdness in buying and selling. There is also the tendency for "progressive" men to extend this "farm trading" beyond the requirements of the land actually farmed. So long as our marketing is done in the present manner, there will be a temptation to specialize in these "business" transactions rather than in the art of production.

However, one step in the right direction has been taken by the establishment of Farm Institutes, as these provide the essentials for a progressive type of education with a commercial

farm as its basis. Here is found an environment full of rural interests, with endless scope for creative work and a profusion of subjects at hand for study and debate. The commercial success of the Institute Farm shows the farmer that the teachers appreciate the practical issues, and this inspires confidence; the right type of student comes to the Institute; advisory work becomes productive; progressive schemes are supported.

It has also to be borne in mind that upwards of 90 per cent. of the students in agriculture at a Farm Institute will actually become farmers or farm workers, and that the period of training does not exceed one year. The personal qualities, experience, skill and knowledge required to make a successful farmer have therefore to be stressed. It is not possible in this article to discuss this question fully, but it may be said that no amount of manual skill or science will compensate for lack of initiative, industry and judgment, and that good management (direct or indirect) on safe lines is one of the essentials of success.

The Residential Farm Institute.—In laying a foundation on these broad lines, the Farm Institute starts off with certain advantages. The long-course students are in residence for a complete year, and, although their education has varied a great deal, they all find a common interest in the farm. Environment counts for much, and a high standard of institutional management, a successful farm, facilities for study and recreation, all contribute to create the right atmosphere. This is no longer "school"; it is the beginning of the students' life work, and, as they see the teaching of the class room confirmed by the practice on the farm, they get an appreciation of the value of science with practice and, therefore, take kindly to study. It is possible to introduce many lessons from the history of agriculture in this country, and from the development of agriculture in other countries, and to create the outlook which will hasten an extended use of improved methods not only in farming, but also in the marketing and distribution of our home-grown foods.

The Herts Institute ("Oaklands," St. Albans).—Having dealt with some of the fundamental issues, a description can now be given of the methods adopted at the Hertfordshire Institute.^{1*} The programme of work varies from term to term, but, taking the year as a whole, it may be divided into three parts—practical work out of doors, class room lectures or

* Numbered references are given at the end of the article.

discussions, and reading and study. The practical work does not make experts in a variety of manual processes, but provides a very sound initial training in such things as the feeding and management of farm stock in the methods to be adopted in producing clean milk and in certain field operations. Included in this part of the programme, are daily questions on farm management, stock, judging, farm excursions and demonstrations, lessons on farriery and on the care of farm machinery, etc. From this work, in conjunction with systematic records from the farm, much useful matter is provided for elaboration in the class room.

No more useful materials can be found for educational purposes than the ordinary crops and stock on the farm. From these, all kinds of measurements, weights and records can be taken, providing for all stages of educational work and leading up to interesting studies of management and economics. With an ever-growing accumulation of data, collected under supervision by past and present students, there is an added interest to lectures and discussions indoors. The spirit of inquiry is fostered and faculties of observation and deduction are developed.

The third part of the programme brings in wider questions relating to agricultural history, national policy, food supplies home and foreign, methods of marketing, etc. The days are past when farms can be conducted as isolated units. Every young man, when he starts farming for himself, will find that the industry as a whole must fight for its rights. As one of the leaders, or as one of the rank and file, he will have to contribute his quota to the solution of many problems. A system of training for the vocation of farming cannot be complete unless it provides a stimulus to study the many difficulties ahead. It is for this reason that at "Oaklands" so much time is devoted to reading and study. A beginning is made with subjects of general farming interest, gradually leading up to more serious study of such matters as have been enumerated above.

The Demonstration Farm.—Reference has already been made to the many ways in which the Institute Farm has contributed to the promotion of agricultural education in this county. This farm has, in fact, been invaluable, both directly and indirectly: directly, for the training of teachers and students, and, indirectly, in creating the spirit of goodwill so necessary for the smooth and efficient running of the whole machinery of agricultural education. These results have fully justified the use of a farm in the county scheme, apart

from other functions which it has fulfilled. Before discussing the latter, it is necessary to have a clear conception of what is meant by a Demonstration Farm. Briefly, such a farm is an ordinary commercial farm, except that provision is made to keep every possible kind of record both with regard to crops and to stock. It may occasionally be necessary to introduce a little more variety in cropping and stocking than would be found in practice, but this is very different from the position on an experimental farm, where commercial practice is usually sacrificed in the interests of research.

Farm recording is, therefore, the keynote of the Demonstration Farm, and the value of such records is illustrated by the following examples from "Oaklands":—

- (a) Internal cost records are a fruitful source of information and add greatly to the value of other records. The opportunity is presented to investigate intermediate stages which escape detection under the general costings scheme. At "Oaklands," results are accumulating in a variety of directions and cost figures have already influenced the cropping and stocking of the farm. In addition, cost accounts have given guidance in the management not only of the farm but also of the commercial poultry and horticulture departments.
- (b) Although the conditions on a milk-selling farm are not favourable to the production of baby beef, it has been possible to make bull calves, from dairy shorthorn cows sired by a dairy shorthorn bull,² into baby beef at a profit. The associated data on the rate of growth of the animals, weights at birth and carcass per cent. are also all of interest and value.
- (c) From three breeds of grass ewes, each crossed with a Suffolk ram, by recording the number and weight of lambs at birth and by weighing each lamb at intervals till marketed, an exact measure of the relative economic value of these breeds has been obtained.³
- (d) When farmers were giving exaggerated estimates of the yield and feeding value of a crop of marrow-stem kale, the weighing of a sufficient number of plots and the analyses of the kale replaced fictitious figures with facts. Among other records which are being kept are the following:—
 - (1) The tillering power of winter-sown Spratt Archer barley.
 - (2) Observations among sugar beet, mangolds, and marrow-stem kale from the time of seeding to harvest.
 - (3) Methods of determining yield per acre of root crops.
 - (4) The value of inoculation of lucerne sown with and without a cover crop.
 - (5) A comparison of twice and three times milking.
 - (6) Observations on the rate of growth of pigs.

The difficulty on a Demonstration Farm is not where to find material worth recording, but to keep within the limits of what can be accomplished and analyzed. Any farm in as a commercial proposition teems with material, the study, measurement and recording of which would provide

information immediately useful for teaching purposes and urgently required as a basis for future research.

Adult Education (County Work).—A few of the directions in which county work has developed in Herts. until its effect is now felt in practically every village and rural district are detailed below.

(1) *Lectures, Discussion Societies, etc.*—Upwards of 200 lectures are given each year, sometimes in the form of single lectures, but generally as a series of four to eight. Whatever the subject chosen, whether relating to agriculture, horticulture, dairying or poultry keeping, it is surprising how often the member of the staff who is lecturing is able to give experiences, examples or figures from the commercial departments at the Institutes, to bring home his arguments. Certain it is that this intimate acquaintance with practical and commercial affairs is a source of both versatility and strength. In discussion societies, the ordinary lecture gives place to less formal ways of spreading information. Farmers themselves take part in the discussions or debates, so that all present gain from the experiences of others. It is at such meetings as these that the value of records and statistics is appreciated, as differences of opinion are interminable and often unanswerable except with another opinion unless facts and figures can be quoted.

(2) *Deficiency of Lime on Arable Land.*—Although Herts. rests on chalk it is seldom that this comes to the surface. It crops out in the north, and, throughout the county, old chalk pits give evidence of extensive chalking in the past. To-day deficiency of lime is one of the striking features in many parts of the county⁴: in some parts it is isolated fields or parts of fields that need liming; at other places large areas require liming as a first step towards restoring them to a profitable state of cultivation. On the mixed soils, it is often difficult for the farmer to decide where lime should be applied and where it is not required. In the one case, expenditure on liming is money well spent; in the other, no benefits can accrue. For this reason, during the past year or two, many thousands of acres have been examined by the Agricultural Chemist. The method adopted is to walk over each farm and to test the soils *in situ*. Precise information can then be given, so that each farmer knows exactly how he stands with regard to this important question. Naturally these visits lead to much useful advisory work being done in other directions at the same time.

(3) *Grass Land Improvement.*—By selecting centres for manorial trials, on the typical soil formations in the county, a great deal of useful information has been collected. With such data available, along with the recorded benefits of efficient grazing from the Institute Farm, it is now possible to give reliable advice on the improvement of grass in the county.

At a later date it is hoped to start one or two trials of the new method of increasing the stock-carrying capacity of grass land by the aid of rotational grazing and successive applications of nitrogenous manures.

(4) *Dairying.*—In a county where practically all the milk produced is sold in the liquid state, chief interest attaches to economy in methods of production, to butter-fat tests, and to clean milk production. Bulletin No. 6 issued from the Institute,⁵ and showing at a glance how to select the cheapest concentrates and how to combine them to make a balanced ration, is now being regularly used for many herds. Butter-fat testing was started four years ago in connexion with the County Milk Recording Society, and now over 1,000 individual samples are tested each month. The accumulated figures from over 37,000 samples provide useful data on the quality of milk from various breeds, and on the variation in yield from different milkings, and the relationship between quality and quantity.

(5) *Poultry Keeping.*—The setting up, in 1924, of egg-laying trials for poultry farmers, small-holders and others in the county, is likely to prove a real stimulus to this industry in Herts. The profits from poultry are so intimately connected with egg production per bird that this scheme for keeping egg records strikes at the very root of the essentials for financial success from poultry. This again is an example of the value of authentic records.

(6) *Manual Processes.*—The skill of the agricultural labourer is often mentioned, but too seldom encouraged. For over 30 years encouragement has been provided to the farm workers by holding competitions in manual processes. In the case of youths under 20 years, it is a condition of entry in these competitions that definite instruction should be given on their farms prior to the competition. In the past four years, great strides have been made in extending the scope of these competitions until they now embrace the following operations: ploughing, stacking, thatching, drilling, hedging, ditching, land-draining, milking, farriery, hurdle-making, poultry-trussing, and pruning.

(7) *Horticulture*.—Space does not permit describing in detail all the activities in the county, but mention must be made of the great good which is being done to very different classes of the community by spraying trials on fruit trees in large nurseries, by model allotments open to the inspection of all allotment holders in each district, and by pruning demonstrations and competitions.⁶

(8) *Rural Education*.—It is impossible for a Farm Institute to keep itself aloof from the big question of rural education. As a first step, the aim at "Oaklands" has been to enlist the sympathy and co-operation of the elementary school teachers in the county. With this end in view, a rally of these teachers is held at "Oaklands" each year, when subjects of mutual interest are discussed. It is hoped in the near future to hold a similar rally for secondary school teachers.

More concrete assistance is given in two types of courses given by the Institute Staff:—

(a) Teachers' Course in Horticulture, at "Oaklands."

(b) Teachers' Course in Rural Science, in the County.

The former course is held on Saturday mornings at different seasons and culminates in a one week's residential course at the Institute in the summer. It is designed to help teachers to make the fullest use of their school gardens as an aid to ruralizing the curriculum in country schools. The latter course has lately been started in two districts. Its object is, through the teachers, to foster a love of country life, and to stimulate the desire for further education in rural affairs. In one centre, also, a young farmers' club has been formed. These steps, however, must be looked on as preliminaries, and much time and thought are now being devoted to the preparation of a scheme to augment and link them up with continuation classes in rural districts for boys and girls between the ages of 14 and 16.

Conclusion.—Throughout this article emphasis has been laid on the phase of agricultural education which relates to farmers and farmers' sons, while horticulture and poultry keeping have only had casual mention. At "Oaklands" both these subjects are dealt with in the same way as that described above. The instructors in both are also responsible for commercial departments at the Institute. In the case of the poultry plant, financial success has been secured from the start⁷; with horticulture the commercial side was developed later, but already estimates are based on securing a profit. Through both these departments, contact is maintained not only with the strictly rural areas, but also with many

urban districts. The chain of progress, the lines of action, and the ideals aimed at are precisely similar to those in operation on the agricultural side.

Reviewing the work done in the county, there is no doubt that very substantial progress has been made in the short space of five years. It certainly has been a severe strain on the staff to maintain all the necessary activities—administrative, commercial, educational and advisory—but the results have justified their efforts. An edifice of progressive thought and enterprise has been built up which cannot fail to leave its mark on the county.

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MONTGOMERY AND CORNISH MARL RED CLOVER

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THE seed of Cornish marl red clover is produced exclusively in Cornwall, chiefly in the Mawgan, St. Columb, Wadebridge, St. Minver, and adjoining districts. The soils on which the crops are grown are generally of a calcareous nature, particularly in the coastal districts; hence the suffix "marl." The valuable qualities of the variety are often attributed to the fact that it has been grown for a great number of years on marly soil. Cornish marl, like all other red clover varieties and other leguminous species, is a lime-loving crop and will only give the best returns on soil relatively rich in this ingredient; it is, however, capable of producing excellent crops on soils which are known to be more or less deficient in lime.

The seed growing of Montgomery red clover is confined to a comparatively small area in the east of Montgomeryshire and extending for a few miles into Shropshire, with Montgomery, Welshpool, Forden Berriew, and Kerry as the

principal centres in Montgomeryshire, and Chirbury and Westbury in the latter county. Most of the seed crops are grown on moderately heavy soils, but equally good crops are obtained on fairly light land.

Historical.—It is definitely known that the two varieties have been grown continuously in their respective areas for over 60 years, but their exact origins are still obscure. The view sometimes expressed that Cornish marl originated as a result of natural crossing between ordinary red clover (*T. pratense*) and zigzag clover (*T. medium*) is totally erroneous. The theory is untenable for two reasons: in the first place, Cornish marl does not possess a single character which suggests that it is of hybrid origin; and, secondly, ordinary red and zigzag clovers are completely cross-sterile. Several attempts have been made by the writer to intercross the two species, but without any success.

It is possible that Montgomery and Cornish marl may have originated from natural crosses between ordinary cultivated red and wild red clovers. In the main, the indigenous wild red clovers are earlier, smaller, less leafy, and altogether inferior for fodder purposes to the cultivated varieties. A few types have, however, been found in Montgomeryshire, Cornwall, and various other districts which are distinctly later than the broad red clover, and which resemble the cultivated late varieties fairly closely in certain characteristics, such as leafiness and high "tillering" capacity.* When laying down land to grass, it used to be the practice, at least on some farms in Montgomeryshire two or three generations ago, to sow hay sweepings to which some home-grown red clover seeds were added. The hay sweepings would be expected usually to contain a small proportion of seeds of wild red clover, and consequently a certain amount of intercrossing between wild and cultivated forms would inevitably occur when the fields were kept for seed. More wild red clovers would be introduced at each sowing, and as the number of wild red × broad red clover crosses and their segregates increased, the strain may be supposed to have been gradually changed in the direction of greater longevity. It is probable that this process was considerably accelerated when it became the practice to harvest the second and third year crops, for only the seeds from the most permanent plants would be saved.

* In the absence of a more appropriate term, "tillering" is used in this article to denote the development of the main stems in red clover.

Seed Production.—When crops are intended for seed, they are usually sown alone, in which case the usual seeding is 8 lb. to 12 lb. per acre, or with Italian rye-grass, when the average seeding is 8 lb. to 10 lb. of red clover and 2 lb. to 4 lb. of rye-grass. Occasionally a complete mixture of grasses and clovers is used.

The age at which the crops are first harvested for seed and the subsequent treatment of the fields differ greatly from farm to farm, even in the same district, and depend mainly on the system of crop rotation employed. In some cases, the crops are seeded in the first (harvest) year, and are then either ploughed up or kept for seed in the second year; but in most cases they are mown for hay in the first year, then seeded in the second year, sometimes again in the third year and occasionally in the fourth year. It is by no means an uncommon practice to take two and even three successive seed crops from the same root. The following figures represent the percentage acreage of Montgomery and Cornish marl harvested for seed in the first, second, third, fourth and subsequent years in 1926:—

	1st year	2nd year	3rd year	4th to 6th year
Montgomery ..	30.8	53.0	11.9	4.3
Cornish marl* ..	—	81.9	9.5	8.6

* The figures for Cornish marl were kindly supplied by Mr. Basil Jenkins, Assistant Organizer for Cornwall.

The fields are closely grazed up to about the end of May before putting them by for seed. It is only very occasionally that the first crops are cut for hay and seed taken from the second growth. Unless the crops are mown early in June, the aftermath will either not flower at all or will flower too late to produce a seed crop. When grazed up to the end of May, the crops are usually in full bloom at about the end of July or the beginning of August. The time of harvesting depends necessarily on weather conditions, but in normal seasons the seeds are usually ripe by the first or second week in September.

The yields from the first and second year leys are considered to be somewhat similar. If the fields have been given a dressing of phosphatic manures during the previous winter, the third year leys are often quite as productive as in the first year, but after the third year the yields fall off rapidly. The yield of seed varies very considerably according to the season; for instance, the average crop in 1924 was only $\frac{1}{2}$ cwt. to 1 cwt. per acre, while in 1925 as much as 5 cwt. per acre were obtained.

The average yield of dressed seeds over a run of years is about 2½ cwt. to 3 cwt. per acre. The number of acres of genuine Montgomery and Cornish marl seeds harvested during the last few years were :—

					Montgomery	Cornish marl
1923	..	..	..	..	245	—
1924	..	..	..	..	174	102
1925	..	..	..	..	112	130
1926	..	..	..	..	232	127

Chief Characteristics.—All red clover varieties may be classified into three main groups, namely :—

- (1) Wild.
- (2) Early-flowering or broad red clover, as, for example, English broad red, Chilian, Canadian, American medium, Brittany, New Zealand, and many others.
- (3) Late-flowering or single-cut red clover, as, for example, English late, Montgomery, Cornish marl, Altaswede, American Mammoth, Swedish, Danish, and Norwegian lates.

The late-flowering varieties differ from the early-flowering clovers in many important characteristics, but from the farmer's point of view the chief difference is that the latter behave in the main as biennials, while the former are more perennial. All the late varieties are capable of producing good crops in the second year as well as in the first, while a few will even last well for three or more years.

It will be shown later that Montgomery and Cornish marl are very similar in regard to their productivity and persistency. They are so similar in other characteristics—as, for example, “tillering,” habit of growth, size of the leaves, and time of flowering—that to all intents and purposes they may be regarded as the same variety. In the seeding year the plants form short, dense, leafy growth and, unless sown very early, they will flower only sparingly or not at all. They remain throughout the winter and early spring in an almost dormant condition. In this stage the crowns are well protected by a thick covering of radical leaves, which give the plants their characteristic tufted appearance during this period. They differ greatly from the early-flowering and some of the other late varieties in this respect. In the case of most of the broad red clovers a certain amount of growth occurs throughout the winter except during cold weather, with the result that the crowns are more or less exposed to frost. The fact that Montgomery and Cornish marl are better protected during the dead season is, probably, one of the chief reasons why they are more persistent than most of the other red clovers.

With the exception of Norwegian and some of the Russian lates, Montgomery and Cornish marl are later in starting active growth in the spring than any other variety. As a rule, they seldom make a start before the third or fourth week in April. Thus, they are about two weeks later than English late and about four to five weeks later than English broad red clover.

Although they make very rapid growth during the early summer, they are essentially late-flowering clovers. They are usually in the full-bloom stage during the fourth week in July—that is, at about the same time as American Mammoth and Norwegian late—but about two weeks later than English late, and about four weeks later than English broad red. When they are cut at this stage, the aftermath growth is invariably very small.

When grown as spaced plants, they are usually prostrate to semi-prostrate in habit of growth during the early stage, but they become semi-prostrate to semi-erect towards the flowering stage. Under field conditions, they are forced, owing to competition with other plants, to assume a more erect habit. The stems, which are long and usually well-branched, are more numerous, more slender, and rather weaker than in other varieties; also the leaves are smaller than those of most other red clovers, and decidedly smaller than those of English late and broad red clovers. In common with many of the other late varieties, Montgomery and Cornish marl have, in all stages, a more leafy, uniform growth and a fresher green appearance than the early-flowering varieties.

Hay and Aftermath.—In recent years a large number of trials have been conducted at Aberystwyth and other centres in Wales to compare the cropping qualities, and the persistency, of about twenty varieties and nationalities of red clovers. It is outside the scope of this article to consider in detail all the different varieties included in these trials. In order to have a clear perspective, however, of the value of Montgomery and Cornish marl, it is necessary to compare the results given by these two clovers with those obtained from some of the other most productive varieties commonly grown in this country. The varieties selected for this comparison are English late, English broad red, and Chilian; and, in order to emphasize the danger of using foreign varieties which are not adapted to our conditions, the results given by Italian red clover are also shown.

The results given by these six varieties in the various trials conducted at Aberystwyth are summarized below. These trials were carried out on light and medium soils, some of which were deficient in lime. In all cases, except in trials A 81 and A 85 III, the clovers were sown alone. In A 81 they were sown with timothy and in A 85 III with perennial ryegrass. In each trial the plots were sown at a uniform rate, based on the same number of germinating seeds per acre, and each variety was replicated several times. To facilitate comparison, the yields of pure clover of the different varieties are expressed as percentages of those given by Montgomery or Cornish marl in one trial in which there were no data for (Montgomery).

Seeding Year.—In appraising the relative suitability of the different varieties of red clover for certain purposes—for example, for inclusion in one-year leys—due account has to be taken of their productivity during the seeding year, especially of the amount of stubble grazing they afford. Generally speaking, the slow-growing varieties, such as Montgomery, Cornish marl, Swedish, and Norwegian late, are less productive in the seeding year than most of the early varieties and English late. This is indicated by the following figures, which represent the relative yields in the seeding year of a few of the varieties included in two trials sown without any nurse crops in 1920 and 1922. The 1920 trial was sown in April and mown in September, while the 1922 trial was sown in May and mown in October.

Year	Montgomery	Cornish marl	Norwegian	English late	English broad red	Chilian
1920	100	80	50	140	156	135
1922	100	—	—	133	119	103

When the clovers are sown under a cover crop, the superiority of English late and English broad red is even more marked than is indicated by the above results. By virtue of the fact that they are able to recover much more quickly after the cover crop has been cut, they almost invariably produce much more autumn grazing than Montgomery and Cornish marl, particularly after a late harvest. It should, however, be mentioned that after an early harvest the latter usually produce quite an appreciable amount of dense, leafy growth. As already explained, Montgomery and Cornish marl produce but very little winter growth. Consequently, for winter and spring grazing they are much inferior to most of the early red clovers. For instance, in two trials, sown in

1922, English broad red on the average produced 2,150 lb. per acre of green fodder, and Chilian 1,100 lb., from about the middle of October to the middle of March, 1923, while Montgomery produced only 410 lb. per acre during the same period.

First Harvest Year.—The relative aggregate yields of hay and aftermath produced by different varieties of red clover during the first harvest year are shown in the following table:—

TABLE I

Trial No.	Year	Montgomery	Cornish marl	English late	English broad red	Chilian	Italian
A 1	1920	—	100	127	100	92	24
A 14	1921	100	134	180	175	106	92
A 19	1921	100	114	104	111	86	38
A 39 I	1922	100	—	98	67	57	5
A 39 III	1922	100	82	87	49	—	—
A 39 V	1922	100	111	107	62	48	20
A 81	1924	100	—	—	35	38	—
E 37	1924	100	—	63	47	—	—
A 85 III	1925	100	97	111	70	—	—
A 109	1926	100	—	—	76	—	—

On reference to Table I, it will be seen that, relatively, both Cornish marl and Montgomery gave exceedingly good crops in the first year, the former being on the whole slightly the more productive. Though they gave better crops than English late in several trials, on the average they were slightly less productive than this variety. The results prove conclusively that, for the conditions under which these trials were conducted, Montgomery and Cornish marl may be relied upon to produce, in spite of the shorter growing season, far heavier yields of hay and aftermath in the first year than even English broad red, which in these trials proved to be one of the most consistent croppers of the early clovers. The relatively low yields of Montgomery and Cornish marl in 1921—the only year in which these two varieties were surpassed by English broad red and Chilian—were directly due to the effect of the severe drought which occurred that year. The drought, which lasted practically from the middle of April to the end of July, set in before the late varieties, but after the early clovers, had started active growth. The results of these and other trials conducted at various centres in Wales agree in the main with those

obtained at Aberdeen,* where it was found that the Welsh red clover (that is, Montgomery) produced, on the whole, heavier hay crops than any of the other varieties and nationalities tested, even in the first year.

The amount of hay given by any variety depends to a large extent on the time of cutting. In the case of Montgomery, it has been found that, although the heaviest yields of hay are obtained when the crops are mown at the full-bloom stage, it is quite immaterial, as far as the aggregate yields of hay and aftermath are concerned, when the hay is mown, provided it is not cut before about the third or fourth week in June, when the clovers are in the late-bud stage, and not later than the fourth week in July, when they are in the full-bloom stage. The increased yield of hay resulting from late cutting is counterbalanced by a proportional decrease in the aftermath and *vice versa*.

On the other hand, the quality of the hay depends, to a great extent, on the time of cutting. The hay from Montgomery clover, mown at about the beginning of July is more leafy and succulent, and of higher nutritive value, than that mown two weeks later. Apart from the question of quality of the hay, it is important for another reason that hay crops containing a large proportion of late-flowering clover should be cut early. These clovers generally tend to become badly laid during the early flowering stages, Montgomery and Cornish marl being the worst offenders in this respect. On this account it is always advisable to cut crops containing these two clovers before the end of June. Even when they are mown three to four weeks before the full-bloom stage, these varieties will generally give better and heavier crops of hay than the early clovers.

Neither Montgomery nor Cornish marl will produce much second growth after a late hay cut, but when mown early the aftermath crops compare favourably with those of broad red on most soils, and are distinctly better on the poorer soils and in exposed districts. For example, the weights of hay and aftermath obtained as green fodder from Montgomery and English broad red plots, which were cut early in July

* "Red Clover," Wm. M. Finlay, North of Scotland College of Agriculture, *Bulletin* 24, 1919; and "Report on Grass Seed Mixtures, 1907-1913," North of Scotland College of Agriculture, *Bulletin* 30, 1926.

of the first harvest year (1926) and again in the middle of September, were :—

		Montgomery Cwt. per acre	English broad red Cwt. per acre
Hay	.. .. .	165.7	110.7
Aftermath	.. .. .	112.7	80.6

Second Harvest Year.—The relative aggregate yields of hay and aftermath given by different varieties of red clover in the second harvest year are shown in the following table :—

TABLE II

Trial No.	Year	Montgomery	Cornish marl	English late	English broad red	Chilian	Italian
A 14	1922	100	102	103	56	25	0
A 39 I	1923	100	—	60	5	1	0
A 39 III	1923	100	96	64	23	—	—
A 39 V	1923	100	115	52	5	2	0
A 81	1925	100	—	—	33	12	—
E 37	1925	100	—	62	27	—	—

In all the trials, with the exception of one (A 14), Montgomery and Cornish marl produced far heavier crops in the second year than any of the other late varieties; these last, in turn, were greatly superior to all the early-flowering varieties. In some of the trials, the early varieties had died off to such an extent during the previous winter that their contribution in the second year crops was almost negligible.

On light soils, particularly if they are deficient in lime, the productivity of even the most persistent clovers is generally considerably less in the second year than in the first. On the lime-deficient soils at Aberystwyth, the yields of Montgomery and Cornish marl in the second year were, in extreme cases, 37 to 40 per cent. less than in the first year. The corresponding reduction in the yields of English late ranged from 19 to 23 per cent., and, in the case of English broad red, from about 3 to 4 per cent. However, on the better class land the second year crops of some of the late varieties were sometimes quite as bulky as those of the first year.

Third Harvest Year.—The relative aggregate yields of different varieties of red clover in the third harvest year were as shown in Table III. The results shown in this Table suggest that, at Aberystwyth, Montgomery is more productive in the third year than Cornish marl, but in the various trials conducted in the counties both have given on the

TABLE III

Trial No.	Year	Mont-gomery	Cornish marl	English late	English broad red	Chilian	Italian
A 14 ..	1923	100	88	66	35	28	0
A 39 V ..	1925	100	70	61	0	0	0

whole fairly similar results, Cornish marl being slightly superior in some, and Montgomery in others. In most cases, all the varieties—both late and early—with the exception of Montgomery, Cornish marl and English late, had died back completely by the third year.

Persistency.—On several trials, from which no third year yield data were obtained, actual counts of the number of plants were made before the plots were ploughed, in order to ascertain the persistency of the different varieties. The average results in the three main trials are shown in Table IV. In two of these trials, the counts were made during the late spring of the third year and in the other in the spring of the fourth year. The average number of live plants per square yard of different varieties of red clover in the third and fourth harvest years are shown in the following table :—

TABLE IV

Trial No.	Harvest year	Mont-gomery	Cornish marl	English late	English broad red	Chilian	Italian
A 39 I ..	3rd (1925)	51	—	33	8	4	0
A 81 ..	3rd (1926)	68	—	—	7	4	—
A 39 V ..	4th (1926)	29	31	10	2	0	0

The figures given in Table IV prove conclusively that in these trials Montgomery and Cornish marl were more persistent than the other four varieties included. Similar evidence obtained for the other clovers shows that these two are much more lasting than any of the 22 varieties and nationalities tested in these trials.

The greater persistency of these two varieties is now fairly generally recognized. Numerous instances may be quoted

where they give excellent stands in the third and, in many cases, in the fourth year. In the seed-growing areas of Montgomeryshire and Cornwall, four, five and six-year-old crops are by no means uncommon, but in view of the fact that a considerable amount of seed is shed during harvesting, particularly in wet seasons, it is possible that many of the old clover fields in the seed areas may have become re-established as a result of self-seeding.

Productivity under Grazing Conditions.—As a result of several trials, conclusive evidence has been obtained that the late-flowering clovers are able to withstand grazing conditions better than the early varieties. The results further suggest that Cornish marl and Montgomery are the most suitable for this purpose. For example, one experiment, in which the plots were cut every 28 days for seven and four consecutive months during the first and second growing seasons respectively, so as to resemble grazing conditions, gave the following relative aggregate yields :—

	Mont-gomery	Swedish late	English late	Wild	English broad red	Vale of Clwyd
First year ..	100	100	65	62	35	43
Second year ..	100	45	36	91	negligible	negligible

Cornish marl was not included in this trial, but from observations made on other trials it is obvious that it behaves very similarly to Montgomery under pasture conditions.

Resistance to Various Diseases.—It is sometimes claimed that Montgomery and Cornish marl are completely immune from clover "sickness" (due to *Tylenchus devastrix* and *Sclerotinia trifoliorum*). The relative resistance of different varieties and nationalities of red clover to the eelworm and stem-rot diseases is being investigated by Rayns* in Norfolk, and by Wakerley† in Lincolnshire, and valuable information has already been obtained with regard to this important problem. Wakerley, in his trials, found that none of the red clovers tested—namely, Vale of Clwyd, Suffolk broad red, Dorset marl, Lincolnshire broad red, Chilian and Montgomery—was immune, but of these Montgomery and Dorset marl proved to be the

* The writer wishes to express his gratitude to Mr. F. Rayns, Director of the Norfolk Agricultural Station, for supplying him with full particulars concerning these investigations, the results of which have not yet been published.

† Report on experimental demonstrations for the year 1924, F. Wakerley, Kesteven Agricultural Committee.

least susceptible. The average relative results of similar trials carried out by Rayns at two different centres are shown below. These trials were sown in 1925. In the autumn and the following spring, actual counts were made of the number of plants, of each variety, that had become infected. The plots were mown for hay and the green weights of the produce taken.

	Relative No. of infected plants Broad red=100	Relative weight of hay Broad red=100
English broad red	100.0	100.0
Chilian	79.5	99.9
Vale of Clwyd	54.9	110.8
Montgomery	65.0	167.1
English late (Norfolk)	52.0	166.1
" " (Cotswold)	55.5	167.7

It is evident that in these trials Montgomery was decidedly more resistant than the three early clovers included, but was slightly more susceptible than the two English late clovers.

Although it has been found that Montgomery is not completely immune from clover sickness when grown on infected areas in the east of England, it is, however, a well-known fact that this clover has been grown continuously for over forty years, in four and five-course rotations in parts of Montgomeryshire and Shropshire, without the land becoming in the least infected, and that it has been grown successfully on farms within this area when other varieties had completely failed. It should, however, be noted that, for reasons which are at present little understood, the coastal western counties are practically free from clover sickness, only a few isolated eelworm and stem-rot attacks having been reported.

In Wales, the two diseases which cause the greatest damage to red clover are anthracnose (*Gloeosporium caulivorum*) and leaf spot (*Pseudopeziza trifolii*).* Anthracnose disease is often responsible for very considerable damage to seed crops, but, as its maximum attack does not occur until the plants are flowering freely, serious damage to the hay crops may often be avoided by cutting the hay early. In recent years the leaf-spot disease has caused considerable damage to hay crops at Aberystwyth. It was very prevalent in 1923 and 1925,

* For fuller information concerning these diseases see "Preliminary Investigations with Herbage Plants," Welsh Plant Breeding Station, *Bulletin H 1* (1919-21); "Scorch," or *Gloeosporium* Disease of Red Clover," W. M. Ware, Vol. XXX, No. 9 (1923), of this JOURNAL; *Comparative Studies of Kabatiella caulivora*, Kirch, Karak, and *Colletotrichum trifolii*, Bain and Essary, *Two Fungi which cause Red Clover Anthracnose*, Kathleen Sampson (in the press).

and was largely responsible for the poor yields obtained from the early-flowering clovers in those years.

Although Montgomery, Cornish marl and other late varieties are by no means immune from these two diseases, they are certainly much less susceptible to them than the early-flowering clovers.

General Considerations.—The early-flowering varieties, such as broad red, are generally considered to be more suitable for sowing in one-year leys than the late clovers, partly because they afford better stubble winter and spring grazing, and partly because they produce two full crops during the following season. Although it is possible that, in certain districts and on certain types of soil, broad red may produce, in the first year, heavier crops than the late varieties, yet it is very probable that English late, Montgomery or Cornish marl may be used to better advantage on many farms where broad red is now exclusively sown. The results of various experiments, carried out in Aberdeen, Leeds,* and Devon,† as well as at Aberystwyth and other centres in Wales, all proved that, at least in these districts, the home-grown, late-flowering clovers are usually much more reliable, even in the first year, than English broad red, while the results of the experiments in Norfolk and Lincolnshire have demonstrated that they are also more suitable for soils subject to clover sickness.

As far as the writer is aware, there are no exact experimental data available for drawing a direct comparison between the relative effects of the different red clover varieties on soil fertility, but it is sometimes claimed that Montgomery and Cornish marl are superior to most other clovers in this respect. Although it remains for future investigation to show to what extent this claim is justifiable, there is no doubt about the high standard of productivity of the land, as reflected by the heavy crops obtained, where these two clovers have been grown for a number of years.

For two-year leys, the late-flowering clovers should be sown in preference to the early types. Of the late clovers, the three native varieties are the most reliable for this purpose. English late is generally the most productive in the first year, but in the second year it is usually surpassed by Montgomery

* "Report on Nationalities and Varieties of Red Clover," W. G. Smith, University of Leeds, *Bulletin* 57, 1906.

† "Grass and Clover Seeds Mixtures," D. B. Johnston Wallace, *Essex County Farmers' Union Year Book*, 1925. *Scheme of Agricultural Education and Guide to Experiments*, Colin D. Ross, Devon County Agricultural Committee, 1926.

and Cornish marl, which, on account of their greater persistency, should always be included in mixtures intended to be down for three years or longer.

Montgomery and Cornish Marl Seed-Growing Associations.—Until quite recently, the terms "Montgomery" and "Cornish marl" were applied in a loose way to all red clovers—irrespective of the variety—harvested for seed in these two counties, with the result that a considerable proportion of the seeds sold as such were not the true extra-late Montgomery and Cornish marl strains. Fortunately, this unsatisfactory state of affairs has now been remedied. Within the last four years, the growers in both these areas have formed themselves into associations for the express purpose of ensuring the genuineness of the crops grown for seed. This is effected by annual inspection of the growing crops, when all those which do not conform to the standard type are rejected, and only those which are pure and true to name are certified as genuine. The annual lists of growers may be obtained from the honorary secretaries of the associations:—Mr. C. James, Brynawel, Montgomery, and Mr. Hoskings, Town Mills, St. Columb, Cornwall.

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CHARACTERS WHICH DETERMINE THE ECONOMIC VALUE OF GRASSES

III. TILLER PRODUCTION AND POWERS OF RESISTANCE TO REPEATED DEFOLIATION

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THE continuous production of leafage must, in the light of recent investigations and of what has been stated in previous articles of this series, be regarded as the *sine qua non* of a valuable pasture grass.

Leaf production is, in the last resort, a function of tiller production, while it is to be supposed that grasses which tiller freely would be more likely to be able to withstand heavy grazing than those which tiller but poorly. Work with cereals as shown, conclusively, that tiller production is difficult to study and is influenced, to a marked degree, by agronomic conditions—by spacing and depth of sowing, for example—as well as by the ordinary environmental factors of soil and climate.

Progressive Tiller Development.—The relative potential tillering capacity of different species and strains can, however, be studied by growing plants under such conditions as to give scope for maximum production. This has been done, in the case of a number of grasses, with a view to the study of progressive tiller development. The procedure was as follows. The seeds were sown in boxes on February 28, 1923, and started in a cool house. On April 16, the boxes were sampled and 100 seedlings for each lot counted for tillers. The seedlings were planted out, on June 13, as widely spaced plants. On this date 100 seedlings were again counted for tillers. On August 28, 25 plants were lifted from each lot and the tillers again counted. The remaining plants, for the majority of species and strains, were then allowed to grow on until at or about the heading stage, at which time they were assumed to have attained to an adult condition; 25 representatives were dug from each lot, on May 9, 1924, and the tillers again counted. The results of these counts are given in Table I.

TABLE I.—To show the progressive Tiller Development from seedling to heading stage for 15 different strains and species of grasses.

Species and strains	Number of tillers per plant			
	Apl. 16, 1923	June 13, 1923	Aug. 28, 1923	May 9, 1924
Cocksfoot—Indigenous ..	1.6	8.1	152	211
" Commercial ..	1.0	5.2	73	105
Perennial rye-grass—				
Indigenous ..	1.7	18.3	445	557
Commercial ..	2.0	14.9	388	443
Timothy—Indigenous ..	1.3	8.8	156	218
" Commercial ..	1.0	5.3	52*	70*
Tall oat-grass—Indigenous ..	3.1	10.6	129	307
" Commercial ..	2.3	5.2	69	142
Red Fescue—Indigenous ..	2.0	31.7	358	993
Hard Fescue—Commercial ..	1.8	39.8	269	435
Meadow Foxtail—Indigenous ..	1.4	15.7	103	262
" Commercial ..	1.6	15.0	108	150
Meadow Fescue—Commercial ..	1.9	8.9	137	263
Rough-stalked meadow-grass—				
Commercial ..	2.0	19.8	583	728
Sweet vernal-grass—Indigenous ..	1.9	18.0	214	785

* The Commercial Timothy plants were very badly rusted at this stage.

Rough-stalked meadow grass, indigenous sweet vernal grass, red fescue, and the perennial rye-grasses will be seen to have

outstanding capacities for tiller production, while commercial timothy, commercial tall oat-grass and commercial cocksfoot are relatively poor in this respect. Meadow fescue shows to poor advantage when compared to the two rye-grasses. The outstanding tillering capacity of the indigenous strains, compared with the commercial, is noteworthy and is in complete harmony with all the earlier trials reported from the Station. Of the species under review, ordinary commercial timothy, tall oat grass and cocksfoot, all with relatively poor tillering capacity, are essentially hay grasses which do not normally withstand heavy grazing. Under suitable soil conditions, high-tillering plants, like rough-stalked meadow grass and perennial rye-grass, are competent to withstand heavy grazing. That tillering capacity is not, however, an absolutely safe guide to capacity for withstanding heavy grazing is, perhaps, suggested by the fact that red fescue is probably not a grass which often assumes a dominant position on heavily grazed pastures.*

Tillering appears to take place at an early stage in the case of most of the grasses, but varies considerably in rapidity of development. The figures would suggest that, relative to maximum tiller development, the perennial rye-grasses are among the most rapid tiller producers, while rough-stalked meadow grass is also noteworthy in this respect; two species, be it noted, which, perhaps to a more marked degree than any of the other valuable pasture species, are competent to develop a dense sole to a sward.

The Effect of Repeated Cutting on Tiller and Root Development.—The retarding influence of repeated cutting on the production of potential panicle tillers has already been alluded to; while the effect on tiller production as a whole has been previously reported upon from the Station. It was thought desirable, however, to repeat the earlier trials and to include a larger number of species. The results from trials with single spaced plants, subject to pre-treatment in 1924, and harvested in 1925, are set out in Table II. Data for weight of roots and weight of stem and leaf together, are also shown in the table.

The significance of the figures is manifest, for, without a single exception, hay weight, number of tillers, and root weight

* It is unfortunate that Yorkshire fog, the bent grasses and crested dogtail species, upon which no breeding work is being conducted at the Station, had not been brought into the various agronomic investigations. Yorkshire fog and most of the bent grasses are, however, high-tillering species.

TABLE II.—To show (1) Yield of Hay, (2) Number of Tillers, and (3) Weight of Roots from plants harvested in 1925, respectively, for a series cut 11 times (pasture cuts) and for a series cut for hay and aftermath only in 1924.

Species and strains	Wt. of hay per plant in gms. dry wt.		No. of tillers per plant		Wt. of roots per plant in gms. dry wt.	
	Pre-cut 11 times	Pre-cut for hay and aftermath	Pre-cut 11 times	Pre-cut for hay and aftermath	Pre-cut 11 times	Pre-cut for hay and aftermath
Cocksfoot—Indigenous ..	61.1	129.6	117.1	141.0	5.9	10.6
Commercial ..	37.4	93.9	41.3	82.7	3.8	7.2
Tall oat-grass—Indigenous ..	53.2	140.9	79.3	143.3	4.9	13.4
Commercial ..	9.7	61.2	24.8	53.3	1.0	7.2
Perennial rye-grass—						
Indigenous ..	29.9	50.7	176.0	280.0	2.8	4.8
Commercial ..	13.3	35.6	61.7	146.3	1.5	3.9
Meadow Foxtail—						
Indigenous ..	42.9	89.4	135.1	235.5	8.5	21.7
Commercial ..	17.9	53.4	54.8	129.8	3.6	12.8
Timothy—Indigenous ..	67.5	171.5	97.2	116.0	4.7	6.1
Sweet vernal grass—						
Indigenous ..	19.8	61.3	142.0	332.1	4.6	15.8
Meadow Fescue—						
Commercial ..	14.6	61.4	49.5	97.6	3.2	6.6
Red Fescue—Indigenous ..	14.7	68.5	153.3	476.0	2.4	11.1
Average for all species and strains ..	31.8	84.7	94.3	186.1	3.9	10.1
Relative	37.5	100	50.6	100	38.6	100

have been decreased by a pre-treatment consisting of 11 pasture cuts. The magnitude of these decreases is rendered apparent by the relative figures at the foot of the table.

It is difficult, therefore, to resist the conclusion that heavy grazing, despite any residual effects from the droppings of the animals, cannot but help to weaken the plants chiefly selected by the grazing animal. This conclusion is the harder to resist because trials previously conducted at the Station have shown that a single heavy dressing of sodium nitrate was, at all events, not competent to narrow, materially, the margin between plants pre-treated on a pasture basis and those pre-treated on a hay and aftermath basis.*

* See Stapledon, R. G., and Beddows, A. R.: "The Quantitative and Qualitative Response of Cocksfoot (*Dactylis glomerata* Lin.) to Sodium Nitrate and to Superphosphate," *Welsh Journ. Agric.*, Vol. II, 1926.

Field plots at the Station have given evidence in the same direction and have shown reduction both of yield and of tillers, per unit of area, as the result of pre-treatments, consisting of grazing with sheep or cutting with a garden mowing machine, compared with the taking of a hay and aftermath crop. Relative results from the three treatments are set out in Table III.

TABLE III.—To show relatively the Yield of Hay and Aftermath in the second harvest year when following, respectively, (a) pasture cuts with a mowing machine; (b) intermittent grazing with sheep; and (c) a hay and aftermath crop. The effect on relative tiller production is also shown. Average figures for 24 species and strains replicated on 1/400th acre plots: first harvest year, 1924; second harvest year, 1925.

	Hay after hay	Hay after mowing machine	Hay after sheep
Relative yield of hay + aftermath	100	79	86
Relative tiller production .. .	100	75	87

It will be noted that the differences are not so great in the field plots as in the case of the single plants, but they are none the less definite and pronounced. It is interesting, also, to note that the effect on both yield and tiller production has not been so great on the plots intermittently grazed by sheep as on those cut monthly with the mowing machine. This fact is chiefly to be attributed to the more severe defoliation caused by the mowing machine, although it is likely to be influenced also by the manurial residues resulting from the sheep grazing. The effect of sheep grazing is, however, very largely a function of the heaviness with which the different species are in fact grazed. This is well shown by comparing tall fescue, a species which the sheep almost wholly neglected, with Montgomery red clover, which was defoliated by the sheep to a greater extent than by the mowing machine. The relative statement, hereunder, in respect of yield, compared with the average figures given in Table III, will make the position clear:—

	Hay after hay	Hay after mowing machine	Hay after sheep
Tall fescue .. .	100	46	177
Montgomery red clover .. .	100	73	59

It will be seen that, in the case of tall fescue, the highest yield in the second harvest year has been after sheep and not after hay and aftermath; the sheeped plots were hardly defoliated by the animals, but received a fair share of manurial residues from those having access to the sheep area as a whole.

The Montgomery red clover on the other hand, despite relatively heavy manuring consequent upon excessive grazing, has given an appreciably lower hay yield following sheep than following the mowing machine, although the latter treatment constituted relatively heavy defoliation without any manurial compensation whatsoever.*

From the evidence immediately under review, it would appear, therefore, that, because certain fields near a home-stead, although heavily and constantly stocked, produce abundance of grazing, year after year, it is not legitimate to argue that heavy, continuous grazing does not weaken the plants which are most attractive to the grazing animal. Such an argument could only carry weight if it were shown by a system of control plots that those grazed on an intermittent basis, allowing of periodic unhampered leaf development, or those following after hay and aftermath, were no more productive than the plots continuously grazed.

It is true, of course, that swards accustom themselves to the conditions superimposed and the effect of constant heavy grazing cannot fail to do otherwise than eliminate species and strains incapable of withstanding the conditions.

The figures in Table II are themselves proof of selective influences, for, in practically all cases, the indigenous strains have withstood rigorous pre-treatment better than the commercial, and this whether the effect be estimated by yield, tiller production, or root weight. The point to be emphasized, however, is that the indigenous strains, no less than the commercial, have suffered from the pre-treatment.

Recent trials with a great number of pedigree indigenous strains of cocksfoot are very illuminating in this connexion. The results show that strains do, however, exist in which a sum of pasture cuts may outyield the sum of the hay and aftermath cuts. Out of 26 strains, tested in 1925, three behaved in this manner. In the second harvest year (1926) both the drills cut as pasture, and those cut as hay and aftermath, were allowed to grow on to hay and aftermath. It is interesting to note that the three strains which had given higher pasture yields than hay yields, in the first harvest year, gave higher hay yields after pasture than after hay in the second harvest year. This may be taken as showing that the three strains in

* The trial, from which this field evidence has been drawn, is now in its fourth harvest year and includes both indigenous and commercial strains of the chief grasses and clovers. It will be reported upon from the Station in detail in due course.

question were particularly well able to withstand constant cutting or continuous grazing. They were strains therefore of a character which might be expected to survive on a natural sward heavily grazed. The yields of these three strains are compared in Table IV with the average yields of the 26 strains under test, and also with the averages for the three highest yielding strains. The figures show that these "pasture" strains, although above the average, were not particularly high-yielding and were considerably lower in the scale than the best strains; and, although the difference was greatest in respect of hay yields, it was quite pronounced in pasture.

TABLE IV.—To compare the Yields of different pedigree strains of Cocksfoot under pasture and hay conditions respectively.
Gms. of dry fodder per metre drill.

Particulars	1925 (first harvest year)		1926 (second harvest year)	
	Sum of six pasture cuts	Sum of hay and after- math	Sum of hay and aftermath	
			When pasture in 1925	When hay in 1925
Average of 26 strains ..	206	323	207	251
Average of three strains in which pasture out- yielded hay and after- math and in which hay after pasture outyielded hay after hay ..	230	213	231	191
Average of the three highest yielding strains	288	584	272	441

It has, however, to be remembered that gross weight does not necessarily constitute a fair estimate of the stock-carrying or fattening capacity of herbage. It has been insisted that it is leaf production that matters—constant production of juvenile leaf. Constant cutting has been shown to increase the ratio of leaf to stem, but that is not to say that it increases the yield of leaf—it is only exceptionally that it does so.

The evidence referred to above does, however, suggest that constant cutting or heavy grazing may tend to select strains with a special capacity for the production of "leaf shoots" rather than of stem shoots. This view is further suggested by

the fact that in the case of the trials, alluded to earlier in this article, a particular indigenous strain of cocksfoot and a particular indigenous strain of tall oat grass, although producing less tillers under a pre-treatment of eleven cuts than under a pre-treatment of hay and aftermath, none the less produced more leaf shoots (non-stem tillers) under the former than the latter pre-treatment.

It is evident, therefore, that swards have an infinite capacity for reacting to the management superimposed upon them. Under ordinary conditions obtaining on permanent grasslands, this capacity is the more pronounced because the sward necessarily consists not only of numerous species but of numerous strains of each of the constituent species.

Practical Conclusions.—The practical conclusions to be drawn from the evidence brought forward in this and previous articles, and from the foregoing discussion, would seem to be as follows:—

(1) That heavy, continuous grazing of course converts leafage while in its most nutritive condition and on this account alone compensates for a certain necessary reduction in quantity.

(2) Such heavy grazing long continued, tends to select strains having to a high degree a capacity for the production of non-stem bearing tillers, and for leaf production, and on this account, too, tends to compensate for reduction in quantity.

(3) Long-continued heavy grazing almost certainly reacts adversely on the inherent productivity of the majority of the strains actually selected and, moreover, probably does not tend in the direction of necessarily selecting the most productive strains.

(4) Apart from the evidence brought forward, it is hardly on physiological grounds to be supposed that even grasses, despite their rather exceptional manner of growth, can withstand perpetual defoliation without suffering some harm.

(5) The benefits resulting from close grazing, in so far as the stock is concerned, can probably be obtained, without exaggerated harm to the plants and without undue selection in an adverse direction, by adopting a scientific method of intermittent grazing—resting and heavy grazing: a method also likely to give rise to a greater weight of nutritive leafage than one of constant depasturage.

The matters dealt with in this article will be again referred to in the next and closing contribution of this series in connexion with persistency and aggressiveness.

Thanks are due to Mr. A. R. Beddows, B.Sc., for the collection of much of the data on which the present article has been based and for the conduct of trials under review during the writer's absence in Australia and New Zealand. Thanks are also due to Mr. Wm. Davies, M.Sc., and Mr. W. E. J. Milton, N.D.A., for the collection and preparation of the field data which have been brought under review.

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TABLE-POULTRY PRODUCTION AS A FARM INDUSTRY

W. M. ELKINGTON.

THE production of table fowls is a branch of poultry culture that has failed to keep pace with developments in other directions. It may be that the growth of the egg-producing industry has had a deterrent effect upon the business of raising table chickens because it has tended to popularize a class of fowl whose edible properties are of small account; in addition to which there has been, and still is, a surprising lack of appreciation of the commercial possibilities of table-poultry production. The economic problems associated with the war, which necessitated the curtailment of this branch of the poultry business, appear to have left, in many minds, an impression that, at the best of times, the production of poultry flesh is a proposition beset with financial risks, and that it can only be regarded as a subsidiary operation necessitated by the inevitable presence of surplus cockerels.

Egg production is of more cosmopolitan character than the production of table poultry because the products are more easily handled and marketing facilities are more general, whereas the raising of table-poultry is influenced to some extent by local marketing conditions, and even more by means of access to centres where there is always a steady demand. We must not forget that poultry flesh is still regarded by many people in this country as a luxury, and for the present there is no prospect of supplies being large enough to ensure its adoption as a staple dish.

Profit in Table-Poultry.—Contrary to popular belief, the profits from table-poultry production, under proper organization and with favourable marketing facilities, show a wider

margin than do those from egg production; and from the point of view of the general farmer there are several advantages, including a quicker turnover and a smaller capital outlay. In this case operations are confined largely to the first six months of the year, and there is no heavy outlay for housing and equipment as is necessitated by the management of a flock of layers. The table-poultry producer carries a comparatively small permanent stock for breeding purposes, and he turns over his money in a lump sum in three to four months from the date of hatching, instead of rearing pullets to the laying stage—say, six to seven months—and getting his turnover piecemeal.

Table-Poultry Production by the Farmer.—To get the best returns from a business of this kind, the farmer should take up table-poultry production on specialist lines—not necessarily on the same lines as the Sussex fatteners, who, in many cases, are not rearers and raisers, but rather he should breed specially for the production of table chickens instead of regarding this work as a mere side line for the disposal of the inevitable cockerels from stock bred primarily for the purpose of egg production. It is not suggested that useful table chickens cannot be raised from the egg-laying class of stock in such breeds as White Wyandottes and Light Sussex; but it is very clear that better margins of profit are realizable from birds bred specially for table qualities, and it is also evident that the specialist table-chicken raiser who commences operations early in the season will enjoy substantial marketing advantages over the more casual producer who is mainly concerned with the disposal of his unwanted cockerels.

Table-poultry production as a farm industry should be based upon a definite policy, which can be summed up briefly as catering for a specific demand. To put it more plainly, the producer should make it his business to ascertain what buyers require, and plan his operations accordingly. This is more important because market requirements may differ in various parts of the country, and it does not follow that London is the only centre that presents possibilities of market expansion. Producers will do well to investigate the conditions of local markets, which in many cases are well able to absorb regular supplies of limited quantity.

Necessity for Steady Supply.—Just as the egg merchant demands certainty of supply, so the table-poultry salesman requires some assurance of regularity, and there is plenty of scope for producers who will co-operate with salesmen in

order to build up a steady and remunerative trade. Any retailer will agree that in the early part of the year it is not a question of selling the goods but of getting them, and lack of home-raised chickens necessarily compels dealers to carry on a limited trade in cold-stored chickens of foreign origin. For this reason producers can count upon the co-operation of salesmen, if they are prepared, on their part, to tackle the business of production on systematic lines with a view to marketing regular supplies.

Time for Remunerative Trade.—It will readily be understood that the most remunerative trade in table poultry is done during the spring and early summer, when supplies are scarce and buyers are prepared to take a small chicken at a relatively high price. This branch of the trade offers plenty of scope to the specialist producers, but naturally it entails more trouble and risk in breeding, hatching and rearing. In order to commence hatching operations in December, it is necessary to maintain a stock of vigorous hens and early pullets from which a supply of fertile eggs can be relied upon at the right time. Incubators and suitable brooding accommodation for mid-winter chickens must also be available, and it will be understood that, while substantial reward awaits those who engage in these operations, there is need for something out of the common in the way of specialization, and the farmer who would raise table chickens successfully must have some ability in out-of-season breeding, hatching and rearing.

The Factor of Quality.—Apart from the production of early chickens, which, although a highly remunerative undertaking, may present difficulties of an insuperable nature to many, there is undoubtedly a great opportunity for the production of better class chickens later in the season, that is, from May onward. Supplies are still so scarce in May that a well-fed chicken, weighing 3 lb. to 4 lb., will always fetch a good price; but later on the markets receive so many consignments of what are obviously unwanted cockerels—many in poor condition and of inferior table quality—that dealers welcome supplies that bear the obvious mark of the specialist producer, and these will always command a comparatively high price. It is a matter of quality rather than of size, and since quality depends upon the breed, as well as upon the feeding, it is necessary to make a few observations upon these points.

Best Breeds for Table Production.—Even in these days of the egg-producing specialist, whose influence has been

stamped upon so many modern breeds, the table-poultry producer has a good selection without going beyond the breeds that are essentially of utility character. There are the Sussex—the Light, Speckled, and Brown—and the Faverolles, a breed whose excellent table qualities have not sufficiently been recognized. For smaller table chickens, of the *petits poussins* class, there is the White Bresse; while those who cater for a select *clientèle*, and aim to produce chickens that, in depth and width of breast, bear some resemblance to a partridge or a pheasant, will find an Old English Game or Indian Game cross with any of the above-mentioned breeds produce the desired result. Mr. J. H. Gilbert, who is in charge of the King's poultry farm at Windsor, and who is one of the most skilful producers of plump-breasted table chickens in this country, once informed the writer that a White Bresse male and Indian Game hens produced chickens of a remarkably fine quality, and though this cross may not appeal to those with whom rapidity of growth and low cost of production are first considerations, it may confidently be recommended to all who are desirous of catering for the highest class trade.

For those who desire to combine egg-production and table-chicken raising with one breed, under an economical general-purpose plan, the Light Sussex and the White Wyandotte stand out among the pure breeds, because there are many strains that have been cultivated specially for egg production whose edible qualities are well suited to the production of early table chickens. The Light Sussex has the advantage of white legs and flesh, a merit of considerable value in the London market; yet the White Wyandotte, despite its yellow shanks, is a good feeder, and fills out into an excellent table bird at about fourteen weeks. In a general-purpose scheme it may be worth while paying some attention to sex-linked crosses, particularly to the Rhode Island Red × Light Sussex, from which the male chickens inherit the leg and flesh colouring of the Sussex. Many people regard sex-linkage as a means of weeding out cockerels as soon as they are hatched, but it is significant that breeders who use the Rhode Island Red-Light Sussex cross make a point of selling off their day-old pullets from early hatches and retaining the cockerels for table purposes, the inference being that these are the more valuable members of the family.

Qualities for the Breeding Stock.—Methods of raising chickens for the table necessarily start with the assurance of

robust character in the breeding stock and generous treatment for the chickens, particularly during the early stages. The specialist table-poultry producer, when mating his stock, may not be much concerned with the laying records of his hens; but he makes certain that every bird in the breeding pen is thoroughly fit and capable of producing chickens that will grow well. For earliest hatching he may have to rely upon early pullets for sufficient eggs to fill his incubators; but, after the New Year, moulted hens should be in fit condition for breeding from, and these are likely to produce the sturdiest progeny.

System of Rearing.—The brooder-house system of rearing is specially well suited to the raiser of early table chickens because it affords adequate shelter and facilities for night feeding at a time of year when such advantages have an important influence on the rate of growth. Since early broods are comparatively small, as a rule, the indoor brooder answers the purpose very well, and excellent results can be obtained by converting a well-lighted outhouse into a brooder shed, dividing it into several compartments by means of fine mesh wire-netting, and placing a hover in each for 60 to 80 chickens. With ordinary care in management the birds will do well under these conditions, and two feeds by lamplight, say at 7 p.m. and 10 p.m., will have an excellent effect in promoting the growth and welfare of the chickens during the period of short days.

Feeding.—In regard to feeding, the average farmer enjoys an advantage as a chicken raiser through being able to utilize a quantity of skim milk, which is a valuable aid to growth and flesh production. When milk is available it should be included in the dietary from the time the chickens are a week old—either as a drink or for moistening the food. A considerable portion of moist or wet mash is essential for growing table chickens, and, in the case of *petits poussins* or early spring chickens, weight and condition depend more upon a generous diet throughout the rearing stage than upon any special fattening just before killing. With such materials as Sussex ground oats mixed with milk and served in troughs, with one feed of wheat each day, plump young chickens should be produced without any special cramming.

Cramming.—The business of cramming is a highly specialized branch of table-poultry production that is not, at this juncture, advocated for general farmers unless there are special circumstances that render it practicable. If farmers

are to be interested in raising table chickens as a farm industry we must set an ideal well within their reach, and the scheme for rearing chickens of the uncrammed class to meet a general demand calls for enterprise and industry rather than special skill. Moreover, it is based upon the concrete fact that the markets are in a position to absorb any reasonable quantity of well-fed chickens of the right class from March to June, while during the remainder of the year chickens of quality, bearing the mark of the specialist producer, will always hold their own in the market.

* * * * *

NEW DAMAGE TO PEAS BY THE PEA MIDGE

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THE grubs of the Pea Midge (*Contarinia pisi* Winn.) have been known for a long time to the growers of peas. They are small, white and footless and are frequently found in the pods of peas in considerable numbers, usually from 30 to 40 in each pod. These grubs can "jump," and in some districts are known as "the white flea of pea pods." Most varieties of peas are attacked, especially Marrowfats.

Previous records of this midge have stated that only pods are attacked, but last year (1926), both in a garden at Cambridge and on an experimental plot at Wye, the flowers and the terminal shoots of peas were found to be infested with white grubs resembling those of the Pea Midge. On further investigation, a number of peas on allotments at Wye were found to be suffering in the same way. These grubs were carefully bred out and proved to be the Pea Midge (*Contarinia pisi* Winn.).

Nature of Damage.—About the third week in June, full-grown grubs were found in the flowers and a few adult midges were observed laying their eggs in the terminal shoots. The flowers which contain the grubs may be recognized by their being swollen, especially the bottom part of the sepals (Fig. 1). The petals are very crinkled and often scarcely show at all, the sepals on the other hand being of normal length. From 9 to 99 grubs were found in each infested flower. Damage by the Pea Thrips is very similar, but in this case the flowers are usually shrivelled up altogether. The attacked terminal shoots are

also very noticeable; the flower stems remaining about half an inch in length and all clustered together (Fig. 2). All the flowers in each case either produce no pod or else a very small mis-shaped one. As a result, this attack of pea flowers and shoots is more serious than when the grubs are found in the pods.

An estimate of the damage can be seen at a glance from the following tables, made after a detailed examination of rows of peas at Wye.

TABLE I.—THREE SOWINGS OF GRADUS PEAS ON EXPERIMENTAL PLOT AT WYE EXAMINED ON JULY 6, 1926.

	1st Sowing		2nd Sowing		3rd Sowing	
	Total	Per cent. attacked	Total	Per cent. attacked	Total	Per cent. attacked
<i>Shoots—</i>						
Attacked ..	35	7.0	19	4.8	13	2.1
Free ..	462		378		601	
<i>Flowers—</i>						
Attacked ..	143	41.3	228	35.9	241	18.7
Free ..	203		406		1,042	

TABLE II.—FOUR SOWINGS OF PEAS OF DIFFERENT VARIETIES ON ALLOTMENT AT WYE EXAMINED ON JULY 6, 1926.

	1st Sowing		2nd Sowing		3rd Sowing		4th Sowing	
	Quite Content		Duke of York		Dr. Kitchin		Marvel	
	Total	Per cent. attacked	Total	Per cent. attacked	Total	Per cent. attacked	Total	Per cent. attacked
<i>Flowers—</i>								
Attacked	40	31.3	38	25.5	10	23.3	0	—
Free ..	88		111		33		0	

From these two tables it will be seen that between 18 per cent. and 41 per cent. of the flowers were attacked, and in one case from 2 per cent. to 7 per cent. of the shoots were also infested. The loss of pods in each case would be very considerable. It may, further, be pointed out that the earlier sowings of peas suffered most, those varieties in full flower about the first week in July actually suffering the most. Those which had not flowered by this date were the most free, but those which had already podded were found to be attacked to a slight extent in the pods. The estimated infestation of the pods was 5 per cent.

Soon after July 6, the grubs "jumped" out of the flowers and shoots and fell to the ground, where they pupated. On July 14, the midges started emerging from the pupæ and continued hatching until the first week in August. These midges

160. A

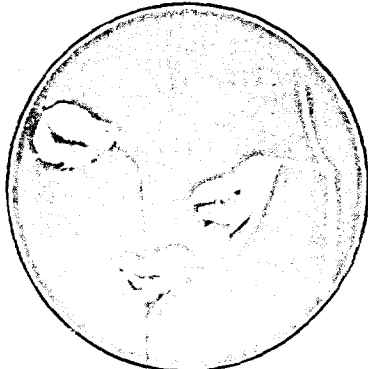


FIG. 1.—Showing damage to Pea flowers.



FIG. 2.—Showing damage to Pea shoot.

NEW DAMAGE TO PEAS BY THE PEA MIDGE.

at once started laying eggs in any pods they could find. Thus, there had been at least two broods of the Pea Midge in the course of the year (1926); the adults of the first brood being on the wing during the last two weeks of June, while those of the second were on the wing during the last two weeks of July and the first week of August. The life-cycle of the second brood adults was roughly a month.

It is interesting to note that Lind, Rostrup, and Kolpin Ravn* have reported an attack of an unidentified midge on the shoots and flowers of peas in Denmark in 1913, which is probably this same midge. Similarly, Dr. Harrison† reported the grubs of a midge (*Contarinia* sp.) as attacking the terminal flowers and shoots of peas in Northumberland in much the same way as described in this paper. But, as the species of the midge was not stated, it is only a reasonable conjecture that it was the Pea Midge (*C. pisi* Winn.).

Control.—It is suggested that digging in naphthalene, at the rate of 3 cwt. per acre, between infested rows, will do a great deal towards getting rid of this pest. Handpicking the damaged flowers and shoots will likewise do good.

The writer is indebted to Mr. F. R. Petherbridge of the Cambridge School of Agriculture for sending him notice and material of the attack at Cambridge.

Summary.—The Pea Midge (*C. pisi* Winn.), besides attacking pea pods, also attacks the flowers and shoots.

The attacked flowers may be distinguished by the swollen base of the sepals which are of normal length, the petals being crinkled and shortened. The appearance is similar to that of flowers attacked by the Pea Thrips. In an attacked shoot the flower stems remain very short.

There are two broods per year of the midges; the first attacking pea flowers, shoots or pods, whichever are available at the time of emergence of the midges; the second brood attacking the pods.

Soil fumigation is recommended as a means of control.

* Lind, J., Rostrup, S., and Kolpin Ravn, F.: *Oversikt over Landbrugsplanternes sygdomme i 1913*. 79 Beretning fra Statens Forsøgsvirksomhed i Plantekultur, Copenhagen, No. 30, 1914.

† Harrison, J. W. H., *Entomologist*, Vol. LVII, p. 8, 1924.

CANKER IN FERTILITY PEAR TREES

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THE Fertility variety of pear, on account of its regular and heavy bearing, has been extensively planted in certain districts. Many growers, however, complain that this variety is so subject to canker, particularly when worked on seedling free pear stocks, that it is impossible to grow it as a standard tree.

A Cause of Failure.—Recent observations made at East Malling suggest one reason for the failure of this variety to develop satisfactorily into good standard trees. At the Research Station there is a trial plot of the Fertility pear, standard and bush trees worked on various stocks, the trees being now seven years old. During the spring of 1926, they came into leaf and flower apparently normally, but shortly afterwards, early in May, on many of the trees, a number of branches showed wilting leaves and flower trusses. The standard trees were far worse, in this respect, than the bush trees, for while many of the former had large branches (about three feet long), showing the disease, the trouble on the bush trees was comparatively slight. The most conspicuous examples were certain standard trees on which the main "leader" was dying back, as in the tree shown in Fig. 1, the head of the tree with withered leaves contrasting with the rest.

In every case examined, there were lesions caused by the pear scab fungus (*Venturia pirina*) at the lower end of the dying portion. Where a spur was killed, there were scab lesions on the spur itself or at the base where it joined the branch, and many of them showed, in addition, an obvious canker round the base of the spur. These cankers were still more evident on the affected branches, and, in every instance where a branch was dying back, there were present the comparatively superficial scab lesions and the more deeply penetrating cankers caused by the canker fungus (*Nectria galligena*).

The cankered areas on the branches were sometimes six inches long (Fig. 2). They bore numerous irregular cracks, in which the dark brown scab pustules could readily be seen with a lens. Some of the cankers also showed the whitish pustules of the "summer stage" of the canker fungus, and, on others,

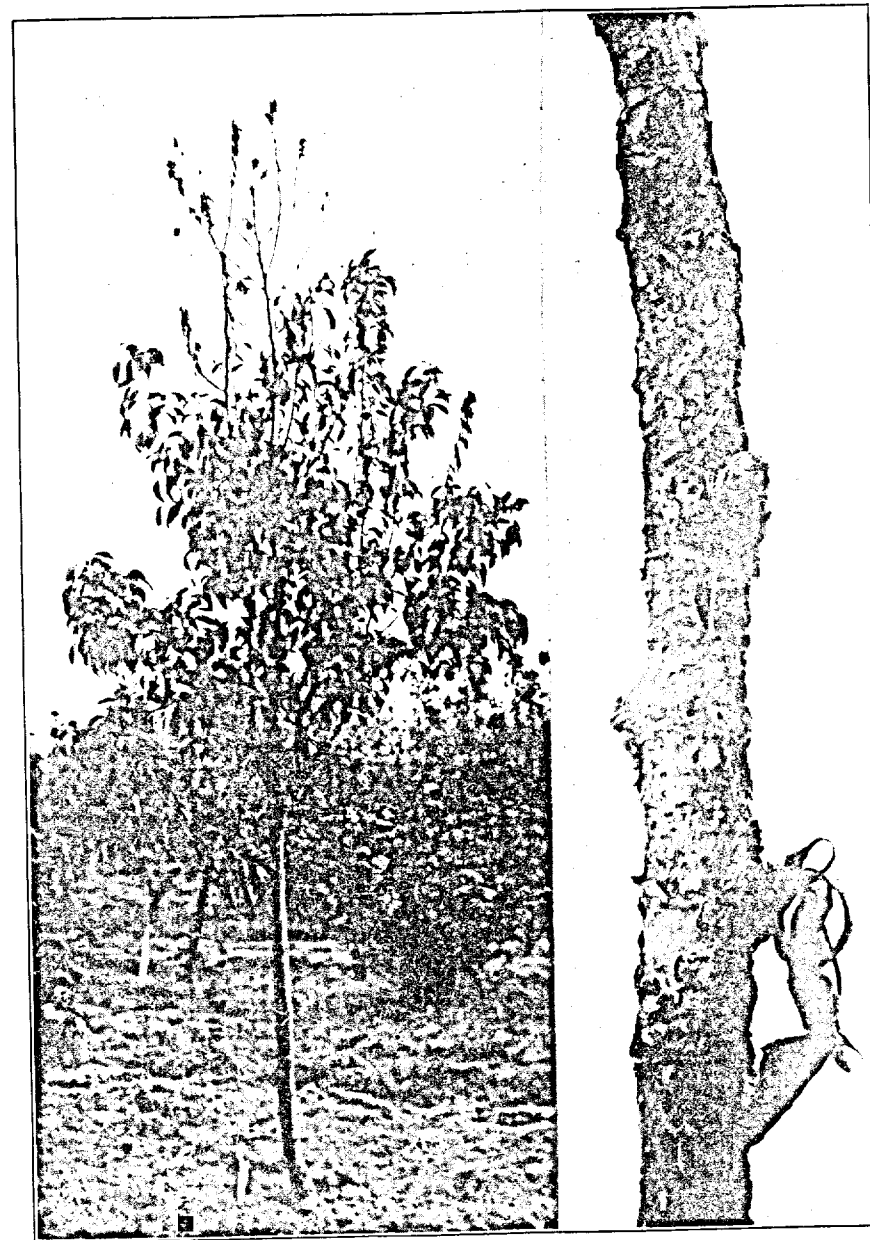


FIG. 1.—A Fertility Pear Tree with dead branches. The leading branches at the top show the disease most conspicuously.

FIG. 2.—The type of canker causing the disease. The irregular cracking of the bark is due to the Pear Scab fungus. The white pustules are the conidial fructifications of the canker fungus.

CANKER DISEASE OF FERTILITY PEAR TREES.

such pustules developed in a few days on keeping the cankers in a moist chamber.

Canker and Scab Fungi Both Present.—In no case was any canker found on these trees without the presence also of the scab lesions. This fact suggests that, in this particular outbreak, the predisposing cause leading to the death of the branches was the infection of the young twigs by the scab fungus; this allowed the canker fungus to gain an entrance, through the scab wounds, and infect the woody parts, thus cutting off the upward flow of sap to those parts of the tree terminal to the cankers.

Wiltshire,* when studying the relation of scab infections to the incidence of cankers in apple trees, found that the canker fungus is able to gain an entrance through scab wounds, and the observations on the trees under consideration show that a similar result obtains in pear trees.

All parts showing definite evidence of infection by the canker fungus were cut away,† but there was still left a considerable amount of bark badly infected by scab, though not, at the time, showing canker. When the trees were examined in July, some weeks after the cankers had been removed, it was seen that the scab lesions which remained were quite superficial and were being cut off by a corky layer below. On rubbing the bark, the scaly layers were easily removed, leaving a healed scar.

Few of the standard trees were entirely free from cankers and one or more branches had to be cut out from most of them. On the bush trees, however, canker was almost negligible; on these, with the exception of one tree from which one small branch had to be removed, the few cankers present were confined to small shoots or spurs. The probable explanation of the comparative freedom from severe canker attack shown by the bush trees is that these had been annually "leader-tipped" and spur-pruned, so that those parts of the young shoots, liable to infection with scab, were mostly removed during the ordinary pruning operations; the leading shoots of the standard trees, on the other hand, had been allowed to "run" for several years, and the trees had merely received slight thinning.

* Wiltshire, S. P.: "Canker Infection of Apple Trees through Scab Wounds," *Annals of Applied Biology*, 1X, 1922, pp. 275-281.

† The writer wishes to take this opportunity of expressing his indebtedness to Mr. A. C. Painter, who personally cut out the cankered branches and recorded the number removed from each tree.

Influence of the Stock in Predisposing to Infection.—Whether the type of stock used has any influence on the degree of infection in this form of canker infection cannot, perhaps, be stated with certainty, but the records taken of the number of cankered branches removed from each tree suggest that, when grown as standard trees on certain stocks, Fertility pear trees are very susceptible. The stocks used for the standard trees in the trial plot, on which these observations were taken, were seedling hawthorn, mountain ash, wild service, white beam, common seedling pear, and seedling wild pear. One or more of the trees on each stock showed cankered branches and spurs, but those on common pear were, on the whole, far worse than those on other stocks. Two trees, the worst of all, were on this stock; from each of these two trees five large branches had to be removed together with a number of smaller branches, shoots and spurs. On the bush trees, the amount of canker was too small for the records to give clear indications that the type of stock had any influence on the degree of infection.

The trees on common and wild pear stocks had made the most vigorous growth, a fact which seems to indicate that growing this variety on a stock inducing vigour makes it more susceptible to attack by this form of disease.

Control Measures.—To summarize the foregoing observations, there are, at the Research Station, two sets of trees (both on a similar series of quince and free pear rootstocks), one set grown as standards with 4 ft. 6 in. length of stem, and the other as bush trees with a stem of 2 ft. Both sets are interplanted on this same experimental plot, the only difference in treatment being that the bush trees have had the leading branches tipped and the laterals spurred annually. The standard trees have been seriously crippled by canker, while the bush trees have been practically free from it.

It would appear, therefore, that the grower, who wishes to cultivate Fertility pears, has two alternatives: either to grow bush trees, on which the normal operations of leader tipping and pruning reduce, indirectly, the liability to scab infection and subsequent canker; or to grow standard trees, which cannot be so economically or effectively pruned and sprayed, and will also need considerable attention to keep them free from cankering.

The observations at East Malling go to show, clearly, how much more effectively canker in Fertility pears can be controlled

when the variety is grown as a regularly pruned bush; it is this, rather than choice of stock, which is the deciding factor in producing healthy trees.

It must be remembered that scab itself causes serious disfigurement of the fruit, and systematic spraying, to control scab infection of fruit, leaves and shoots, should be routine practice. Since, as shown here, such infections on the shoots lead the way to canker, effective spraying against scab will also reduce canker. If, therefore, the grower decides on standard trees, special attention must be given to the spraying operations, particularly as standard trees soon get so tall that, to reach the uppermost branches, a high-pressure power sprayer is required. Bordeaux mixture is the best fungicide at present known for use against scab, and it can generally be used with perfect safety on pears. The first spraying should be carried out just before flowering and the second immediately the fruit is set. When trees have been seriously infested the previous year, or where subsequent canker infection is feared, later sprayings should not be neglected. If cankers make their appearance, they should, as a matter of course, be cut out at the earliest opportunity.

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MAY ON THE FARM

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The Root Break.—The sowing of mangolds is generally completed in April or early in May, but beet sowing continues during the first half of this month. Before June arrives, thought will be given to the side hoeing of the earliest sowings, for which purpose there are specially useful appliances that are still unknown in some districts. Land, that requires more cleaning and working than is consistent with the timely sowing and likely success of the above crops, is generally devoted to turnips or kale, unless its condition be such as to necessitate half or complete summer fallowing. With sprouted setts, potatoes may be planted considerably later than is advisable with ordinary seed.

In many districts, marrow-stem kale is taking the place of a considerable part of the acreage formerly devoted to swedes. The advantages of kale over swedes are that it is much superior as a cleaning crop; it requires less horse and hand hoeing; it can, if necessary, be left unsingled; it is less subject to finger-and-toe and does not become mildewed after drought,

as do swedes when sown before June in warm districts or when the latter half of summer is drier than the first half; it is more responsive than swedes to liberal manuring, and, as a food for milk production, it is richer in protein and mineral matter. Where sheep are fed on arable land, however, it is difficult to replace the swede crop for feeding after mid-winter. Marrow-stem kale becomes leafless and woody, and thousand-headed kale usually does not feed so many sheep per acre as does the swede crop. Swedes also can be lifted and pitted for use during hard frost and are perhaps more suitable for growing with artificials alone. Moreover, where half the root crop is drawn off the land, for feeding to bullocks in the yards, the swede lends itself better to this practice than thousand-headed kale.

Whether the crop chosen for May and June sowing be swedes or kale, the land requires skilful management at this time of the year to ensure a full plant and escape from the attentions of the turnip fly. One of the main considerations is soil moisture; what the soil contains must be carefully conserved, for little reliance may be placed on the benefit of rains until the crop has developed an extensive root system. "Spring rain only damps." With this object in view, the land should be worked in comparatively small strips rather than in large breadths. The size of the strip to be completed and drilled, before proceeding with the next, depends on the staff available; commonly an acre is a convenient size; the rest of the field waiting for attention should be worked superficially to prevent drying out.

Where the ridge system is adopted, and yard manure is applied in the ridges, only so many drills should be opened as can be manured and split in the same day, unless there are good reasons for departure from this rule. On free loams, the best germination may usually be obtained by drilling immediately after splitting the ridges. On land that has not worked down to a suitably fine tilth, however, it may be better to delay sowing for a week or more, during which time the middle of the drill becomes moist by the rise of moisture from below. The rise of moisture may be hastened, and the loss by evaporation from between the clods prevented, by the use of the ridge roller. The ordinary flat roll and the Cambridge roller are of less value for this purpose; indeed, their use may be detrimental to the object in view, as, by pushing the loose top soil off the ridges and consolidating that left on the ridges, they accelerate the loss of moisture from the middle of the ridge where it is most needed. The ridge may be drawn out rather deep, preferably

with the lea plough, and left to settle and for the weed seeds to begin germinating; then, just before drilling the seed, the dry, cloddy top soil may be harrowed off with the chain harrows and the seed deposited in firm, moist soil in which it comes away quickly.

Insect Pests of Roots.—Beet and mangolds are often badly checked and sometimes thinned considerably by the leaf maggot, which makes the characteristic white blotches on the leaves where the inner tissues have been eaten away. Farmers have frequently asked whether it is possible to prevent or remedy an attack by spraying, but generally it is only when the pest has actually gained entry into the leaves that its presence is realized; and, at this stage, it is impossible to reach the maggot with a spray fluid without destroying the leaf on which it feeds. The best method of treatment, so far discovered, is to roll the crop and thereby crush the maggots. A top dressing of nitrate of soda or nitrate of lime given immediately after rolling will assist the young plants to make new growth. The possibility of rolling, however, is limited to the early stages of the crop, when the implement may pass over the plants without crushing the young tap root. Rolling and top dressing are also recommended in the treatment of attack by springtails, which cause strangle-neck in mangolds, and the flea beetle, which riddles the leaf in a manner similar to the work of the turnip flea beetle.

Hot, dry weather about the end of May generally results in the appearance of the turnip beetle and the disappearance of brairds of swedes. The beetles are attracted to the crop by its scent and it is thought that the, admittedly, useful preventive measure of soaking the seed in turpentine owes its virtue to its masking the natural odour of the crop. The smell of tar is apparently repulsive to insects and, for the prevention of attack by such pests as this, entomologists advise the application of a mixture of tar-oil and soot, one of the former per hundred of the latter. Of the remedial measures, three have been well tried and proved, *viz.*, rolling the seedlings, the application of 1 cwt. of nitrate per acre along the line of plants, and pushing a tarred board over the crop.

Crop Sequence.—One of the many reasons for the practice of crop rotation is the fact that soils are generally more productive when the kind of crop is changed from year to year than when the same species is repeated. Some crops, such as red clover, turnips and oats, are well known to be liable to disease if grown too frequently on the same ground; others,

such as wheat, barley and mangolds, are more tolerant of repetition. There is no doubt, however, that change of crop has an influence on productivity quite apart from considerations of parasitic disease.

In the course of time, farmers have found that certain crops are better than others as a preparation for the next crop. Clover, for example, is regarded as a good preparatory crop for either wheat or potatoes; but, for mangolds or swedes, clover lea is not a good predecessor. Rye is for some reason regarded as bad for the next crop. Potatoes, mangolds and cabbages affect the next crop differently, as may be seen whenever these three crops are grown in the same field and are followed by corn. Sometimes differences attributable to the kinds of root crop grown may be seen in the seeds crop two years later.

Although crops differ in the kind and amount of manurial ingredients which they remove from the soil, these differences are not now regarded as sufficient to explain their effects on the succeeding crop. Neither can past teaching concerning the different depths of rooting be accepted, since further work has shown that the cereals are in fact of deeper rooting habit than the tap-rooted crops. According to the conclusions arrived at by the Rhode Island Experiment Station workers, the effect of one crop on its successor depends on its influence on the reaction of the soil. Some crops, such as mangolds, swedes and cabbages, remove more bases than acids from the soil; others, such as maize and barley, leave the soil less acid. Crops differ also in the amount of aluminium and phosphorus which they remove per acre.

In one experiment, carried out at the station mentioned, the test crop, onions (chosen on account of its sensitiveness to soil sourness) gave the following yields after the different crops indicated: after mangolds, 72; after cabbage, 88; after swedes, 99; after maize, 296; and after red top grass, 524 bushels. In another experiment, barley grew less well after beet and carrots than after lucerne and barley. Such differences were, however, much reduced where the soil experimented upon had been suitably limed.

Calf Rearing.—There is some truth in the saying that pedigree goes in at the mouth; for the conformation of the mature animal is appreciably influenced by the liberality or otherwise of the treatment received during the growing period. This fact has been clearly demonstrated by a long series of trials carried out by the Missouri Experiment Station, in which calves of

similar ancestry were reared on three different planes of nutrition. Those fed as much as they would eat throughout their growing period made steers of heavy, broad, low-set, typical, good-beef type; those continuously fed to produce a strictly limited rate of daily gain became long-legged, narrow-chested and ungainly in appearance; while the lot fed on an intermediate scale grew into steers of intermediate type. The ultimate size of the cattle, as measured by length of frame and height at the withers, did not differ as much as one would have expected, but the underfed animals were later in attaining their maximum length and height.

Probably, it is impossible to make a calf of poor ancestry into a mature animal of good type and conformation by liberal feeding; but the photographs in the report of the above-mentioned experiment prove that calves of good breeding may grow up into animals having the appearance of bad breeding when the rearing conditions have not been satisfactory. There is also general agreement among successful breeders that the health and progress of the calf during the first six months of its life have great influence on its ultimate appearance. One careful breeder and student of cattle has made observations which have led him to the conclusion that poor rearing and too early breeding are a common cause of dairy cows going wrong under the strain of heavy milk production. The effects of a serious attack of scour in calfhood may be permanent; and a calf that has suffered a check in growth, especially such a check as is associated with leg weakness, may always be distinguished as a yearling by its lack of size and substance and by the disproportionate growth of its head and horns.

In farming practice, the recognized preventives of rearing troubles are a sufficiency of clean milk and plenty of dry bedding. Pedigree breeders generally prefer to allow their valuable calves to suck; but there are exceptions where pail feeding is preferred. In rearing for commercial purposes, however, it is necessary to limit the allowance of milk, and the problem arises as to what is the minimum amount and how it may best be supplemented with other foods. During May and June, when milk is generally more plentiful and comparatively low in price, it is possible to be more liberal with the milk allowance than it is in the winter months. At any time of the year, however, the rate at which the milk ration may be diminished depends on the progress which the calf is making in learning to eat dry foods—gruel feeding being out of date.

Calves are very fond of broken linseed cake and whole oats, which they digest more completely than do mature cattle; and these, in equal parts, make a good mixture. When water is constantly before them, calves soon learn to drink and to eat a milk substitute, so that, if necessary, milk may be discontinued entirely at about twelve weeks old. Better calves can, however, be obtained if a little milk is continued for a few weeks longer. Moreover, concentrated foods are deficient in bone-forming matter and in the vitamin which controls rate of growth; for supplying the latter requirement, therefore, the use of a little cod liver oil is advisable.

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NOTES ON MANURES FOR MAY

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Dressings for Turnips.—Turnips and swedes are grown under a number of different systems in which the manurial treatment ranges from what might be described as a man-gold dressing at one end of the scale down to a light dressing of superphosphate at the other. The chief factor responsible for these differences is the climate. Drought is the great enemy of the crop; hence we find that yields are higher in the northern and western districts than in the south-east. Over the 10-year period 1915-24 the average crop of turnips and swedes was 16·7 tons per acre in Scotland, but only 11·7 tons in the eastern counties. Where conditions are favourable, manuring is on a higher scale than in less suitable areas.

In a useful summary of the manurial experiments, carried out in North Wales* at 127 centres during the last 40 years, it is shown that the average increase in crop due to phosphatic manuring was 7·4 tons, or 49 per cent. Many farmers, in the district covered by the experiments, regarded it as waste of land to drill their swedes in the absence of phosphate. Basic slags and finely ground rock phosphates were about as effective as superphosphate in these trials.

Extensive experiments, carried out by the Irish Department of Agriculture during 1901-11, give a good view of the response

* E. J. Roberts : *Welsh Journal of Agriculture*, II, 1926.

of the swede crop to manuring. The summarized results are as follows :—

Treatment per acre	Swedes : Tons per acre	
	With 10 tons dung (Mean of 238 centres)	No dung (Mean of 147 centres)
No artificials	19·0	4·9
4 cwt. superphosphate	23·8	17·5
4 cwt. superphosphate	25·0	19·0
1 cwt. sulphate of ammonia } 4 cwt. superphosphate	26·0	22·0
1 cwt. sulphate of ammonia } 3 cwt. kainit		

Under these conditions, an addition of superphosphate to farmyard manure is all that is required, but where no dung is available a complete mixture of artificials usually does best. Similar results have been recorded in a large number of other experiments.

In the drier parts of England the risk of failure through summer drought is intensified when only artificials are used; a light dressing of well-rotted dung is desirable under such conditions, when 3-4 cwt. of superphosphate or basic slag will be the only additional manure required. When swedes are grown for sheep, with the purpose of manuring the arable, it is often impossible to provide dung for the crop, and all cultivations are directed towards conserving moisture in the seed bed. A complete mixture of artificials, relatively rich in soluble phosphates, would meet such cases. On light and chalky soils, the potash will generally be most necessary, while a little quick-acting nitrogen will be advisable on all but the richest land.

Superphosphate is the most popular phosphatic manure for general arable purposes; and it is often noticed that swedes, receiving their phosphate in this form, are stronger in their earliest stages than those having insoluble phosphates. On soils which are badly in need of phosphate, especially in the wetter districts, there is evidence that very finely ground rock phosphates are effective for turnips. Farmers who usually apply soluble phosphate, but are thinking of availing themselves of this relatively cheap material, would be advised to try rock phosphate on a small area first and compare the results with their ordinary treatment. Another plan which has worked well is to give about one-third of the phosphate in the form of superphosphate and the remainder as finely ground rock. High-grade basic slag may be used instead of superphosphate without loss of efficiency.

Swedes suffer from two diseases which can be controlled by suitable manurial treatment. Finger-and-toe is caused by an organism which only thrives under acid conditions, and, on soils liable to this trouble, choice should be made from such alkaline manures as basic slag, cyanamide, nitrate of soda and of lime; a dressing of chalk or lime would also be advisable. Farmyard manure made by stock receiving diseased roots should not be used for the turnip land. The turnip fly attacks the plant in its early life, and manuring can do something to hasten the crop past its vulnerable stage. Quick-acting phosphate and a supply of active nitrogen in the seed bed is a good insurance, and, if top dressing is practised, nitrates should be used. These manures, however, cannot be relied upon in times of persistent drought.

Top Dressing Sugar Beet.—The greater part of the nitrogen given to this crop is applied before drilling, and usually takes the form of an autumn dressing of farmyard manure, followed by 1 cwt. of sulphate of ammonia, included in the mixture of artificials applied, when the land is being worked down in spring. As in the case of mangolds, growers have found that a little additional quick-acting nitrogen, applied after the crop has been singled, has a beneficial effect on the yield. Nitrate of soda and nitrate of lime are the commonest fertilizers used for this purpose, as they are highly soluble and also immediately available to the plant. In 1925, an extensive series of county experiments was carried out on the growing of sugar beet in Ireland. Part of the data brought out the effect of adding a top dressing of 1 cwt. of nitrate of soda to beet which had already received a dressing of farmyard manure and complete artificials. The tests on this point were carried out at 163 centres and four varieties of beet were used in each experiment. The complete figures are published in an interesting report,* and the general trend of results is conveyed in the following table:—

Average of 163 centres. Four varieties at each centre.		Washed beet		Sugar	
Manuring		Tons	Cwt.	Per cent.	
Dung + complete artificials ..		10	0	17.6	
.. + complete artificials + 1 cwt. nitrate of soda ..		10	8	17.5	

* *Journal of the Department of Lands and Agriculture*, XXVI, No. 1, 1926.

Thus, on the average, 1 cwt. of nitrate of soda, used as a top dressing after singling, has increased the crop by about 8 cwt. of washed beet per acre without appreciably depressing the sugar content. At present prices, this is itself a remunerative increase, but the report goes on to say that owing to the value of a top-dressing for helping the young plant over critical periods in its early life, in no fewer than 190 cases it was decided to top-dress the whole experimental area, thus losing the comparison in those cases where presumably the undressed portion might have shown up very badly.

On the Continent, dressings, up to the equivalent of about 3 cwt. of nitrate of soda, are given in addition to dung, phosphate, and potash, and about half of this nitrogen is usually applied on top. It is recognized that, on rich land or on soils in high condition, somewhat smaller amounts of quick-acting nitrogen are required. Some recent results obtained in this country indicate that, on land in very good heart, top dressings may not be remunerative when dung and complete artificials have been used.

Presuming that top dressing is advisable, an application of at least 1 cwt. per acre of nitrate of soda or nitrate of lime would, under present conditions, be in place in most cases. The manure should be given about the time of singling; for, if left till later in the season—say, after the end of June—the ripening of the beets is retarded. If sulphate of ammonia is to be used for top-dressing purposes, early application is particularly desirable.

Further evidence is still wanted as to the profitableness of increasing top dressings above the usual level of 1 cwt. per acre. As the dressings are increased, the margin is admittedly smaller, and the scale of treatment must be suited more exactly to the soil and type of farming in question. Top dressings increase the leaves of the crop to a somewhat greater extent than the roots; the extra amount of organic matter thus obtained is of value, whether fed or ploughed in.

Unrotted Farmyard Manure.—Farmers are familiar with the comparatively poor action of long, strawy dung when applied immediately before potatoes or spring-sown crops. Used in this way, dung may cause an actual depression in the yield, the result often being ascribed to the straw having let the drought into the land by leaving the seed bed open and hollow. This loosening action is only one of the causes at work, for it

has been shown that, when unrotted straw is ploughed in the soil, bacteria develop so rapidly under the influence of the increased supply of organic matter that the nitrogen which they require is abstracted from the soil and built up into their own substance. The land is thus temporarily impoverished and the crop suffers. The nitrogen thus removed is not permanently lost, but will become available as the organisms die and decay. The case is similar, but still more pronounced, when straw is ploughed under.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named and are net cash for prompt delivery.

Description	Average price per ton during week ending April 13					Cost per unit at London
	Bristol	Hull	L'pool	London		
	£ s.	£ s.	£ s.	£ s.	s. d.	
Nitrate of Soda (N. 15½%)	13 15	13 15	13 10	13 12	17 7	
" " Lime (N. 13%)	..	..	..	11 12	17 10	
Sulphate of ammonia:—						
Neutral (N. 20·6%)	12 6*	12 6*	12 6*	12 6*	11 11	
Calcium cyanamide (N. 19%)	9 16*	9 16*	9 16*	9 16*	10 4	
Kainit (Pot. 14%)	3 2	2 17	2 17	2 15	3 11	
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0	
(Pot. 20%)	3 12	3 2	3 9	3 2	3 1	
Muriate of potash (Pot. 50·53½%)	9 10	8 5	8 13	9 7	3 6	
Sulphate " (Pot. 48·51½%)	11 10	10 5	10 16	11 5	4 5	
Basic slag (T.P. 40%)	..	..	..	3 10s	1 9	
(T.P. 30%)	..	3 2s	3 1s	3 0s	2 0	
(T.P. 28%)	..	2 11s	2 10s	..	..	
(T.P. 26%)	..	2 7s	2 6s	..	..	
(T.P. 24%)	..	2 2s	..	..	..	
Ground rock phosphate (T.P. 58%)						
Very fine grade ¶	2 15	..	..	2 15d	0 11	
Fine grade ¶	2 10	..	..	2 12d	0 11	
Superphosphate (S.P. 35%)	3 9	..	3 12	3 10	2 0	
(S.P. 33%)	..	..	3 9	..	..	
(S.P. 30%)	3 2	2 15	3 5	3 3	2 1	
Bone meal (N. 3½%, T.P. 45%)	8 15	8 10	8 10	8 0	..	
Steamed bone flour (N. 4½%, T.P. 60·65%)	6 0†	6 10†	6 5	5 15	..	

Abbreviations: N.—Nitrogen; S.P.—Soluble Phosphate; T.P.—Total Phosphate; Pot.—Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

§ Fineness 80% through standard screen of 14,400 holes to the square inch (120 mesh sieve).

¶ Fineness 80% through standard screen of 10,000 holes to the square inch (100 mesh sieve).

d Price for 4-ton lots f.o.r. at Northern London Stations. At G.W.R. and S.R. London Stations the cost to purchasers is 2s. 6d. per ton extra.

A certain amount of rotting, associated as it is with unavoidable losses of valuable material, is, therefore, desirable before dung can exert its best effect. The process should be carried out without unnecessary exposure of the manure to wind and weather, for such treatment only increases the losses without benefit to the quality of the resulting product. Probably, the method which is most economical, as far as the preservation of plant food is concerned, is to plough the manure into the soil in winter while it is still in a fairly long condition, this plan being most applicable to heavy soils where the winter rainfall is not excessive.

* * * * *

NOTES ON FEEDING STUFFS FOR MAY

E. T. HALNAN, M.A.,

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The Origin, Composition, Nutritive Value and Uses of Dried Sugar-Beet Pulp.—In the production of cane sugar from sugar beet, the beets are sliced, and the sugar in the slices is removed by a process of diffusion with water. The diffusers consist of large metal cylinders connected together in series, each series, say, of twelve diffusers being known as a battery. The action of the battery is to produce a diffusion juice of high sugar content, and to enable the slices to be almost completely exhausted of their sugar. As each batch of slices in the diffuser becomes exhausted, it is discharged and conveyed to a pulp press, where it is pressed to remove as much water as possible. The press pulp so obtained contains 85 to 90 per cent. of water and every 100 tons of beets entering the factory yield approximately 40 to 50 tons of press pulp. This press pulp is then passed through a drying chamber and yields approximately six tons of dried pulp.

The development of sugar-beet factories in this country has given rise to the production of considerable quantities of dried sugar-beet pulp, and, since this product is a distinctly useful feeding stuff, it is desirable that British farmers should use this home-produced material for feeding to their stock. At the present time, considerable quantities of this material are being exported to America and elsewhere, so that it is evident that the British farmer is not making as full use of this material as he might. This disinclination on the part of the British farmer to use dried sugar-beet pulp may possibly be due to lack of knowledge of the feeding value of this

material or to lack of knowledge of the methods of feeding it. In the following paragraphs an attempt will be made to present such facts as are known on these two points.

Composition of Dried Sugar-Beet Pulp.—Dried sugar-beet pulp is rich in carbohydrates and low in proteins and oil, and when damped approximates to roots in character and utility. Analyses of dried sugar-beet pulp produced in Great Britain show that considerable variations in composition occur, but the following analysis may be taken as indicating the average composition:—

Water	9.5	Carbohydrates	60.5
Proteins	8.6	Fibre	16.2
Oil	0.7	Ash	4.5

The sugar content of the dried pulp varies generally from 1 to 6 per cent., the amount present varying with the efficiency of control of the diffusers at the factory. To indicate the variability of composition, the following fluctuations, in composition—from figures obtained from one group of factories—will suffice: Water, 9 to 15 per cent.; protein, 7.5 to 10 per cent.; carbohydrates, 56 to 58 per cent.; ash, 3.4 to 4.8 per cent.; fat, 0.5 to 0.8 per cent.; fibre, 16.8 to 20.1 per cent.

Digestibility.—The dried sugar-beet pulp is a digestible material, as the following figures show. The protein is 51 per cent. digestible, the fat is 50 per cent., the carbohydrates 86 per cent., and the fibre 72 per cent. digestible. 100 lb. of dried sugar-beet pulp of average composition will therefore contain 4.4 lb. of digestible protein, 0.4 lb. of digestible fat, and 63.7 lb. of digestible carbohydrates and fibre, and will have a starch equivalent of 59.8. On the basis of these figures, dried sugar-beet pulp compares very favourably with other feeding stuffs at its present market price.

Feeding Value of Dried Sugar-Beet Pulp.—As the analysis indicates, dried sugar-beet pulp is a starchy material, and should therefore be fed in conjunction with foods rich in protein and oil. It is important to realize that, if wetted before feeding, dried sugar-beet pulp should be regarded as a root substitute and be fed accordingly, whereas if fed dry it should be regarded as a concentrate. Owing to its capacity for absorbing water and swelling in the process, less danger arises from careless feeding in the case of the wetted pulp than in the case of the dry pulp. Dried sugar-beet pulp when fed wet is suitable for all classes of stock and has been fed successfully to cattle, milch cows, horses, sheep, and pigs.

If fed wet, the pulp requires soaking for about 12 hours before feeding. In an experiment carried out at Little Snoring, in Norfolk, it was found that 14 lb. of dried pulp required about 28 lb. of water, and that, for fattening bullocks, 14 lb. of dried pulp were equivalent in feeding value to 1 cwt. of roots. At Cirencester and in Nottingham extensive feeding experiments have proved the value of dried sugar-beet pulp as a food for dairy cows, and the material was proved to be quite palatable, the cows readily consuming the dried pulp. If fed in the dry

Farm Values.—The prices, in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follow:—

	Starch equivalent Per cent.	Protein equivalent Per cent.	Per ton £ s.
Barley (Imported)	71	6.2	9 13
Maize	81	6.8	7 12
Decorticated ground nut cake	73	41.0	10 15
„ cotton cake	71	34.0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2.28 shillings, and per unit protein equivalent, 1.42 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The “food values” which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9.6	8 18
Oats	60	7.6	7 8
Barley	71	6.2	8 11
Potatoes	18	0.6	2 2
Swedes	7	0.7	0 17
Mangolds	7	0.4	0 16
Beans	66	20.0	8 19
Good meadow hay	31	4.6	3 17
Good oat straw	17	0.9	2 0
Good clover hay	32	7.0	4 3
Vetch and oat silage	13	1.6	1 12
Barley straw	19	0.7	2 4
Wheat straw	11	0.1	1 5
Bean straw	19	1.7	2 6

DESCRIPTION	Price per qr.		Price per ton	Manu- rial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Pro- tein equiv.
	s. d.	lb.	£ s.	£ s.	£ s.	100 lb.	s. d.	d.	%
Wheat, British...	—	—	12 7	0 14	11 13	72	3 3	1.74	9.6
Barley, British feeding	—	—	10 0	0 11	9 9	71	2 8	1.43	6.2
" Canadian No. 3 Western	33 0	400	10 2½	0 11	9 11	71	2 8	1.43	6.2
" Argentine	35 0	—	9 17	0 11	9 6	71	2 7	1.38	6.2
" Persian	30 3	—	8 10	0 11	7 19	71	2 3	1.20	6.2
" Russian	36 3	—	10 3	0 11	9 12	71	2 8	1.43	6.2
Oats, English, white	—	—	9 7	0 12	8 15	60	2 11	1.56	7.6
" " black and grey	—	—	9 0	0 12	8 8	60	2 10	1.52	7.6
" Scotch white	—	—	10 0	0 12	9 8	60	3 2	1.70	7.6
" Irish black	—	—	8 10	0 12	7 18	60	2 8	1.43	7.6
" American	21 6	320	7 10½	0 12	6 18	60	2 4	1.25	7.6
" Argentine	24 3	—	8 10	0 12	7 18	60	2 8	1.43	7.6
" Chilian	22 6	—	7 17	0 12	7 5	60	2 5	1.9	7.6
Maize, Argentine	32 6	480	7 12	0 11	7 1	81	1 9	0.94	6.8
Beans, English winter	—	—	10 10	1 10	9 0	66	2 9	1.47	20
Peas, English blue	—	—	17 0*	1 6	15 14	69	4 7	2.45	18
" " dun	—	—	12 10	1 6	11 4	69	3 3	1.74	18
Dari, Bombay	—	—	11 0	0 14	10 6	74	2 9	1.47	7.2
Millers' offals—									
Bran, British	—	—	7 17	1 5	6 12	42	3 2	1.70	10
" broad	—	—	8 17	1 5	7 12	42	3 7	1.92	10
Middlings, fine, imported	—	—	10 5	1 0	9 5	69	2 8	1.43	12
" coarse, British	—	—	8 5	1 0	7 5	53	2 6	1.34	11
Pollards, imported	—	—	7 10	1 5	6 5	60	2 1	1.12	11
Meal, barley	—	—	10 15	0 11	10 4	71	2 10	1.52	6.2
" maize	—	—	9 10	0 11	8 19	81	2 3	1.20	6.8
" " germ	—	—	8 15	0 18	7 17	85	1 10	0.98	10
" " gluten feed	—	—	8 15	1 5	7 10	76	2 0	1.07	19
" locust bean	—	—	8 10	0 9	8 1	71	2 3	1.20	3.6
" bean	—	—	12 10	1 10	11 0	66	3 4	1.78	20
" fish	—	—	22 0	3 18	18 2	53	6 10	3.66	48
Maize, cooked flaked	—	—	10 5	0 11	9 14	85	2 3	1.20	8.6
Linseed	—	—	17 10	1 9	16 1	119	2 8	1.43	19
" cake, English 12% oil	—	—	12 3	1 15	10 8	74	2 10	1.52	25
" " 10% "	—	—	11 15	1 15	10 0	74	2 8	1.43	25
" " 9% "	—	—	11 10	1 15	9 15	74	2 8	1.43	25
Soya bean cake 6% "	—	—	11 5*	2 9	8 16	69	2 7	1.38	36
Cottonseed cake, English, 5½% "	—	—	6 15	1 12	5 3	42	2 6	1.34	17
" " Egyptian, 5½% "	—	—	6 10	1 12	4 18	42	2 4	1.25	17
Decorticated cottonseed cake,									
8% oil	—	—	10 0	2 9	7 11	74	2 0	1.07	35
" " meal,									
7% oil	—	—	10 5	2 9	7 16	74	2 1	1.12	35
Coconut cake, 6% oil	—	—	9 0	1 9	7 11	79	1 11	1.03	16
Ground-nut cake, 6% oil	—	—	8 2	1 13	6 9	57	2 3	1.20	27
Decorticated ground-nut cake,									
7% oil	—	—	10 15	2 11	8 4	73	2 3	1.20	41
Palm kernel cake, 6% oil	—	—	7 17	1 1	6 16	75	1 10	0.98	17
" " meal, 6% oil	—	—	9 15*	1 1	8 14	75	2 4	1.25	17
" " meal 2% oil	—	—	8 5*	1 2	7 3	71	2 0	1.07	17
Feeding treacle	—	—	6 5	0 9	5 16	51	2 3	1.20	2.7
Brewers' grains, Dried ale	—	—	7 15	1 2	6 13	49	2 9	1.47	13
" " porter	—	—	7 5	1 2	6 3	49	2 6	1.34	13
" " Wet ale	—	—	1 7	0 8	0 19	15	1 3	0.67	4.8
" " porter	—	—	1 2	0 8	0 14	15	0 11	0.49	4.8
Malt culms	—	—	6 0	1 12	4 8	43	2 1	1.12	16

Prices at London except where otherwise stated.

* At Hull.

† At Liverpool.

‡ At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of March and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him

state, it is important to accustom the animals to this material by introducing it gradually into the ration.

Quantities to Feed.—The following figures may prove useful as a guide to those using dried sugar-beet pulp:—

	Per head per day (maximum quantities)
Horses	5 lb.
Cows	7 lb.
Fattening cattle	10 to 14 lb.
Calves	2 to 3 lb.
Pigs	1 to 3 lb.

The writer hopes that all farmers who have used this material will communicate with him, giving the results of their practical experience with it and details of their methods of feeding.

MISCELLANEOUS NOTES

THE report of the Medical Officer of Health for South-West Kent (a most important hop-growing district) on the health of the hop-pickers in 1926 gives an interesting account of work by official and voluntary agencies on behalf of the hop-pickers. Reference is made to the increasing attention given to the various problems raised by the annual migration of pickers and to the closer co-operation between the various interests concerned which has been effected during the last three years by the Mid-Kent Hop-pickers Committee, a representative body, of which Mr. J. A. Spender is chairman. This Committee has concentrated, in the first place, on improvement of transport conditions, and appreciation is expressed of the arrangements made last year by the Southern Railway, who conveyed more than 25,000 pickers to stations in South-West Kent.

The scale on which assistance is given to the pickers by the voluntary dispensaries is indicated by the fact that, in addition to help given by local practitioners, two women doctors, 31½ qualified nurses, and 50 V.A.D.s were engaged on this work last year, when over 7,000 patients (who made nearly 14,000 attendances) were treated. There are nine main dispensary centres, but many of these have branches, and one at Marden (organized by Mrs. Spender) is now

* "Living Conditions of Hop-pickers in Kent": see this JOURNAL, June, 1925, p. 219. "Hop-pickers' Accommodation," model by-laws drawn up by the Ministry of Health: see this JOURNAL, August, 1926, p. 468.

provided with excellent buildings, comprising hospital wards, administrative quarters and an isolation hut. Patients suffering from infectious diseases or other serious ailments are dealt with at the neighbouring hospitals and infirmaries.

A much needed development was the appointment, last year, of some additional temporary sanitary inspectors for the hop-picking season. From these officers' reports it appears that a number of new huts were erected in 1926 and that sundry improvements were made in existing structures. It is pointed out that, in some of these new huts, excellent results have been achieved at moderate cost.

There appears to be general agreement that living conditions for the hop-pickers have been substantially improved as far as supplies of drinking water are concerned, and that a noticeable effort has been made to improve accommodation, particularly in regard to cooking and sanitary arrangements. In both these directions, however, much remains to be done, and it is to be hoped that the beginning made last year may be the foundation of a general advance in 1927.

* * * * *

THE following figures relative to the distribution of the Ministry's publications during the last two financial years may be of interest. The number of leaflets

The Ministry's Publications distributed *free* during 1926-27 was 36,654 as compared with 55,692 during the year 1925-26, a decrease of 19,038, that is 34 per cent. The number of leaflets *sold* during the year was 60,968 as compared with 60,511 during the previous year, an increase of 457. Of the Sectional Volumes of bound leaflets on connected subjects 14,569 were sold in 1926-27 as compared with 14,029 during the previous year, an increase of 540 copies.

The Ministry's "Miscellaneous Publications" on subjects of practical interest to farmers and horticulturists, including the new series of Research Monographs, show an encouraging increase. The total number of these publications distributed during 1926-27 was 17,255 copies as compared with 15,316 during the previous year, *i.e.*, an increase of nearly 13 per cent.

Certain of these publications are evidently highly appreciated, judging from the numbers sold and the steadily increasing demand. For example, *British Breeds of Live Stock*, of which a fifth edition has now been called for, has had a sale of over 13,000 copies; Prof. T. B. Wood's *Rations for Live Stock*, also in its fifth edition, of 18,850 copies; and *Edible and Poisonous Fungi*, of over 5,000 copies.

THE Director of the Rothamsted Experimental Station, Sir John Russell, has renewed this year the opportunity for farmers' and farm workers' associations and clubs, chambers of agriculture and horticulture, students' societies and other bodies interested in agriculture and market gardening to inspect, during the summer months, the experimental plots at the Station, where Mr. H. V. Garner, M.A., will act as guide and demonstrator. Among items of interest to be seen are experiments on the manuring of arable crops, especially sugar beet, potatoes, mangolds, barley, oats, wheat; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land and hay land; inoculation of lucerne; crop diseases and pests; demonstrations of good types of tillages. It is desirable that arrangements for visits should be made beforehand, and that ample notice should be given to prevent possible clashing of dates, although no farmer need refrain from visiting because he has been unable to write fixing a date. All communications on the subject of visits should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

* * * * *

MR. HUGH C. SAMPSON, C.I.E., B.Sc., formerly Director of Agriculture, Madras, has been appointed Economic Botanist at the Royal Botanic Gardens, Kew.

New Appointment at Kew This appointment has been made in connexion with the grant of £4,000 for five years which has been received from the Empire Marketing Board through the Ministry of Agriculture and Fisheries.

The grant will be devoted partly to the employment of the economic botanist, 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, and partly to 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.

The close liaison which exists between Kew and the agricultural and botanical departments of the world has proved of great benefit to the Dominions and Colonies in the introduction of new staples and the development of the natural vegetable resources of the Empire. With the progressive opening up of new territories and the continual expansion of agricultural

enterprise in the Dominions and Colonies, the need has arisen for a closer co-operation and a more direct service, and these the grant is designed to afford.

* * * * *

THE Ministry is prepared to receive, not later than the 15th of this month (May) applications for grants in aid of scientific investigations bearing on agriculture, to be carried out in England and Wales during the academic year commencing October 1, 1927. The conditions on which these grants are offered are set out in the prescribed form of application (A. 53/T.G.), of which copies may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1.

* * * * *

THE general level of the prices of agricultural produce during March was 43 per cent. higher than in March of the base years 1911-13, or two points lower than in February, and six points below the level of a year ago, when a fall of four points was registered between February and March. Prices showed little movement on the whole, but, as is customary at this period of the year, eggs were considerably reduced in price. Milk and potatoes were also cheaper, while fat sheep were dearer.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1922 :—

Month	Percentage Increase compared with the Average of the corresponding month in 1911-13					
	1922	1923	1924	1925	1926	1927
January	71	67	60	71	58	49
February	75	63	61	69	53	45
March	73	59	57	66	49	43
April	66	54	53	59	52	—
May	69	54	57	57	50	—
June	64	49	56	53	48	—
July	67	50	53	49	48	—
August	68	52	57	54	49	—
September	59	52	61	55	55	—
October	61	50	66	53	48	—
November	63	51	66	54	48	—
December	61	55	65	54	46	—

Grain.—Wheat, barley and oats all showed a decline of 2d. per cwt. on the month, and the index figures for wheat and oats were each a few points lower at 57 and 14 per cent. above

pre-war, respectively, the former being at nearly the same level as a year earlier, while oats were about 10 per cent. cheaper. The index figure for barley was, however, one point higher on the month, at 38 per cent. increase on 1911-13, owing to a relatively greater decline in prices in the corresponding period of the base years. Wheat averaged 11s. 8d., barley 10s. 11d., and oats 8s. 1d. per cwt.

Live Stock.—The prices of fat cattle showed a further reduction of about 6d. per live cwt. in March, and at only 26 per cent. dearer than pre-war were at the lowest level reached in recent years. Dairy cows and store cattle were also comparatively cheap at 25 and 27 per cent. above pre-war. Fat sheep and pigs, however, were both somewhat dearer than in February, the former having appreciated about $\frac{1}{2}$ d. per lb. estimated dressed carcass weight, and the index figure is one point higher at 45 per cent. increase on 1911-13. The index numbers for both pork and bacon pigs are well maintained at recent levels, but these are lower than in March, 1926. Store pigs, however, met with a good demand during the month under review, and at 116 per cent. above pre-war are fully as dear as a year ago.

Dairy and Poultry Produce.—There was a considerable fall in the price of eggs during the month under review, the average quotation being 1s. 2d. per dozen as compared with 1s. 10 $\frac{1}{4}$ d. in February, and the index number fell sharply by 23 points to 39 per cent. above the level of March, 1911-13, a position which is very similar to that of the two previous years. Milk also was cheaper, principally in the Manchester area, and the index figure is 6 points lower on the month and 16 points below the level of March, 1926. Butter and cheese remained practically unaltered in price, and the relative index figures showed no movement from those recorded in February. Prices of fowls were rather higher on the month, but ducks were unchanged as compared with February, while in the base years prices advanced in March.

Other Commodities.—Potatoes were somewhat cheaper than in February, and, as prices increased in March in the base years, there was a reduction of 9 points in the index figure, bringing the figure to 85 per cent. above pre-war as compared with 31 per cent. in March, 1926. Vegetables generally were about 37 per cent. dearer than pre-war, or 4 points below the level in February. There was no change in hay prices, and these were practically identical with those of March of the base years. Wool was a little dearer, but, as there was a corres-

ponding increase in the base period, the index number was only slightly altered to 33 per cent. above the level in 1911-13.

Index numbers of different commodities during recent months and in March, 1925 and 1926, are shown below :—

Percentage Increase as compared with the Average
Prices ruling in the corresponding months of
1911-13

Commodity	1925	1926		1927		
	Mar.	Mar.	Dec.	Jan.	Feb.	Mar.
Wheat	79	55	61	61	60	57
Barley	45	14	31	33	37	38
Oats	38	25	17	20	16	14
Fat cattle ..	51	43	28	33	30	26
Fat sheep ..	97	52	44	57	44	45
Bacon pigs ..	67	85	63	70	63	63
Pork pigs ..	66	89	72	82	75	76
Dairy cows ..	48	37	30	28	26	25
Store cattle ..	43	31	21	29	30	27
Store sheep ..	104	61	41	55	48	41
Store pigs ..	47	115	115	135	125	116
Eggs	49	41	46	46	62	39
Poultry	57	50	49	38	39	34
Milk	82	72	65	65	62	56
Butter	58	46	40	37	40	40
Cheese	57	77	28	38	36	36
Potatoes	138	31	110	95	94	85
Hay	-1*	6	2	-1*	-2*	—
Wool	105	39	29	32	32	33

* Decrease.

Farm Workers' Minimum Wages.—A meeting of the Agricultural Wages Board was held on March 22, at 7 Whitehall Place, S.W. 1, the chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages and proceeded to make the following Orders carrying out the Committees' decisions.

Devonshire.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to come into operation on March 26, when the existing rates are due to expire, and to continue in force until March 25, 1928. The rates in question are, in the case of male workers of 21 years of age and over, 32s. 6d. per week of 52 hours from May 30 to September 19 (instead of from June 16 to September 30 as at present) and 50 hours during the remainder of the year, with overtime at 8½d. per hour on week-days and 10d. per hour on Sundays, except during the hay and corn harvests, when the overtime rate is 10d. per hour. The minimum rate for female workers of 20 years of age and over is 5d. per hour for all time worked.

Somerset.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers

to come into operation on April 1, when the existing rates are due to expire, and to continue in force until September 30. The minimum rates in question are, in the case of male workers of 21 years of age and over, 32s. per week of 52 hours (instead of 50 hours as at present), with overtime at 9d. per hour, and, in the case of female workers of 21 years of age and over, 6d. per hour for all time worked.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

* * * * *

Enforcement of Minimum Rates of Wages.—During the month ending April 15, legal proceedings were taken against 17 employers for failure to pay minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers in agriculture. Particulars of the cases are as follows :—

County	Court	Fines			Costs			Arrears of wages	Workers con- cerned
		£	s.	d.	£	s.	d.		
Hereford ..	Bromyard ..	3	10	0	—	—	—	65 0 0	3
Monmouth ..	Chepstow ..	0	10	0	—	—	—	35 7 1	3
Chester ..	Chester ..	—	—	—	—	—	—	3 5 0	1
Yorks, W.R.	Wakefield ..	—	—	—	—	—	—	—	2
Cambs. ..	Wisbech ..	4	0	0	1	5	6	29 0 0	2
Norfolk ..	Terrington ..	4	0	0	1	0	0	33 0 0	2
Salop ..	Shifnal ..	—	—	—	0	10	0	28 6 3	4
Somerset ..	Wincanton ..	1	0	0	0	7	6	4 10 0	1
" ..	Long Ashton ..	1	0	0	—	—	—	7 9 7	1
" ..	Somerset ..	5	0	0	0	5	0	15 0 0	1
" ..	Wells ..	—	—	—	2	2	0	15 0 0	1
Devon ..	Lifton ..	0	10	0	0	17	0	13 2 3	1
Salop ..	Ludlow ..	—	—	—	1	2	6	—	1
" ..	" ..	—	—	—	1	2	6	11 0 0	1
" ..	" ..	—	—	—	0	15	0	5 0 0	1
" ..	" ..	—	—	—	1	2	6	20 0 0	1
" ..	" ..	—	—	—	1	2	6	14 0 0	1

* * * * *

Foot-and-Mouth Disease.—Since the April JOURNAL was issued there has been a fresh centre of disease discovered at Ellel, Lancaster. Two outbreaks occurred on adjoining farms in that parish on April 5 and 6 respectively. No other outbreaks have been confirmed.

Twenty-three outbreaks have been confirmed in all since January 1 last, involving nine counties and the slaughter of 1,082 cattle, 738 sheep and 352 pigs.

* * * * *

Leaflets Issued by the Ministry.—Since the date of the list given in the April (1927) number of this JOURNAL, p. 92, the following leaflets have been issued :—

New :—

No. 165. Rhododendron Bug.

No. 172. Greenhouse White Fly.

Rewritten :—

No. 224. Narcissus Cultivation.

Revised :—

No. 400. List of the Ministry's Publications.

NOTICES OF BOOKS

The Rural Industries of England and Wales. Vol. I. Timber and Underwood Industries and Some Village Workshops. Vol. II. Osier-growing and Basketry and some Rural Factories. By Helen E. FitzRandolph and M. Doriel Hay. (Oxford: The Clarendon Press. Price 5s. net each.)

These are the first two volumes of a four-volume survey of Rural Industries, made on behalf of the Agricultural Economics Research Institute at Oxford. Even without the remaining volumes, the work already published constitutes an outstanding landmark in the history of the subject. It is full of interesting facts about the industries it covers and is the first fairly complete survey of its kind.

In 1919, so a preface by Mr. C. S. Orwin, Director of the Institute, tells us, the Institute set the inquiry on foot at the suggestion of the Development Commissioners. It began with an investigation into rural industries in the neighbourhood of Oxford, but was extended the next year, with the authority of the Development Commission and the Ministry of Agriculture, to an inquiry into the principal rural industries in England and Wales. The compilers were to consider—

(1) The existing rural industries and the causes of their establishment in particular localities, such as easy access to local supplies of raw material and labour and local markets for the finished product.

(2) The various types of organization in these industries, such as small factories and workshops or individual production; organizations for the purchase of raw materials or the sale of finished products; educational facilities and the possibility of technical instruction.

(3) The economic and social effect of rural industries; the conditions of labour attendant on them; the connexion between rural industries and agricultural employment; and how far such industries tend to depress or ameliorate the lot of the agricultural workers.

(4) The prospects of development of such industries and of the introduction of new industries, or of the resuscitation of former industries now dead or in a state of suspended animation. In this last connexion, the existence of competition, both urban and foreign, was to be borne in mind and consideration given to the conditions under which rural industries can compete with urban production.

This shows the very wide terms of the inquiry and the considerable problem which the investigators were called upon to examine. They have not in these volumes followed the terms too meticulously and the survey seems, consequently, to fall into a better channel; although, doubtless, all the headings will be dealt with as it becomes expedient or useful to do so.

Among the larger industries dealt with in Volume I are furniture-making, turnery, coopering and clogging; and, among the smaller, the making of all kinds of wicker and wooden baskets, fencing, hurdles, brooms, barrel-hoops, hay-rakes, and the making of charcoal. The processes and tools used, and the organizations employed in the various districts, are thoroughly discussed, with results which cannot fail to be of mutual advantage to those engaged in the industries. The consideration of village workshops covers those of the wheelwright, blacksmith, saddler, as well as the rural ropewalk, and village net and cord-making. This will also be found to be an interesting and useful section, with information as to several branches of work that has never been previously collected.

The second volume deals mainly with osier-growing and basketry. It sets out the geographical distribution of the industries, that is, according to the osier and willow districts, discusses conditions in the principal of them, as well as their business organizations, labour supply, cultivation and marketing. There is, of course, quite a large demand for agricultural and other baskets, extending from those in use by potato diggers to those required by fanciers for the transport of pigeons, rabbits, and so on. Then there are the various kinds of skeps required as domestic baskets, fish baskets, broccoli crates and chip baskets. The fact that all these are being made in competition with supplies from Belgium, Holland, and elsewhere shows that the industry is, at any rate, able to maintain itself, and deserves the support and encouragement of home buyers. Some of the firms in the industry which were not too soundly established have already been wiped out by foreign competition, so that the struggle for existence is a very real one. The standard of British work must at least be maintained where the foreigner's is being improved. Covent Garden requires the best baskets; we trust that the home industry will continue to produce them. We know that labour and materials are, very often, cheaper on the Continent, but our industries should be able to secure an advantage by proximity to the country markets and by the elimination of middlemen. The problem is by no means easy, though it may, conceivably, be made less difficult for some growers and makers by the ready support of our own people.

Bitter Pit in Apples: A Review of the Problem.—Being Special Report No. 28 of the Food Investigation Board of the Department of Scientific and Industrial Research. (London: H.M. Stationery Office. Price 1s. net.)

The appearance of apples affected with bitter pit is generally familiar to those engaged in growing and marketing apples. The flesh of the apples shows small brown spots, dry and spongy, which are usually most numerous just under the skin. Bitter pit is known in America, Australia and Europe, both as an orchard and storage trouble: it seems to cause most trouble in the warmer countries.

In this report, the present position of our knowledge is critically discussed. So far, no organism has been found and, in consequence, many theories have been advanced to explain the causes of bitter pit, but, as the report points out, in no case has direct experimental verification been obtained, whilst, on theoretical grounds, most of the theories are open to grave objection.

It would appear that severe pruning on the one hand, and heavy water supply towards the end of the season on the other, are circumstances predisposing to bitter pit. It has been found to develop in storage to a much greater extent in fruit which has been gathered in a relatively immature condition than in fruit allowed to ripen thoroughly on the tree. The report has brought together our results of research work on bitter pit and revealed the lack of knowledge of the whole matter.

Temperature Conditions in Regard to the Cold Storage of Fruit.—Special Reports of the Food Investigation Board of the Department of Scientific and Industrial Research. No. 29: *Temperature Conditions in Small Cold Storage Chambers Containing Fruit.* 1s. net. No. 27: *Temperature Conditions in Refrigerated Holds Carrying Apples.* 1s. 6d. net. (London: H.M. Stationery Office.)

In the storage of fruits, the limits of temperature within which good results can be obtained are comparatively narrow. If the temperature is too low, there is a liability to internal breakdown and even killing of the

fruits: whilst, if too high, the fruit matures too quickly. Uniformity of the correct temperature, throughout the whole store at all times, is the ideal condition at which cold storage aims. That this counsel of perfection is difficult to secure in practice is shown in the two above-mentioned reports.

Report No. 29 gives a detailed account of the temperature distribution in five cold storage chambers containing fruit, situated in different parts of England. The temperature of parts of the fruits differed as a rule by at least two degrees, and sometimes by as much as five. Surprising to relate, forced air circulation increased these inequalities of temperature: for it was found that the air failed to penetrate the main bulk of fruit, its flow being short circuited. Observations, in these different chambers, agree in indicating that the actual cooling of the stack of fruit depends, to a great extent, more upon convection currents operating in the quiescent night period than upon the forced air movement. The conclusion is, therefore, drawn that the refrigeration should be applied to the top of the stack, which should be so arranged as to facilitate the movement of air currents by convection.

Report No. 27 gives an account of the temperature movements in the refrigerated hold of three vessels bringing Australian apples to this country. In every case, it was found that a considerable period of the voyage (from 10 to 20 days) was occupied in cooling down the warm fruit to the temperature of the carriage. No uniform temperature all over the hold was secured whilst the fruit was being cooled down. In the lower hold, the warmest and coolest parts of the cargo frequently differed in temperature by 15° and rarely by less than 10°. Forced air circulation again failed to bring about either more rapid cooling or a more uniform temperature. The observations showed the desirability of providing vertical air channels in the cargo, and the application of refrigeration from the top.

The Feeding of Domestic Animals. By Professor Nils Hansson. Fütterung der Haustiere: Ihre theoretischen Grundlagen und ihre wirtschaftliche Durchführung, von Nils Hansson. Übersetzt von Franz von Meissner; überarbeitet und mit einem Vorwort versehen von Professor Dr. Georg Weigner. (Dresden: Verlagshandlung Theodor Steinkopff. Price: paper covers, 8 marks; bound, 10 marks.)

More than forty years ago, Fjord, working at Copenhagen, commenced an investigation into the values of the common farm feeding stuffs for milk production. From 1898 onwards, these early experiments have been continued and expanded by the famous Swedish scientist, Professor Nils Hansson, at his Institute in Stockholm. Data have been accumulated in hundreds of trials with groups of dairy cows, and from these results has been elaborated the Scandinavian food unit system, which, at the present time, is the accepted basis of feeding in Sweden, Denmark, Norway, Finland, and other countries in northern Europe.

Thus, at a time when Kellner, in Germany, was carrying out the series of investigations on *fattening oxen*, which led, ultimately, to the formulation of his well-known system of starch values, Hansson, in Sweden, was working from an entirely different standpoint, basing his system of food values on results obtained with *milking cows*. The work of Kellner has influenced profoundly the development of nutritional science in this country; whereas Hansson's results appear to have received but tardy recognition, due, in large measure, to the fact that so little of his published work has been translated from the original Swedish. The translation of the present work into German

was the result of a widespread desire among scientists in Germany to know more about a system of feeding which has proved so successful in dairy countries like Sweden and Denmark. It is to be hoped that the appearance of an English edition will not be long delayed.

The Feeding of Domestic Animals, to give the volume an English title, is divided into three main sections. The first of these opens with an account of the composition and digestibility of feeding stuffs and concludes with a discussion of the merits of the different methods of assessing the productive values of feeding stuffs. Of particular interest to English readers is the comparative account of the Hansson food unit, the Kellner starch value and the Armsby net energy value. The nutritive properties of the individual feeding stuffs are dealt with in the second section, while the concluding section is devoted to a thorough consideration of the scientific principles underlying the nutrition of calves and other young stock, of dairy cows and fattening oxen, of sheep, pigs, goats, and horses. Mention should be made of the tables at the end of the book. Table I shows the average composition and digestibility of a very large number of feeding stuffs, together with their productive values in terms of food units, starch values and, this representing a novel feature, of milk-producing values also. In Table II, the nutritive requirements of all classes of farm stock are recorded in great detail.

Professor Hansson's textbook should be read with interest and profit by all who are concerned with the feeding of farm animals in accordance with accepted scientific principles. An English translation, however, is necessary, if the work is to have more than a limited scope of usefulness in this country.

Studies on the Origin of Cultivated Plants. By N. Vavilov. (Bulletin of Applied Botany and Plant Breeding, xvi, No. 2. Leningrad, 1926.)

The considerable amount of research on the time and place of origin of the various cereals, and other agricultural crops, carried out during the past decade by the Institute of Applied Botany and Plant Cultures is summarized in a very interesting paper by Prof. Vavilov, who has been personally responsible for much of the work. It is impossible to review this work adequately in a small space and it must suffice to say that by combining methods of morphological study, breeding, geographical distribution, and archaeological research the earlier conclusions of De Candolle, Darwin and others, have been very much modified. Five principal centres of origin for the most important field and garden crops are recognized as follows: South-Western Asia, South-Eastern Asia, the Mediterranean Basin, Abyssinia and adjacent regions, and Mexico and Peru. Useful maps and bibliographical references are included in the work.

The Farmers' Guide to Ownership of Land. (London: Central Landowners' Association. Price 3s. net.)

In the past, the ownership of agricultural land was vested in comparatively few hands, and farms were most commonly rented from the owners of broad acres and long rent rolls. The stimulus of high prices between 1916 and 1919, however, encouraged farmers to buy their holdings; while, in many cases, they were practically forced to do so, owing to the owners putting their estates on the market. The new owners have many fresh matters to consider. They have to keep before them the obligations and liabilities of ownership; questions relating to boundaries, fences and gates can no longer be referred to the agent; repairs to buildings will force themselves upon notice; tithe rentcharge, income tax and land tax assume a new aspect; the

velopment of building land and relationships with local authorities may crop up; and even death duties need to be faced.

The Central Landowners' Association is greatly interested in the vent of the new landowners, and has to deal with many applications for advice. The Association is always ready to assist individual members and owners, of all classes, in any difficulties and uncertainties which may face them. In order to provide written guidance on many of the questions which may present trouble to occupying owners, R. Strachan Gardiner, the Secretary of the Association, has recently issued a volume of 84 pages, under the above title. In the preface to this useful little work, Sir G. L. Courthope, the chairman of the C.L.A. Executive Committee, states that it gives everything that the farmer ought to know of the law affecting his farm, and the burdens which he has to bear in the shape of rates, taxes, and tithe.

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SELECTED CONTENTS OF PERIODICALS

Horticulture, General and Miscellaneous

Salesmanship in Agricultural Co-operation. *A. W. Ashby.* (Welsh Jour. Agric., III (Jan., 1927), pp. 53-70.) [381; 334.6.]

Farm Household Management Instruction in the Netherlands. *S. L. Louwes.* (Int. Rev. Agric. Econ., IV (N.S.), 4 (Oct.-Dec., 1926), pp. 517-531.) [376.3.]

Agriculture in Devon and Cornwall. *C. D. Ross, A. Gregg, et al.* (Agric. Prog., IV (1927), pp. 67-84.) [63 (42); 37 (42).]

Agricultural Research in the British Empire: III—Agricultural Research in New Zealand. *J. S. Thomson and J. B. Orr.* (Scottish Jour. Agric., X, 1 (Jan., 1927), pp. 12-17.) [37 (931).]

The Sugar Resources of the British Empire. *Ben H. Morgan.* (Jour. Roy. Soc. Arts, Feb. 25, 1927, pp. 362-379.) [63.343; 63.343: 31.]

The Relation of Meteorology to Agriculture. *R. B. Tennent.* (N.Z. Jour. of Agric., 33, 6 (Dec., 1926), pp. 381-386.) [551.5.]

The Place of Green Manuring in British Agriculture. *H. J. Page.* (Essex County Farmers' Union Year Book, 1927, pp. 262-267.) [63.165.]

The Nutritive Value of Pasture: Review of Investigations in Great Britain. *H. E. Woodman.* (Science Prog., XXI, No. 83 (Jan., 1927), pp. 423-430.) [612.394; 63.33.]

Field Crops

Further Studies in the Formation of Permanent Pastures in North Wales. *R. A. Roberts.* (Welsh Jour. Agric., III (Jan., 1927), pp. 84-99.) [63.33.]

Clover Problems: I—Inter-Varietal Competition. II—The Effect of Time of Cutting for Hay on Yield of Hay. *R. D. Williams.* (Welsh Jour. Agric., III (Jan., 1927), pp. 106-118.) [63.1982; 63.33.]

The Development of Silage Crops at Cambridge. *Arthur Amos.* (Essex County Farmers' Union Year Book, 1927, pp. 237-243.) [63.19832.]

Rothamsted Experiments on the Manuring of Potatoes. *Sir John Russell.* (Essex County Farmers' Union Year Book, 1927, pp. 255-261.) [63.512-16.]

A Summary of Experiments on the Manuring of Potatoes in Anglesey, Carnarvonshire, Denbighshire and Flintshire, 1892-1925. *E. J. Roberts.* (Welsh Jour. Agric., III (Jan., 1927), pp. 100-106.) [63.512-16.]

Horticulture

The Intensive Horticultural Industry of Cornwall. *H. W. Abbiss.* (Agric. Prog., IV (1927), pp. 82-84.) [63.5 (42).]

Modern Methods of Marketing Fruit. *H. V. Taylor.* (Jour. Farmers' Club, 1927, Part 1 (Feb.), pp. 1-19) [63.41: 38.]

Winter Spraying of Fruit Trees with Carbolineum Washes. *H. L. Jones.* (Welsh Jour. Agric., III (Jan., 1927), pp. 298-302.) [63.294; 63.295.]

The Influence of Different Root Stocks upon the Vigour and Productivity of the Variety Budded or Grafted Thereon. *R. G. Hatton.* (Jour. Pom. and Hort. Sci., VI, 1 (Feb., 1927), pp. 1-23.) [63.41-195.]

Experiments upon the Removal of Lateral Growths on Young Apple Trees in Summer: The Effect on Stem and Root Development. *R. G. Hatton and J. Amos.* (Jour. Pom. and Hort. Sci., VI, 1 (Feb., 1927), pp. 61-71.) [63.41-195.]

Plant Pests and Diseases

Some Observations on the Cause of Lanarkshire Strawberry Disease. *C. W. Wardlaw.* (Scottish Jour. Agric., X, 1 (Jan., 1927), pp. 8-12.) [63.24-41.]

A New Bacterial Disease (*Phytophthora medicaginis* var *phaseolicola*) of the Bean. *W. H. Burkholder.* (Phytopathology, 16, 12 (Dec., 1926), pp. 915-927 + 1 pl.) [63.23.]

Net Necrosis of Potato. *D. Atanasoff.* (Phytopathology, 16, 12 (Dec., 1926), pp. 929-940.) [63.23.]

Experiments on the Control of Potato Leaf-Roll. *T. Whitehead.* (Welsh Jour. Agric., III (Jan., 1927), pp. 169-180 + 1 pl.) [63.23.]

The Relative Resistance of Wheat Varieties to Bunt (*Tilletia Tritici*). *K. Sampson.* (Welsh Jour. Agric., III (Jan., 1927), pp. 180-196.) [63.24; 63.311.]

Studies in Rust Resistance. *E. B. Mains.* (Jour. Heredity, XVII, 9 (Sept., 1926), pp. 313-325.) [63.24.]

The Control of Wireworms. *H. W. Miles.* (Agric. Prog., IV (1927), pp. 11-15.) [63.27.]

Live Stock and Feeding Stuffs

Live Stock Improvement Schemes in Northern Ireland. *R. Rae.* (Essex County Farmers' Union Year Book, 1927, pp. 322-326.) [63.6 (415).]

Selling Live Stock in Wales. *A. W. Ashby and H. J. Meredith.* (Welsh Jour. Agric., III (Jan., 1927), pp. 24-39.) [63.6: 38.]

Effect of Feeding and Management of Sheep on the Tensile Strength and Elasticity of Wool. *W. E. Joseph.* (Jour. Agric. Research, 33, 11 (Dec., 1926), pp. 1073-1089.) [63.631; 63.761.]

The Value of Artichokes for Pig Feeding. *H. R. Davidson.* (Essex Farmers' Journal, 5, 11 (Jan., 1927), pp. 470-471.) [63.60432; 63.64: 443.]

The Composition of Flaked Maize. *H. E. Woodman and J. Stewart.* (Jour. Agric. Sci., XVII, 1 (Jan., 1927), pp. 60-61.) [63.60433.]

Dairying

A Comparison of Welsh and Shorthorn Cattle as Milk Producers. *E. J. Roberts.* (Welsh Jour. Agric., III (Jan., 1927), pp. 79-83.) [63.711.]

The Influence of the Stage of Lactation and the Breed of the Cow on the Yield and the Quality of the Milk. *T. J. Drakeley and M. K. White.* (Jour. Agric. Sci., XVII, 1 (Jan., 1927), pp. 118-139.) [63.712; 612.664; 63.711.]

Farmers' Costs of Milk Delivery in Wales. *J. Pryse Howell and*

- H. J. Meredith.* (Welsh Jour. Agric., III (Jan., 1927), pp. 39-52.) [63.70; 63.714; 63.716.]
- A Method of Standardizing Milk Records. *H. G. Sanders.* (Essex County Farmers' Union Year Book, 1927, pp. 195-201.) [63.711.]
- A Study of Some of the Factors Governing Clean Milk Production. *S. B. Thomas.* (Welsh Jour. Agric., III (Jan., 1927), pp. 249-259.) [576.8: 7; 614.32.]
- The Relationship between Various Factors and the Ash Constituents of Milk. *R. O. Davies and A. L. Provan.* (Welsh Jour. Agric., III (Jan., 1927), pp. 236-249.) [63.711: 043; 63.711.]
- The Causes of Variation in the Proportion of Butter Fat in Milk. *J. F. Tocher.* (Scottish Jour. Agric., x, 1 (Jan., 1927), pp. 17-27.) [543.2; 63.712.]
- Cheese Standards. *R. A. Berry.* (Scottish Jour. Agric., x, 1 (Jan., 1927), pp. 41-50.) [63.73.]

Poultry

- Poultry on the Farm. *J. Hunter-Smith.* (Essex County Farmers' Union Year Book, 1927, pp. 140-152.) [63.651.]
- Farm Poultry Keeping. *W. C. Thompson.* (Welsh Jour. Agric., III (Jan., 1927), pp. 284-293.) [63.651.]
- The Antirachitic Properties of Irradiated Feedstuffs. *F. E. Mussell, Roscoe Hill, and J. A. Rosenbaum.* (Poultry Science, VI, 1 (Oct.-Nov., 1926), pp. 25-30.) [63.65: 043; 612.394.]
- Iodine on the Poultry Farm. *W. L. Chandler.* (Poultry Science, VI, 1 (Oct.-Nov., 1926), pp. 31-35.) [63.65: 043; 612.394.]
- A Comparison of the Growth of Chicks behind Window Glass, and a Glass Substitute. *Walter F. Wood, Jnr.* (Poultry Science, VI, 1 (Dec.-Jan., 1926-27), pp. 62-70.) [612; 612.394.]
- Marketing of Eggs Acts, 1924 and 1926 (Northern Ireland). *J. S. Gordon.* (Scottish Jour. of Agric., x, 1 (Jan., 1927), pp. 1-7.) [63.741.]

Veterinary Science

- A Few Observations on the Incidence of Tuberculosis of the Udder in Cows. *J. Howard Jones.* (Welsh Jour. Agric., III (Jan., 1927), pp. 269-273.) [614.54.]
- Some Observations on Braxy in Sheep. *N. Bisset.* (Welsh Jour. Agric., III (Jan., 1927), pp. 273-276.) [619.3.]
- Vermineous Broncho-Pneumonia in the Pig, due to *Metastrongylus Apri*, with Observations on the Chloroform Method of Treatment. *N. Bisset.* (Welsh Jour. Agric., III (Jan., 1927), pp. 276-284.) [619.4; 59.169.]
- Further Notes on Warble Flies in North Wales: Distribution and Control Experiments. *C. L. Walton.* (Welsh Jour. Agric., III (Jan., 1927), pp. 164-169.) [619.2.]

Economics

- Farm Profits and Losses: Four Years' Financial Records of Yorkshire Farms. *A. G. Ruston.* (Agric. Prog., IV (1927), pp. 85-89.) [338.1.]
- Rents and Prices of Agricultural Land in South Wales, 1915-25. *A. W. Ashby and J. Pryse Howell.* (Welsh Jour. Agric., III (Jan., 1927), pp. 5-23.) [333.5 (42); 338.5.]

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THE JOURNAL

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NOTES FOR THE MONTH

In connexion with the Empire Shopping Weeks that are being arranged in a number of provincial towns during the present year, the Ministry is endeavouring through appropriate channels to bring the claims of home produce prominently before local distributors and consumers. In the larger cities, a special exhibition of Empire, including home, produce will form the central feature of the arrangements.

The first of this series was held at Belfast from May 23 to 28. The Northern Ireland Government, the Municipal Authorities, and the various trading organizations all took up the project with enthusiasm; in the result, a standard was set which other cities will find it difficult to surpass. The streets were gay with flags and streamers, various social functions were organized, and the shopkeepers vied with each other in presenting Empire produce (both from home and overseas) to the best advantage. The Ulster Hall was utilized for a special exhibition of Empire goods on lines familiar to those who recently visited the British Industries Fair or the Ideal Home Exhibition.

The Ministry, as the Department responsible for the organization of the Great Britain section, secured the co-operation of the National Farmers' Union, the Food Manufacturers' Federation, the National Food Canning Council, the British Glasshouse Producing Marketing Association, the Western Curers' Association, and the National Association of Cyder Makers. On this occasion, instead of dividing the available space between associations, an attempt was made to stage a composite display representing British agriculture as a whole, and the result fully justified the experiment. The stand was both attractive and dignified, and afforded conclusive evidence of the variety and excellence of the foodstuffs derived from our native soil. In the centre

was an imposing pyramid of fruit products—canned and bottled fruits, preserves and cyder. In another part of the stand, tinned vegetables were shown, also processed and packed cereal foods, such as porridge oats, shredded wheat, etc. The live stock branch of the industry was represented by an excellent selection of bacon, hams and lard, together with meats of all kinds in tins and jars. Dairy produce received adequate recognition; cheeses of all kinds and several makes of crustless cheese in cartons were shown, as well as condensed and dried milk. Finally, there was a most attractive show of glasshouse produce, including tomatoes, cucumbers and mushrooms.

It was an agreeable surprise to local consumers to see the variety of products in tins, bottles, etc., now being produced in England, and it is to be hoped that home producers and manufacturers will follow up the advantage of the sentiment that has undoubtedly been stimulated in favour of their goods.

* * * * *

THIS Conference, the third of its series, was held at Cambridge just before Easter. A report of the meeting is printed elsewhere in this issue of the JOURNAL (p. 201),

**The Cambridge
Agricultural
Organizers'
Conference**

and the addresses delivered at the Conference will shortly be available in printed form as one of the Miscellaneous Publications of the Ministry. The special value of these Conferences is that they bring into direct touch with research workers those who are responsible for agricultural education in the counties and upon whom falls the duty of giving practical advice to farmers. There is not a little to learn upon both sides. The abstractions of research are both necessary and, in a sense, an impediment; it is only by a process of abstraction that a scientific problem can be reduced to its elements and resolved; but this very process removes the researcher from the conditions of everyday life. Further, although researchers are not physically remote from human affairs, but live and move and have their being in our midst, it is very salutary for them from time to time to be confronted by those who insist upon the practical bearing of their speculations on the world of affairs. The world of affairs—covering all those who are dealing with practical farming—also has something to learn; it may learn that researchers are in their way intensely practical and realistic, that they are trained to look for things which get

passed over in the hurry of industry and not to be satisfied with guesses or empirical solutions.

At a Conference, such as that at Cambridge, we have not only one but a team of researchers explaining the bearing of very different investigations on a large problem of agriculture. Confronting them is an audience, scientifically trained, but steeped in practical affairs. The result is a discussion stimulating to all. More than this, the meeting establishes personal links between those engaged upon a common problem—the application of science to agriculture—and leads the way to a quickened and persistent interchange of ideas which cannot but be fruitful.

* * * * *

THE Ninth Annual Report of the Official Seed Testing Station for England and Wales, covering the period from August, 1925, to July, 1926, appears in

Report of No. 6 of the *Journal of the National
Official Seed Institute of Agricultural Botany*, copies
Testing Station of which may be obtained from the
Institute, Huntingdon Road, Cambridge,
price 1s., or post free 1s. 2d.

During the period under review, the total number of samples received for test amounted to 22,884. The sources of the samples, together with comparative figures for previous seasons, are as follows:—

		1925-26	1924-25	1923-24
Seed firms.	Number sending samples ..	1,732	1,741	1,354
	„ of samples received	18,375	17,695	15,831
Farmers, etc.	„ sending samples ..	676	625	310
	„ of samples received	1,404	1,034	769
Public Depts.	„ of samples received	3,105	3,165	2,286
Total number of samples	.. ..	22,884	21,894	18,886

It will be seen that the total number of samples received for test during 1925-26 was 990 greater than in the previous season. The number of samples sent by seed firms shows an increase of nearly 4 per cent., and the increase in farmer samples is approximately 35 per cent. An analysis of the samples shows the following distribution according to species compared with similar figures for the two preceding seasons:—

		1925-26	1924-25	1923-24
Cereals	.. ..	8,402	9,066	7,817
Pulses	.. ..	2,601	1,891	1,714
Roots and vegetables	.. ..	4,954	4,148	3,898
Clovers	.. ..	4,280	4,283	3,304
Grasses	.. ..	2,418	2,334	1,975

The number of cereal samples shows a decrease of about 7 per cent. on the previous season, owing largely to the drop in barley samples. Pulse samples increased by nearly 37 per cent., the number of pea samples being greater than in any previous year. Roots and vegetables show an increase of just over 19 per cent., being the highest figure attained since 1921-22. The number of clover samples, which includes 2,295 of red clover, is almost identical with the previous season, whilst the grass samples show a slight increase.

The number of samples received each month closely follows the curve of the average of the previous seven seasons, and was as follows :—

1925-26.					
August ..	736	February ..	4,155		
September ..	2,008	March ..	4,700		
October ..	2,725	April ..	1,791		
November ..	1,567	May ..	485		
December ..	1,630	June ..	194		
January ..	2,739	July ..	154		

Cereals.—The average percentage germination of wheat for the season under review was 95.8, being identical with the average of the previous eight seasons, but 2.7 per cent. higher than in 1924-25. The average germination of barley was 95.2 per cent., and of oats 93.8 per cent., the former being rather lower and the latter slightly higher than the average for 1917-24. Rye gave an average of 87.8 per cent. compared with 92.4 per cent. for the previous eight seasons, but in this case there was a marked decrease in the percentage of samples germinating below the authorized minimum.

A naked eye examination showed that 11.9 per cent. of the wheat samples were infected by bunt, and 2.7 per cent. with earcockles, whilst 6.9 per cent. of the barley samples showed smut, and ergot was present in 9.5 per cent. of the rye samples. In all cases, the percentage of samples showing evidence of these diseases was less than in the previous season.

A table is included in the Report showing the distribution of cereal samples received for test arranged according to variety. A comparison of this table with that of previous years shows only in certain instances a slight alteration in the "order of precedence."

Pulse.—The average germination of peas (84 per cent.) was below the average for 1917-25 (86.4 per cent.), but slightly better than in 1924-25 (83.5 per cent.). Field beans were slightly above the average (95.7 per cent. compared with

95.2 per cent.); broad beans were below the average (93.6 per cent. compared with 94.1 per cent.); runner beans were higher (82.2 per cent. compared with 77.3 per cent.); and dwarf beans considerably higher (93.1 per cent. compared with 83.2 per cent.).

Root and Vegetable Crops.—Field and garden turnip, rape, kale, brussels sprouts, broccoli, cauliflower, mangold, sugar beet, parsnip and carrot all gave a higher average percentage of germination than for the seasons 1917-25. Swedes were, however, down—80.5 per cent. compared with 85.1 per cent.—as were also onions—56.8 per cent. compared with 67.6 per cent.

Grasses.—The average germination of perennial rye-grass, Italian rye-grass, cocksfoot, timothy and dogstail showed an improvement on the previous season, but meadow fescue was slightly down. The average purity of all these kinds of grasses except dogstail was also better than the previous years. Dogstail showed a marked falling off in purity, the impurities increasing from 2.15 per cent. in 1924-25 to 4.6 per cent.

Clovers.—The average germination of red clovers (all samples) showed an improvement on the 1924-25 season, but was considerably less than the average for 1917-25. The purity, on the other hand, showed a marked improvement on the eight-year average. The average purity of English samples was higher than in any season since the Station has been established. Wild white clover gave an average germination of 75.2 per cent. as compared with 73.7 per cent. during 1917-25, an average of hard seeds of 10.8 per cent. compared with 14.2 per cent., and an average of impurities of 7.2 per cent. as compared with 10.44 per cent.

The percentage of samples of English clover containing dodder was lower than in any previous season—3.2 per cent. of samples. In the case of Chilian, the percentage of samples containing dodder was 89.1 per cent. and of New Zealand 25 per cent.

Investigations, etc.—In addition to the normal tests, particulars of which are given at the beginning of this note, over 4,200 tests of an investigational nature were carried out at the Station during the season. Further work was done with regard to the relationship between field and laboratory tests of peas and the occurrence of leaf stripe of oats. Some useful information was also collected in connexion with the loss of vitality in storage of certain economic crop seeds. Further problems which received attention at the Station include (1)

the incidence in commercial seed samples of seed-borne diseases (2) the identification of the seeds of (a) the various economic species of *Agrostis* (bent-grass), (b) forms and varieties of red and sheep's fescues, (c) the rye-grasses, (d) cultivated species of *Brassica*, and (e) wild white clover.

The Report adds: "There has again been a considerable increase in the number of inquiries dealt with by the Station in connexion with seeds and seed analysis. During the past season, also, a considerable number of small illustration plots have been grown of economic species of *Leguminosæ* and *Gramineæ*. These proved of considerable value, especially to students attending the Seed Analysts' Course, and it is hoped to extend such plots somewhat during the coming season."

The Report also includes a copy of the papers set, in the examination, in the principles and practice of seed testing, which was held at the Official Seed Testing Station in July, 1926.

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SINCE the formation of the first Institute, in 1915, in a small Anglesey village, the Women's Institute Movement has spread with astonishing rapidity in the villages of England and Wales. Because it is a country movement and concerns itself little with propaganda, remarkably little publicity has attended its development. It is, however, now definitely recognized as an important factor in women's education and in public life, and its Annual Meeting is regarded as the country women's parliament.

The National Federation of Women's Institutes now consists of 3,845 Institutes, and has a membership of over 230,000. Each institute is entitled to send a delegate to the Annual Meeting. The agenda for this meeting reflects the varied interests of the different institutes—domestic business, questions peculiar to the country and matters of general public importance appearing upon it. This year the movement has reached a particularly significant milestone in its advance, for whereas in 1920 the National Federation received from His Majesty's Treasury a grant of £10,000 towards the general organizing costs of the movement, this year the movement is for the first time independent of Government aid as regards general expenses, the institutes having themselves built up the income necessary to finance their own organization.

The Annual Meeting was, this year, held in the Queen's Hall, Langham Place, London, W. 1, on May 31 and June 1, at 10.45 a.m.-5 p.m., the chairman of the National Federation Executive Committee, the Lady Denman, C.B.E., being in the chair, and the Minister was one of the speakers.

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THE annual agricultural returns will be collected again this year on June 4. These returns are now compulsory under the provisions of the Agricultural Returns Act, 1925. Every occupier of more than one acre of agricultural land which includes orchard land, market gardens and nurseries, is required to make a return. The forms for the returns will be issued immediately before June 4, and when completed they should be forwarded to the Crop Reporter whose address appears on the back of the form. It is hoped that all occupiers will make their returns promptly so that there may be as little delay as possible in the publication of the tabulated results.

The Act provides that no individual return or part of a return may be used, published or disclosed except for the purposes of the preparation and publication of agricultural statistics, or of prosecutions under the Agricultural Returns Act.

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AGRICULTURAL education in the United States of America during the past 13 years has made remarkable progress through the development of the extension movement. This development dates from the introduction of the Smith-Lever Act in 1914, the keynote of which is co-operation. Prior to this Act, colleges were conducting considerable extension work with their own funds, and the Federal Department of Agriculture was spending, independently of the colleges, a further sum of \$1,000,000. This work is now carried out by a single division, organized at the college, with a director at its head, appointed by the college with the assent of the Secretary of Agriculture. There is, further, co-operation between colleges in part of the extension work and in the plan for the voluntary pooling of all funds available for the various States.

In 1914, the State and Federal Governments were spending \$1,600,000 on extension work in agriculture and home economics, and, by 1924, this figure had increased to \$19,394,639 per annum, of which approximately \$12,000,000 were contributed by the States and counties.

In the same period, the total personnel increased from 1,230 to 4,764 officers, the latter figure including 765 full-time specialists, extension directors and other supervisory officers.

In determining the policy of the extension work for a district, the farmers, with the agents of the co-operating county, State and Federal Governments, together review the local conditions and agree upon what ought to be done. The administration of the work is then entrusted to the State College of Agriculture. The full recognition of local people, conditions and practices, and the enlistment of the active participation of the individual farmer and his family in the planning and the carrying out of local extension work, are the two fundamental considerations to which the success is accredited. Demonstration farms owned and operated by the Government are being replaced by demonstration units owned and operated by the farmers under schemes developed jointly by the farmers and the Government agents. This partnership of the farmer with the Government, together with his work as a voluntary helper in the capacity of demonstrator, chairman or member of committee, has developed a sense of rural leadership, and given to the farmer a greater breadth of outlook, apart from the more direct benefit which accrues from the opportunity of improving his technical efficiency. The primary object of extension work, however, is the adoption of an improved practice, and there is evidence of a much wider use by farmers of lime, cover crops, green manures, fertilizers, seed of improved and standardized varieties, and of the improvement of orchards by renovation, pruning and spraying.

Farmers are advised as to the formation of co-operative organizations for the disposal of their products and for the purchasing of their supplies, provided with general information on marketing problems, encouraged to adopt better business principles, and stimulated to keep and utilize farm records as a means of regulating their business.

THE GRASSLAND CONFERENCE AT CAMBRIDGE

A. B. BRUCE, M.A., Dip. Agric. (Cantab.)

THE Ministry of Agriculture made a happy choice in selecting grassland as the subject of its third conference of agricultural organizers. Grassland husbandry is of great topical interest—in view of the unchecked decline in arable land which recent statistics show, it could not well be otherwise—and it is a fortunate coincidence that, as Professor T. B. Wood pointed out, scientists are now entitled to present a philosophy of grass husbandry. That is to say, recent discoveries at Cambridge and, we must add, at the Rowett Institute at Aberdeen, as well as at Aberystwyth, justify scientists in giving precise scientific reasons upon which a definite rationale of the economic treatment of grassland can be based.

The Conference was attended by upwards of one hundred persons—agricultural organizers, teachers, research workers and practical agriculturists. The proceedings opened with a dinner at Gonville and Caius College on April 7, at which the Minister delivered an address dealing with the administrative and financial outlook of agricultural education and research. On behalf of the University and College authorities, Professor Buckland, President of the College, replied in a witty speech. The health of the Minister was proposed by the senior county organizer present, Mr. T. Hacking, of Leicestershire.

It is not proposed to give here a complete account of the proceedings during the following days. Readers who may wish to study the facts and figures presented by the various speakers are referred to the bibliography given below. It will be sufficient to present a reasoned summary and to indicate a few of the significant features of the interesting contributions made to the discussions that followed the reading of the papers.

The Rôle of Mineral Substances in Nutrition.—On the forenoon of April 8 the Conference had the privilege of having for its chairman Sir F. Gowland Hopkins, F.R.S., whose world-wide reputation as a pioneer in the domain of bio-chemistry needs no emphasis here. A discussion on the rôle of mineral substances in nutrition was opened by Dr. J. B. Orr, Director of the Rowett Institute. He reviewed the present position of knowledge on the subject, including some account

of recent discoveries made at Aberdeen. Up to quite recent years, the science of animal nutrition has been wholly concerned with what may be termed the grosser requirements of the animal in respect of the energy and repair balances as measured by its needs in proteins, carbohydrates and fats. The speaker, while emphasizing the continuing importance of these requirements—especially of the protein fraction—pointed out that the presence of definite, though small, quantities of “ash” substances is indispensable for the activation of the protein and carbohydrate constituents. Their absence or lack of balance may be the cause of malnutrition and the proximate reason, therefore, of disease, and that, in its turn, must react on the economic assimilation of the grosser body-building constituents.

As a guide to the absolute as well as the relative proportions in which mineral substances are needed for the health and working of the animal economy, Dr. Orr drew attention to the composition of the milk of animals in which the farmer is interested. The facts of evolution require that the food of the herbivores should show a close relation to the constitution of their natural food, that is, herbage; and as an index of the food requirements of any species, milk—the natural food of the young of that species—is the best index. When we study the natural food of herbivores, we at once recognize that natural conditions permit of a free range, whereas domestication for the purposes of man inevitably leads, if not to complete at least to a partial restriction of choice of diet. The importance of this consideration is brought home to us, also, when we consider two classes of inter-related facts which recent observation and experiment have brought to light.

First, actual analysis of herbage has shown that the mineral contents of natural grass vary from locality to locality; and, secondly, that the instincts of wild animals can be correlated with the presence or absence of certain minerals in the food they choose. Thus the migratory instinct, by force of which herbivores change their grazing grounds, can generally be correlated with mineral requirement. Again, depraved appetite (now known as *pica*), such as the eating of excreta and carrion, has been shown to be due to the absence of particular minerals in the ordinary diet. Of the latter perhaps the most striking instance can be given from the investigations of Theiler in South Africa. Cattle pasturing in the veldt were found to be suffering from a fatal disease due directly

to the eating of carrion. Theiler has shown that this depraved appetite is due to the deficiency of phosphorus in the herbage of the veldt, and that the addition of phosphates to the diet immediately abrogates the eating of carrion. More recently, Dr. Orr has shown that the progressive debility of the sheep stock in the Falkland Islands is due to the deficiency of lime in the pasturage there. Again, in New Zealand, there are regions in which an iron deficiency is found, accompanied by the prevalence of certain ailments in the grazing stock.

Generally speaking, scientists are now justified in stating (1) that a deficiency of minerals (whether it be the definite absence of one or more, or whether it be an *unbalanced condition of all*) leads to malnutrition, and (2) that a state of even minor malnutrition is followed by a predisposition to disease, sometimes definitely infectious, sometimes purely functional. Thus a deficiency in *lime* produces sterility, various forms of weakness of limbs and joints, rickets and roughness of coat; a deficiency of *phosphorus* causes stiffness of joints, lack of co-ordination of movements; lack of both lime and phosphorus seems to predispose to tuberculosis; deficiency of *iron* causes anaemia and low vitality of young; and deficiency of *iodine* leads also to loss of vitality, and in human beings to goitre.

To return to the significance of the mineral content of milk. The “ash” composition of cow’s milk compares with that of pasture grass as follows*:

	Calcium	Phosphorus	Chlorine	Sodium
Ash of cow's milk	1.7	1.5	1.4	.6
Ash of pasture grass (not hay).				
Good	2.6	1.2	3.5	.7
Poor	1.5	1.1	2.2	1.1

These facts emphasize two conclusions: (a) that good pasture (that is, natural pasture as improved by the skilled agriculturist) is a perfect food for young herbivores—cattle and sheep; (b) even poor (unimproved) pasture approximates in composition to milk.

Finally, Dr. Orr stressed a most significant fact. Under modern conditions, fattening cattle and milch cows are fed on large quantities of plant by-products. Cakes and meals are vegetable substances less nitrogenous and oily matter. These are all, also, more or less deficient in *natural* minerals; there is consequently a mineral drain on the animal body, which, in the case of milch cows, depletes the store of minerals

* These figures compare the content of quantities of equal feeding value of milk and grass respectively.

in the bones. Further, ultimately there is a mineral drain on the soil. Unfortunately, in the present state of knowledge, this drain cannot be definitely corrected, either by direct additions to the soil or by supplementing animal foods by definite "mineral mixtures." Again, it must be borne in mind that this drain is not merely absolute; it may be relative: the balance of mineral substances may be as important as the absolute amounts, and excess of certain mineral constituents may be as dangerous as deficiency.

In the discussion on Dr. Orr's paper, many facts confirmatory of his views were elicited, of which perhaps the most significant was the observation made by Mr. Hay, of Somerset, that in some cases he had observed that the incidence of tuberculosis in cows could be correlated with a lime deficiency in the soil. It may also be recorded that Mr. Boutflour, whose experience of cow rationing is very wide, finds that a mineral addition to cow rations often gives satisfactory results.

In closing the discussion, Sir F. Gowland Hopkins wittily suggested that, as the last man who had taken an interest in a grass diet died so long ago, it was difficult for him, a student of human nutrition, to take an active part in the subject of the Conference! He thought, however, that what had been said pointed to the importance of a conclusion to which his own researches had long been directed, namely, the supreme importance of small factors causing malnutrition and, ultimately, predisposition to disease.

The Function of Minerals in the Animal Body.—On the afternoon of April 8, Mr. J. B. S. Haldane, Reader in Biochemistry, gave a lecture on the function of minerals in the animal body. Of the experiments by which the lecture was illustrated, the most striking was a demonstration of the influence of a solution of mineral substances on the beating of a heart separated from the body of a rabbit. It was shown that a solution approximately of the same composition as sea water maintained pulsation indefinitely, while the omission from the solution of a single ingredient led to a cessation. Another striking demonstration was the action of minerals in relation to the proper functioning of such enzymes as ptyalin, the active principle of saliva. It was shown also that minerals generally are required for the activation of proteins, the free ions of the former determining the physical conditions (solution, etc.) of the latter. Coming to the specific action of inorganic substances generally, it is known that, apart from those present in the bones, they constitute less

than one per cent. of the animal body, and of these, calcium, phosphorus, potassium, sodium and magnesium bulk more largely than other necessary constituents such as iron, iodine, zinc and fluorine.

The Composition and Nutritive Value of Young Grass.—On April 9, the forenoon was occupied by an account given by Dr. Woodman of his recent researches on the composition and nutritive value of young grass, that is, grass in a condition before the formation of flowering stems, with its accompaniment of lignification, has set in. Briefly, the methods employed were the cutting of the grass with a lawn mower at weekly intervals, the drying of the produce, its analysis and the carrying out of digestion experiments with sheep. For purposes of comparison, plots were hayed and periodical cuts of the aftermath were taken. The experiments covered the seasons of 1925 and 1926 and were conducted both on light and heavy land. Figures were obtained showing by weekly intervals the total weight of fodder produced, its chemical composition, and the actual digestibility of the several constituents. Dr. Woodman put before the Conference a number of tables of relevant figures, accompanied by remarkably vigorous and lucid explanations and illustrations. The whole was of extreme value, furnishing as it did an example of careful scientific reasoning, surrounded, as all such reasoning must be, by the limitations which the conditions of the experiments necessarily impose. There is no feature more characteristic of modern research work than the essentially provisional nature of all scientific hypotheses, and the care that is taken to avoid the dogmatic certainty which so often characterizes the utterance of the non-scientific man.

The principal conclusions reached by Dr. Woodman may be stated briefly as follows:—

(1) The produce of closely grazed pasture has a higher feeding value than has hitherto been believed: the *dry matter* of young grass (not exceeding 3 to 4 in. high) may be characterized as a concentrated food of high protein content and remarkable digestibility; it contains, moreover, adequate amounts of vitamins and of minerals such as lime and phosphorus. These characteristics persist during the whole grazing season from April to October.

Thus it was found, in two seasons and on soils of contrasted character, that the *dry matter* of closely mown pastures, in April to June, contained from 21 to 27 per cent. of crude protein, whereas the corresponding figure for hay (cut

June 25) was 9 per cent. In July the figure was, for pasture, 21-25, and for aftermath 18-23 per cent., and for weekly aftermath cuts in July-October the figures were 23-29 per cent. of crude protein.

Next as regards digestibility: The protein of pasture showed 77-85 per cent. digestibility, whereas the protein of hay showed only 56 per cent.

Next, the starch equivalents of the produce *per acre* over the whole season may be contrasted: From pasture cuts 2,300 lb., containing 680 lb. digestible protein; and from hay and aftermath cuts 2,450 lb., containing 430 lb. digestible protein. In regard to these figures, it should be noted that although when measured in terms of starch equivalent the produce in each case is much the same, the pasture cuts contain 50 per cent. more digestible protein.

Finally, the digestibility of the dry matter of pasture grass and that of the moisture-free content of an average sample of a feeding-cake may be contrasted.

Digestible Protein per cent.		Starch equivalent per cent.	
Pasture	Cake	Pasture	Cake
22	19-27	74	52-84
Digestibility of Organic Matter per cent.			
Pasture		Cake	
84		58-80	

(2) Under ordinary farming conditions, the dry matter of good pasture grass, *whatever its botanical composition*, retains the characteristics of a highly nutritious concentrate all through the grazing season, provided that it is kept closely grazed. Where the pasture is sparse and "poor," close grazing and the use of fertilizers to ensure density of herbage should be able to overcome any difficulty arising from inferior botanical composition.

This conclusion is justified by the following facts. The botanical composition of the two pastures under experiment differed widely; nevertheless, the analyses and feeding trials gave much the same results. Further, the botanical composition of each plot changed in the same season under treatment with no sensible effect on the results.

(3) A ration purely of young grass is unbalanced; it is too rich in protein and too deficient in carbohydrates. It should be supplemented by a carbohydrate concentrate such as a cereal grain.

This conclusion follows from a consideration of the figures given above.

The discussion which followed this paper was confined to a consideration of the bearing of the work on practical farming; that it will be profound, particularly on existing methods of management of grassland, was agreed by all the speakers. The extension of Mr. Woodman's investigations will be awaited with interest.

Sectional Grazing plus Nitrogenous Manuring.—On the forenoon of the third day of the Conference (Sir Daniel Hall in the chair), Mr. W. Brunton gave an account of his trial of the Hohenheim system of sectional grazing coupled with nitrogenous manuring. The system in question was fully described in an article published in the issue of this JOURNAL for September last, p. 498. Briefly it consists in stimulating the continuous growth of herbage by repeated applications of a nitrogenous manure (in this case sulphate of ammonia) and the rapid grazing down of the young produce followed by periods of 20-30 days' rest during which (if necessary) a further application of manure is made. Contrary to what has been taught and believed for a generation, this treatment has no evil effects on the quality of the herbage; no mat is produced, and—an unexpected feature—the growth of wild white clover is stimulated.

Mr. Brunton's experiment related to 27 acres of pasture land, a large part of which was originally of poor quality and set aside for grazing by horses. The whole area was divided into seven paddocks by means of rough four-wire fences, the two upper wires being barbed. Arrangements were also made whereby a pipe supply of water was available for the stock in each paddock. The trial has occupied two seasons—1925 and 1926. In the autumn of 1924, the whole area was treated with lime (15 cwt.), superphosphate (5 cwt.), and kainit (4 cwt.), followed by an application of sulphate of ammonia at the rate of 1 cwt. per acre. Further dressings of the last mentioned manure were made during both summers amounting in all, in some cases, to 4 cwt. per annum. The total cost of the fencing, manuring, etc., was at the rate of £4 6s. per acre. The results obtained in 1926 on the 27 acres were briefly as follows:—

MARCH 15. Grazing started with 30 ewes and 40 lambs.

April 8. Milch cows replaced sheep.

October 10. Cows removed.

OCTOBER 23-DECEMBER 31. 120 lambs at grass.

Total pasture days (stock carried multiplied by days of grazing), 8,555.

Average number of cows pastured 46, or 1.75 per acre.

The procedure was to stock the paddock at the rate of 10-12 cows per acre for 5 days; then to allow rests of 20-30 days, during each of which, if necessary, as judged by the growth of herbage, a dressing of sulphate of ammonia was given at the rate of 1 cwt. per acre.

Mr. Brunton is of opinion that, provided care and intelligence are exercised, the system is a sound business proposition. It provides a longer grazing period (note the early commencement and the late close); gives a great saving in the cost of concentrated food (no less than £164 in this case); enables more stock to be carried per acre; and leads to a great improvement in the amount and character of the herbage.

Mr. Brunton's conclusions were confirmed by the results obtained at Reaseheath Farm Institute, Cheshire, of which some account was given by Mr. Carr, Agricultural Organizer for the County.

The discussion which followed Mr. Brunton's address went to emphasize his view that a requisite of the new system is, above all, intelligent management. A point which requires study is the extent to which the system can be applied to ordinary farming; it was generally agreed that under ordinary conditions only a fraction of the grassland of a farm can be treated intensively—a considerable area must be kept for hay and rough grazing—and what this proportion should be remains in doubt. It should be noted, too, that so far no experience with fattening stock is available.

As a result of the enterprise of Messrs. Nitram, Mr. Brunton's experiment is being repeated at some 30 centres in the country. It is interesting to note that the remarkable results obtained confirm Dr. Woodman's work on the high feeding value of young grass.

In the afternoon the Conference listened to an interesting address by Mr. J. G. Stewart, in which a great many problems of grass husbandry were discussed. Mr. Stewart stressed the economic importance of providing winter keep, expressing a hope that plant breeders would give more attention to the practicability of either introducing or breeding a variety of grass endowed with the capacity of growing at low temperatures. A description was given of the experiments being conducted at Hohenheim, to which Mr. Stewart made a visit last summer. Among the notable features there was the luxuriant growth of perennial rye grass and white clover, and the fact that, although the treatment had been followed for ten years, no signs of deterioration were visible.

In the discussion which followed, Professor Stapledon made a valuable suggestion based upon what he had seen in New Zealand, namely, that it should be possible to practise sectional grazing without the necessity of providing special fencing. Mr. Carr, of Cheshire, gave the result of some observations he had made on the evil effects of small dressings of sulphate of ammonia on grassland. Mr. Bond, of Derbyshire, contributed an interesting speculation on the possible action of nitrogen on a dead mat of grass, in a manner similar to that observed by Hutchinson and Richards in connexion with the rotting of straw. In closing the discussion, Sir Daniel Hall suggested that the Hohenheim method would best be applied to second-class pasture.

Results of Grassland Trial Plots.—On the fourth day of the Conference (Mr. R. M. Wi'son in the chair) Dr. Hanley, of Bristol University, read a paper summarizing the results obtained on the plots laid down in pursuance of the Ministry's grassland "campaign" initiated in 1919, and giving the deductions he had made as a result of his visits to these experiments. These reached the remarkable total of 700 in all, situated in 50 different counties. Dr. Hanley presented a classification of poor pastures, indicating in each case suitable means of improvement. In regard to these, his experience led him to doubt the value of indicator plants, such as *Calluna*, as a guide to treatment. The peats often presented an insoluble problem; downland, on the contrary, was the easiest of all to treat. Broadly speaking, in most cases either a complete manure, or phosphates followed by lime, gave the best results, but it was most important in all cases to observe that the full effect of mineral manures is shown under pasture conditions only. It is futile to measure results by taking a crop of hay. Except in the presence of a mat, the use of phosphates was generally successful, high solubility doing better than low. Dr. Hanley was strongly of opinion that further experiments in the use of phosphates in dry conditions, as well as in methods of improved management, were needed, but, on the whole, the grassland campaign had been productive of very useful results.

Grassland Botany.—On the forenoon of April 12, the closing day of the Conference, Professor R. G. Stapledon (Professor Scott Watson in the chair) read a widely ranging paper on grassland problems, considered mainly from a botanical stand-

point, and illustrated by an interesting series of graphs, embodying the results of the researches of the Welsh Plant Breeding Station.

At the outset, the lecturer stressed the importance of two considerations: the effect of the nature of the herbage on stock, and the no less important consideration, the effect of the stock on the herbage. He showed a number of useful seasonal produce graphs of various species, demonstrating that the problem of maintaining a more or less constant supply of produce was dependent on securing some mixture of species. For winter keep he placed Italian rye-grass in the forefront. Generally speaking, a species had to be considered from many aspects, of which its productiveness, persistence and aggressiveness were the most important. The differences in mineral content should also be observed, coltsfoot, for example, being specially rich in phosphates. All round, the clovers were better mineral carriers than the grasses. Incidentally, the high mineral content of rape was emphasized. Professor Stapledon expressed some doubt as to the ability of certain pastures to withstand such a defoliation as a prolonged period of close grazing might entail. He also stressed the usefulness of temporary leys in providing abundance of keep at seasons when it is most needed.

Perhaps the most striking of the valuable series of figures presented by the lecturer was one correlating the laboratory germination percentage with the actual plant population resulting from the same seed. The figures showed conclusively that there is very little correlation between laboratory figures of germination and the actual proportion of plants finally established, the latter depending largely on variety. Great importance was attached to the proper arrangement of grassland, such as the optimum number of animals grazed and the duration of grazing. Belief was expressed in a system under which grass fields should be used both for hay and pasture in the same season.

In relation to grass mixtures, Professor Stapledon advocated a prescription involving a few species each of a suitable strain specially chosen to suit the particular soil and the particular style of farming pursued.

National Aspects of Grassland Husbandry.—The last address of the series was given by Professor T. B. Wood (Professor Sir R. H. Biffen in the chair), and was devoted to a consideration of the national aspects of grass husbandry as they were likely to be modified to suit new conditions, such as (1) the

progressive increase in the area of grass, and (2) the new knowledge now available. He showed that the bulk of the grassland was now producing a "coarse fodder" suitable for maintenance rather than for production. The new knowledge suggested that much of the existing grassland could be utilized for production purposes. What was needed was simply close grazing coupled with better management in the matters of stocking and manuring. On a consideration of the economics of the problem, it would appear that the head of stock carried under ordinary conditions would not be sufficient to eat down the grass in the flush season, and that, consequently, in view of Woodman's results, the surplus produce should be mown, and, if practicable, used (in a dry state) as a concentrated feeding stuff at seasons when growth was less active. Professor Wood presented calculations which showed that, in grazing inferior pasture, animals consumed a considerable portion of the available energy merely in walking about to find an adequate supply of food. As regards the system of sectional grazing advocated earlier in the Conference, it was suggested that farmers generally would have difficulty in putting up the capital needed.

In conclusion, Professor Wood, summing up the trend of the whole conference, suggested that scientists have now a philosophy of grassland husbandry to offer to practical men. Hitherto grass had been treated almost as a jungle product, which needed no special management and might be left to the mercy of nature. Scientific attention had in the past been concentrated on arable husbandry and comparatively little research had been done in the productivity of grassland. As a result of the converging attack of the botanist, nutrition chemist and physiologist, many new facts had come to light, the summing up of which should enable the husbandman to make a reasoned attack on what seemed to be likely to become the agricultural problem of the age—how to make the best use of our ever-increasing grasslands. At the close of his address, Professor Wood created great interest by distributing samples of a grass "cake" made under his direction from closely mown grass, subsequently dried in a malt house and then compressed into an adherent mass. Feeding experiments with this cake are about to be instituted with material to be supplied by Messrs. Nitram Ltd.

Finally, some reference to a domestic side of the Conference should be made. The arrangements for the housing of the members were excellent and directed by Mr. P. G. Dallinger,

the Ministry's Chief Inspector of Education. He, in his turn, feels that acknowledgments are due to Professor Wood and the Master and Fellows of Gonville and Caius College for the comfort which all attending the Conference enjoyed throughout the meeting.

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SOME COMMON AILMENTS OF THE DIGESTIVE ORGANS OF CATTLE

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Introduction.—Ailments of the digestive organs of cattle are necessarily important to the farmer, as they are of frequent occurrence, but can often be relieved by suitable "first-aid" treatment. The farmer should know the causes of such ailments and how they may be prevented; he should, also, be able to recognize the symptoms of each, and have some knowledge of suitable remedial treatment. In the present article, the more common ailments will be dealt with on the lines indicated, and in the order in which they naturally occur, beginning with those of the mouth. Cattle very rarely suffer from trouble with their teeth, to which no further reference is necessary.

Big Tongue.—The tongue is frequently the seat of a disease known variously by the names of big tongue, wooden tongue, timber tongue or *actinomycosis* of the tongue. This disease is more frequently met with in marshy, low-lying districts, and is caused by a fungus found on the stems of grasses. The spores of the fungus enter the tongue through small wounds, and these germinate, developing into actinomyces, or the ray fungus, so named from the way in which the club-like bodies radiate from a common centre. The ray fungus has

been found in man, in the lungs and liver; in animals, in the tongue, the cheeks, the jawbone, and in the udders of milking cows and of sows.

Symptoms of Big Tongue.—At first, there is a falling away in condition, due to the inability of the animal to make full use of the tongue in grazing. There is a constant dribbling of saliva, and a soft, puffy swelling may form under the bottom jaw. If the tongue is examined at this stage, a few scattered hard nodules will be discovered in its substance. Later, the tongue becomes so much enlarged that it cannot be retained within the mouth, and the tip is seen protruding between the lips. The whole tongue is now very hard, stiff and rigid, and is useless for the purpose of drawing food into the mouth; consequently, the animal soon becomes emaciated.

If a diseased tongue is examined after death, many hard nodules can be felt. If one is cut into, the centre may contain a little discharge in which can be discerned small yellowish bodies, about the size of a pin's head. These are the ray fungi, which, under the microscope, are seen to be composed of small, club-like bodies radiating from a common centre, as shown in Fig 1.

Treatment.—The farmer should know that, in the earlier stages, big tongue is curable. Various preparations of iodine are used to dose the animal, and are continued until symptoms of iodine poisoning occur, when the administration must be stopped for a time, and repeated later. Iodine has been found to have a specific action on the ray fungus, but its administration needs to be carefully watched by the veterinary surgeon.

In very advanced cases, where great emaciation arises from the inability of the animal to graze, a special method of feeding may be tried. Bring the animal into the shed; place in the manger a round, flat-bottomed wooden tub, with straight upright sides about 18 inches in height, and half-fill the tub with short-cut food of a good feeding quality. It will be found that the animal is able to scoop up the food into its mouth, even if the tongue is quite useless. In this way, the condition may be slowly improved, and, in time, the animal becomes fit for the butcher.

Choking in Cattle.—The accident of choking occurs in the gullet and is generally caused by careless methods of preparing food, such as roots and cake. Roots should be sliced in a machine, and cake broken in a cake mill. Pieces of mangolds or turnips are apt to slip back in the throat and enter the gullet, but are too large to be swallowed and, lodging some-

where in the gullet, symptoms of choking are brought on. Sometimes the obstruction is at the entrance to the gullet and may be reached, with the aid of a suitable mouth gag, by the fingers and so removed; or the obstruction may be in the neck portion of the gullet, and the lump may be seen on the left side of the neck in the jugular channel. If lower down, where the gullet passes through the chest, there will be no outward sign of the obstruction. Choking in cattle is dangerous and may prove fatal in a short time, either from interference with the breathing or with the action of the heart.

Symptoms.—The beast will cough and make efforts to bring up the piece of food. Soon it will be noticed that a large quantity of saliva is escaping from the mouth. Choking does not cause any increase in the secretion, estimated, normally, at 112 lb. per day, but the obstruction in the gullet prevents the swallowing of the fluid. Sooner or later, more serious symptoms develop; the rumen, or paunch, becomes distended with gas, which cannot escape through the gullet as long as the obstruction remains. A swelling appears on the left side between the last rib and the hip-bone, and, when tapped with the fingers, gives out a hollow sound. The distended stomach presses on the diaphragm and interferes with the breathing, which becomes short and gasping. The animal now exhibits symptoms of acute pain, kicking at the belly with the hind feet, sometimes even attempting to lie down and roll like a horse with colic. With such symptoms, the animal is in great danger and may die suddenly. Prompt treatment is necessary to give relief by the use of the probang, or choke-rope. The old-fashioned choke-rope has now quite disappeared, and its place has been taken by another instrument, the probang. This is made of leather, stitched to form a long tube, armed at each end with a brass knob. Through the tube runs a piece of cane, which gives more rigidity; but it can be removed when the end of the probang has entered the stomach, so allowing a free escape for the accumulated gases. With the probang a wooden gag is supplied; this is a piece of wood with a hole in the centre and straps at each end, as shown in Fig 2. The gag is necessary for the safe use of the probang.

Passing the Probang.—For this operation three persons are required. The beast should first be loosened from the chain and brought into the gangway, so that there is plenty of room in front of its head. The gag is then placed in the mouth, like a horse's bit, and kept in position by the straps passed over the top of the head. Two men stand with the animal's

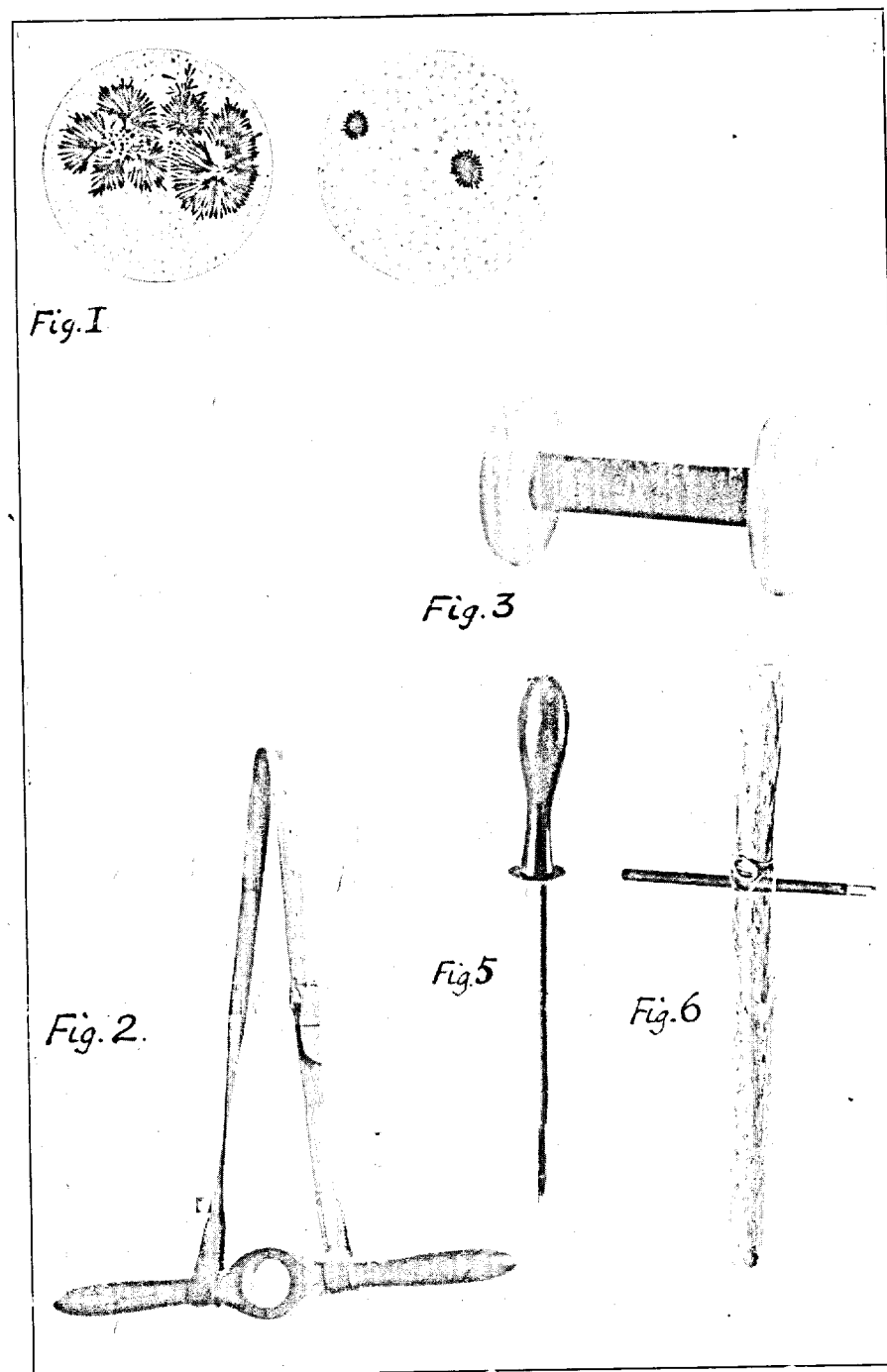


FIG. 1.—The Ray fungus (after Crookshank).
 „ 2.—Wooden gag.
 „ 3.—Mouth gag.
 „ 4.—Probang.
 „ 5.—Trocar and cannula.
 „ 6.—Tube of elder stick with crosspiece.

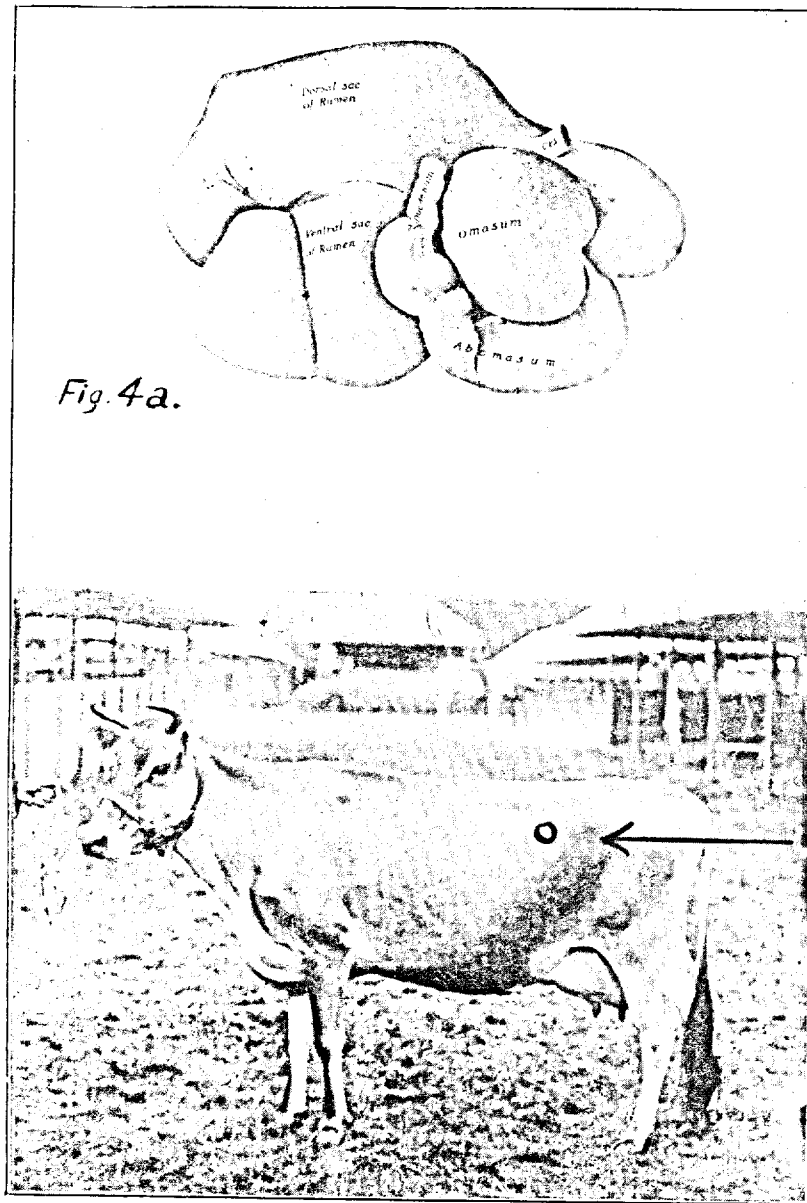


FIG. 4a.—Ruminant's stomachs: exterior (after Sisson).

„ 7.—The circle indicates the place to puncture rumen on left side of animal, between the last rib and hip bone (after E. Matthews).

head between them, each holding a horn with one hand and one end of the gag with the other. The third man greases the probang and passes it through the hole in the gag and so through the mouth. When the end of the probang enters the throat, the animal often presses forward and must be restrained by the men holding the head. The operator must keep watch to see that the head, neck and body of the beast are in a straight line, otherwise the operation will be difficult and unsafe. The probang is passed farther into the gullet until the obstruction is felt, when the beast again presses forward and needs restraint. Here it must be said that the gullet is only a tube of muscle or flesh, and may easily be torn if the probang is roughly used. Keep up a firm, steady pressure on the obstruction, and in a few minutes it will begin to move, and, when once started, it can be pushed without difficulty right down to the stomach. When the end of the probang has reached the stomach, there will only remain outside the gag the end in the hand of the operator. The cane should then be withdrawn and the gases will escape rapidly through the probang. When all swelling of the stomach has disappeared, remove the probang and gag, but take care that the animal does not snatch a mouthful of hay or other food, or choking may occur a second time. Give no solid food for 24 hours; nothing but bran mashes or oatmeal gruel may be allowed.

In the absence of a probang and gag, do not use any makeshift instrument, such as a wagoner's whip, a leather harness trace, or an ordinary piece of rope. They are dangerous and have caused the deaths of many valuable animals. The idea that any piece of rope may be used to relieve choking probably arises from the old-fashioned name "choke-rope," but that was woven specially for the purpose and was used as the probang is to-day. If the proper instruments are not available, relief may be given and danger averted by placing in the mouth the kitchen paste or rolling pin (Fig. 3), secured by cords at each end passed over the head. In some way the paste pin, acting as a gag, prevents the dangerous accumulation of gases in the stomach, and affords the time necessary to secure professional assistance. Sometimes the obstruction disappears after a few hours without any other treatment being required.

In a few exceptional cases, where the distension of the stomach is very great, none of the above methods will be successful, and it is then necessary to puncture the rumen with a trocar, as is done to relieve acute hoven, described later.

fter the distension of the rumen has been relieved by the use of the trocar, it is generally found easy to pass the probang down the gullet to the stomach.

The Stomachs of Cattle.—After the gullet, come the four stomachs of the ruminant, in which a number of ailments may occur. Only two of these need be mentioned as being common; the others are rarely met with. As the stomachs of a ruminating animal are somewhat complicated, it will be necessary to give a short description of the several compartments and of the process of rumination, or chewing the cud. The four compartments are:—

- (a) Rumen, or paunch.
- (b) Reticulum, or honeycomb.
- (c) Omasum, or bible.
- (d) Abomasum, or true stomach.

The diagram (Fig. 4) may help the reader to follow the description. The rumen (A) is by far the largest of the four and occupies nearly half the abdominal cavity. It lies on the

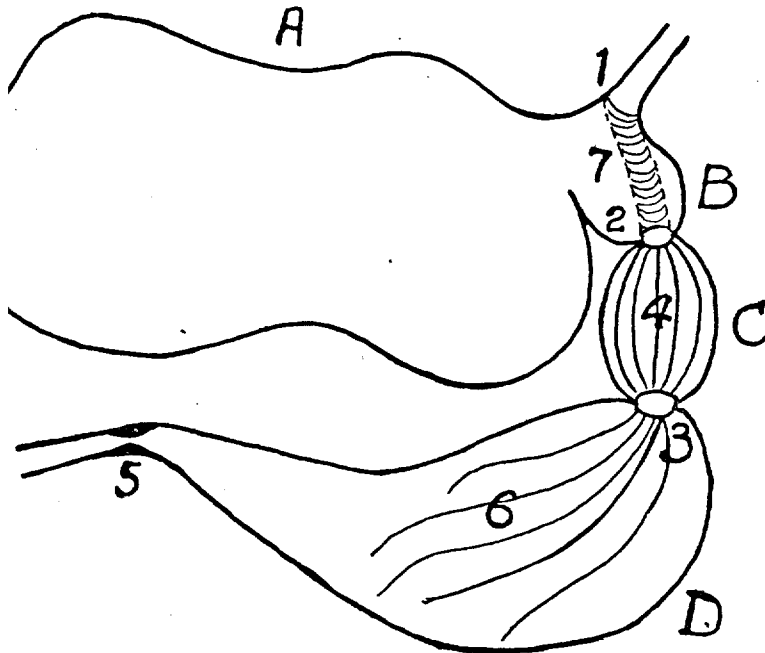


FIG. 4.—Diagram of ruminant's stomachs. (Interior.)

left side of the body, extending from the diaphragm to the umbilicus. It has a very powerful white, voluntary muscular coat, and is lined by mucous membrane, which is white in colour and presents on the greater part of

its surface a large number of leaf-like papillæ. All the food the animal eats passes down the gullet and enters the rumen at (1), where it is stored up until the appetite is satisfied and rumination begins. The second stomach (B), the reticulum, or honeycomb, is the smallest of the four, and is placed in front of the rumen and under the lower end of the gullet (1). It is recognized by the honeycomb pattern on its mucous membrane. The third stomach, the omasum, or bible (C), is placed in front of the rumen to the right of the reticulum. It is oval in shape and about the size of a Rugby football. A circular opening (2) admits food from the reticulum, and another opening (3) communicates with the abomasum (D). Between the two openings there is a large number of parallel leaves (4), like the leaves of a book; hence the name bible stomach.

The fourth stomach (D), the abomasum, or true stomach, is pear-shaped and next in size to the rumen. It is situated on the right side of the rumen and communicates with the small intestine at (5). The fourth stomach is the only one in which gastric juice is secreted, and it is here that digestion of certain constituents of the food takes place. The interior of the stomach is lined by a smooth, slippery and pinkish mucous membrane, containing peptic glands which secrete the gastric juice. There are a few spiral leaves (6) in this stomach.

Uses of the Stomachs.—The rumen, or paunch, acts as a storehouse for the food while the animal is grazing. When the rumen is full, rumination, or the chewing of the cud, begins. This sending up of the cud is effected by contractions of the powerful muscular coat of the rumen, forcing the food mass forward and pressing a portion into the lower end of the gullet (1). The gullet next contracts from its lower end, driving the food upwards towards the mouth, where the chewing of the cud is carried out slowly and deliberately. At the same time, more saliva is mixed with the food in the mouth. When ready, the cud is again swallowed and, on reaching the lower end of the gullet, is diverted by means of a special groove (7) through the reticulum into the omasum, where the food is passed and squeezed between the leaves, and the liquids escape into the abomasum, to be followed later by the solids, which have now been thoroughly prepared for the action of the gastric juice in the fourth stomach. The duty of the first three stomachs is to prepare the food for the digestion, which is carried on in the fourth stomach.

The rumen is never empty, as the chewing of the cud ceases when two-thirds of its contents have been removed. All the food in the rumen *must* be returned to the mouth for the chewing of the cud. No food passes from the rumen and reticulum directly into the omasum and abomasum. If rumination is suspended, as during illness, the food remains in the rumen until the act of chewing the cud is resumed, and it is quite possible for the animal to starve although the rumen contains a considerable mass of food.

Liquid foods, which do not need chewing over again, can pass directly to the omasum and fourth stomach. In all cases of illness, during which rumination is suspended, liquid foods, such as oatmeal gruel and linseed cake porridge, must be given in place of ordinary foods, so that the strength of the animal may be maintained until convalescence is reached and rumination is resumed.

As might be expected, the large and complicated stomachs of the ruminants are liable to suffer from various ailments, but in this article it is only proposed to refer to two, both of which affect the first stomach, or rumen.

Impaction of Rumen.—This ailment, also known as mawbound, or loss of cud, is of frequent occurrence in dairy cows during the winter months. It is generally due to errors of feeding, such as too much short-cut food, brewers' grains, etc., or any food which the animal eats to excess. Foods of poor quality, as bad, mouldy hay, may derange the stomach and cause loss of cud.

Symptoms.—In a dairy cow the first symptom will be a decrease in the milk yield, loss of appetite and loss of cud. The animal has a peculiar grunt or groan, and grinds the teeth together. The rumen can be felt on the left side between the last rib and the hip-bone, and is found to contain a solid mass of food, and the movements of the stomach can no longer be felt. The dung is harder and coarser in texture than in health. A simple explanation of this loss of cud is that the muscular coat of the rumen is suffering from overwork and needs a rest.

Treatment.—First-aid measures consist in giving the stomach a much-needed rest. It is useless to give repeated purgative doses, as they have no effect on the rumen, but a single dose is useful to relieve the constipation. No solid food should be given, as it will only add to the impaction of the rumen. Only liquid foods, such as oatmeal gruel and linseed cake

porridge, or a mixture of the two, are useful, and should be given to the extent of two or three gallons daily.

Sometimes the animal will drink part of this quantity, but more often it has to be given with a drenching horn. The liquid food passes directly to the fourth stomach, where it is digested, and the nutriment is absorbed into the blood from the intestine.

After a few days of this special diet, the muscular coat of the rumen will be rested and the chewing of the cud will be resumed. When it is certain that the animal has begun to chew the cud, a little good hay may be given, sprinkled with common salt. The salt freshens up the contents of the rumen and induces the chewing of the cud.

Prevention.—To prevent impaction of the rumen, sufficient long hay should always be given when short-cut food and brewers' grains are being fed to cattle. During the winter months, an allowance of common salt is desirable, given daily sprinkled over the food.

Hoven, blown, dew-blown or tymphanitis, is the distension of the rumen by gases which are formed by the fermenting food contents. Normally, a certain amount of fermentation goes on in the rumen and the gases produced are expelled through the gullet by frequent eructations, but in hoven the fermentation has been so rapid that large volumes of gas are produced, causing rapid distension of the stomach. Hoven occurs in three forms—acute, sub-acute, and chronic.

Acute Hoven.—This is caused by the rapid fermentation of green foods, such as young clover, young growing corn, or fresh green grass, especially when such foods are wet with dew or rain. Cattle straying into a field of growing clover frequently suffer severely. They eat the fresh green food greedily and quickly, overfilling the rumen, which is then unable to perform its proper function of sending up the cud; fermentation of the food occurs, evolving large quantities of gas, which cannot be expelled rapidly enough to prevent distension. Sometimes acute hoven occurs in the winter and is due to eating frozen roots.

Symptoms of Acute Hoven.—These are unmistakable. The animal is so badly blown as to appear deformed. The swelling of the stomach is seen on the left side of the body, between the last rib and the hip-bone, and may be very large. On tapping the swollen part with the finger-tips a hollow, drum-like sound is produced. The animal is in great pain, bellows loudly and may try to lie down and roll, but quickly gets up

again, as breathing is interfered with in the recumbent position. Owing to the pressure of the distended rumen on the diaphragm, breathing is difficult, quick and shallow. The pressure may also interfere with the action of the heart, and the animal dies quickly either from suffocation or heart failure.

Treatment.—This must be prompt, as the animal is in extreme danger. Medicines are useless, and the only thing to be done is to *puncture the rumen* in order to let the gas escape quickly and so relieve the pressure. This operation can be safely and successfully performed by the farmer himself if he possesses a suitable trocar and cannula (Fig. 5). The trocar is the dagger-like instrument, with a blade seven or eight inches in length and oval in shape; the cannula is a metal tube which forms a sheath for the trocar, but is about an inch shorter than the latter, so that the pointed end of the trocar projects beyond the cannula.

The animal should be placed with its *right* side against a wall or gate, a rope or kicking strap should be fixed on the hind legs above the hocks, and the head secured by the "bull-dogs" placed in the nose. The operator takes the trocar and cannula in his right hand, places the point of the instrument on the skin equidistant between the last rib and the hip-bone on the left side, and about a span beneath the loin-bones (Fig. 7). Then, with a sharp, quick thrust, the trocar is driven into the stomach, carrying with it the cannula. The trocar is quickly withdrawn, leaving the cannula in position in the wound to act as an escape tube for the gas. As the gas comes away, the swelling rapidly subsides and the distressing symptoms disappear. The cannula should be kept in place for several hours, during which time an attendant must remain with the patient and take care that the tube does not get displaced. When the tube is removed the wound rapidly closes. In the absence of the trocar and cannula, the operation can be done with a long-bladed knife, but some kind of tube *must* be inserted in the wound after the withdrawal of the knife. A piece of elder-stick, with the fibre removed, answers the purpose very well if a short piece of stick is lashed to the tube near one end (Fig. 6).

A very simple way of inserting the elder stick is to pass through the tube the steel used for sharpening the carving knife, and in this way guide the tube through the wound into the stomach, and then withdraw the steel. If some kind of tube is not used, the wound closes up in a short time and

the stomach may again become distended with gas, necessitating a repetition of the operation, which is not advisable.

Sub-acute Hoven.—This is due to causes similar to those in the acute form, but the distension of the rumen is less severe and no other symptoms are seen beyond the swelling.

Treatment.—There is no need to puncture the rumen in this case. Two ounces of aromatic spirits of ammonia may be given in a quart of cold water as a drench. Walking exercise is often sufficient to relieve the slight distension.

Chronic Hoven.—In this the swelling occurs daily, and is often caused by foreign bodies, wire nails, etc., in the rumen or reticulum. In such cases little can be done to give permanent relief, but temporary relief may be obtained by drenching as above, or by the use of the probang, which is passed down the gullet to the stomach as in the case of choking, withdrawing the cane to allow the gas to escape through the tube.

Ailments of the Second, Third, and Fourth Stomachs.—Ailments of the reticulum, omasum and abomasum may occasionally occur, but are uncommon and difficult for the farmer to diagnose.

White Scour, or Diarrhoea.—This is of common occurrence in young calves and often very fatal. It will be convenient to describe the malady as :—

(a) Ordinary white scour.

(b) Contagious white scour.

Ordinary White Scour.—Pail-fed calves are particularly liable to suffer from this ailment when they are a few weeks old, the predisposing cause being errors in feeding, giving rise to non-digestion of the milk and subsequent diarrhoea. The faeces are very liquid and offensive, and white in colour on account of the presence of particles of curd.

When a calf is suckled by its mother, as Nature intended it to be, it takes milk many times in the twenty-four hours and in moderate quantities at a time. The milk swallowed passes directly to the fourth stomach, where it meets the gastric juice and is curdled by the rennin in that fluid. The curd so formed from cow's milk is very solid, but can be digested by the other constituents of the gastric juice, pepsin, etc., and completely dissolved. After each meal, the milk taken should be completely digested.

When the calf, however, is taken from the cow immediately after birth, and is pail-fed three times a day for the first fortnight and afterwards only twice a day, it becomes thirsty

and hungry, and takes far too much milk at each meal. This results in the formation of a large mass of dense curd which can only be partially digested. Sometimes the undigested curd becomes hardened and leather-like, remaining in the stomach, where it acts as an irritant, and may be found there on post-mortem examination. Generally, the undigested curd undergoes decomposition by the action of microbes and is broken up into small particles which escape from the stomach into the intestine, acting there as an irritant poison and causing the offensive diarrhoea. Much of this trouble could be avoided by a more rational method of feeding, in which the same quantity of milk is allowed as in the two or three meals, but the number of meals is increased to not less than four, a smaller amount being given at each. Although this entails additional labour, the calves will thrive better by having smaller quantities of milk at shorter intervals.

Treatment.—The treatment usually adopted by the farmer is to dose with laudanum and castor oil, but, as the one drug counteracts the action of the other, such treatment should not be followed. It is far better to give a suitable dose of castor oil alone directly the diarrhoea begins. The purgative action of the oil helps Nature to get rid of the poisonous curd which is irritating the bowel; and, when the oil has acted, the diarrhoea may cease without further treatment being necessary. Should the diarrhoea, however, persist for twenty-four hours after the administration of the oil, laudanum may then be given to soothe the irritated bowel. A very homely but useful remedy at this stage may be prepared by mixing together one teaspoonful of laudanum, one tablespoonful of brandy, and one teacupful of made starch. This dose may be given two or three times a day until the diarrhoea ceases.

Diet.—The milk should be boiled and diluted with one-third the quantity of water. In obstinate cases, milk should be discontinued for a time, the calf being fed entirely on calf meal.

Contagious White Scour.—This trouble is caused by the entrance of microbes into the body, either through the untreated navel or through the mouth with the milk. The disease occurs within a few days after the birth of the calf and is very fatal. It has been estimated that from 70 per cent. to 100 per cent. of calves so affected will die.

Professor Nocard inquired into the cause of the disease many years ago, and suggested a method of preventive treatment which has proved very successful. He found that filth

organisms entered the circulation through the untreated navel and increased rapidly in the blood, causing diarrhoea and extreme exhaustion, which, in many cases, proved fatal in a few hours.

Preventive Treatment.—A ligature should be put on the navel string, about an inch from the belly, immediately after birth, and the navel string should be painted with a strong antiseptic. For the ligature the farmer will find it useful to have a knot of narrow white tape, kept in a wide-mouthed bottle in (95 per cent. pure) carbolic acid. An effective antiseptic is iodized phenol, which can be applied to the navel with a soft brush after the ligature has been put on.

Since Nocard's investigation it has been found that a certain proportion of these cases may be due to the bacillus *coli communis*, which enters through the mouth with the milk. This organism is constantly present in the intestine of older animals and is not harmful to them; but if calves become infected, the multitude of bacteria irritates the intestine, causing diarrhoea. Where these cases occur, the calf place needs thorough cleaning and disinfection. All dirty litter must be removed, the walls limewashed, and the floor and drains washed down with a strong disinfectant. After cleansing, the doors and windows should be kept wide open, with the place empty, for several weeks, so that Nature's best disinfectants, sunlight and fresh air, can complete the destruction of all dangerous organisms.

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PACKAGES FOR EGGS AND DRESSED POULTRY

IN December, 1926, a Committee* was appointed by the Minister of Agriculture and Fisheries to examine the various kinds of packages in use in the trade in home-produced eggs and dressed poultry, and to make suggestions with a view to

* Constituted as follows:—Mr. H. German, National Farmers' Union and Poultry Advisory Committee; Mr. P. Hedworth Foulkes, B.Sc., Poultry Advisory Committee; Mr. H. W. Board, West of England Egg and Poultry Merchants' Association; Capt. A. Keevil, O.B.E., M.C., Poultry Advisory Committee and Market Salesmen and Wholesalers; Mr. W. H. Key, Market Salesmen and Wholesalers; Councillor G. Hall, National Federation of Fruiterers, Florists and Fishmongers; Mr. S. G. Shaw, Federation of Grocers' Associations, Mr. R. Steel, National Federation of Dairymen's Associations, Retailers; and Mr. F. Harrison, The Railway Companies. The Chairman was Mr. A. W. Street, C.I.E., M.C., and the Secretary, Mr. G. W. Thomas, both of the Ministry of Agriculture and Fisheries.

standardization. The main outlines of the Committee's Report are given below.

General.—The present position, as regards packages, in both the home and imported trade, is fully described in the two Reports* recently issued by the Ministry on the Marketing of Eggs and Poultry respectively. It is sufficient, therefore, to draw attention to the basic fact that special care is taken in countries which export to the British market to ensure that their produce is attractively packed in accordance with modern requirements. In many countries, notably in Northern Ireland, the Irish Free State, Canada, and South Africa, this care is enforced, in respect of eggs, by law.

EGG PACKAGES.

(a) **Non-returnables.** *Views of the Trade.*—A questionnaire was sent out by the Committee to a number of wholesale merchants in a large way of business, and, in 55 out of 64 replies received, a preference was expressed for non-returnable cases; this was qualified, in one or two instances, by the statement that, although non-returnables were best for consignment by rail, a returnable case was more convenient when eggs were sent by road. Fourteen replies were definitely and exclusively in favour of the 60 dozen case with wood-wool packing; a preference for 30 dozen cases, with fillers and flats, was shown by the remaining 50, of whom a number stated that they saw no objection to the 60-dozen case. A few of those who favoured a 60-dozen case suggested the use of fillers and flats in the place of wood-wool. An important rider, added in many instances, was "provided the cases are new"; the use of second-hand boxes which have conveyed eggs from overseas is liable to impart a musty flavour to the eggs and is objectionable on other grounds.

Non-returnables Advocated in Principle.—In view of the marked trade preference for non-returnable packages, it is not difficult to understand that the persistence of the returnable in the trade in English eggs is causing distributors, in increasing numbers, to decline to handle the English product. As one large merchant said in reply to the questionnaire, "Over 95 per cent. of our trade is in foreign eggs, for the simple reason that we cannot afford the time taken in sending out our vans to collect returnable empties from our retail customers." Bearing in mind the fact that all imported eggs arrive in non-returnable packages, it is evident that something

* *Egg Marketing in England and Wales* (Economic Series. No. 10).
The Marketing of Poultry in England and Wales (Economic Series, No. 11).

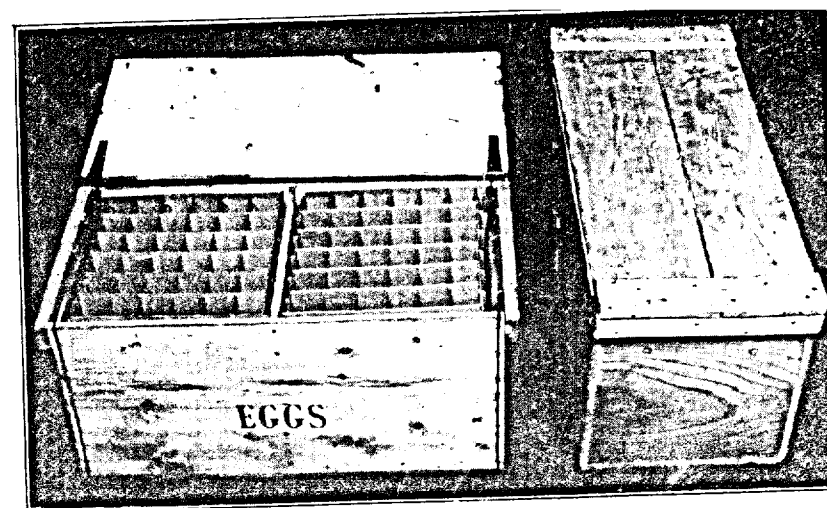


FIG. 1.—A medium-priced English Returnable.

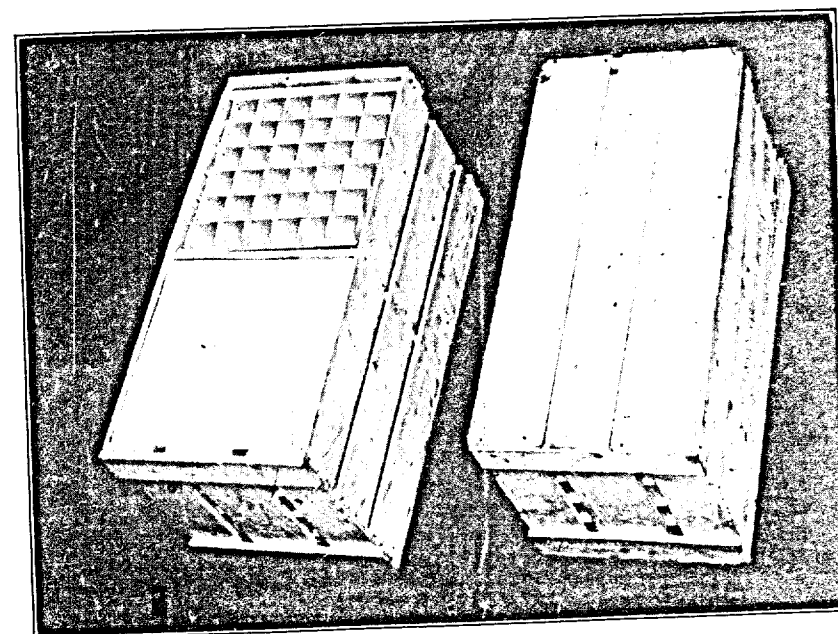


FIG. 2.—An Irish 30-dozen Non-returnable.

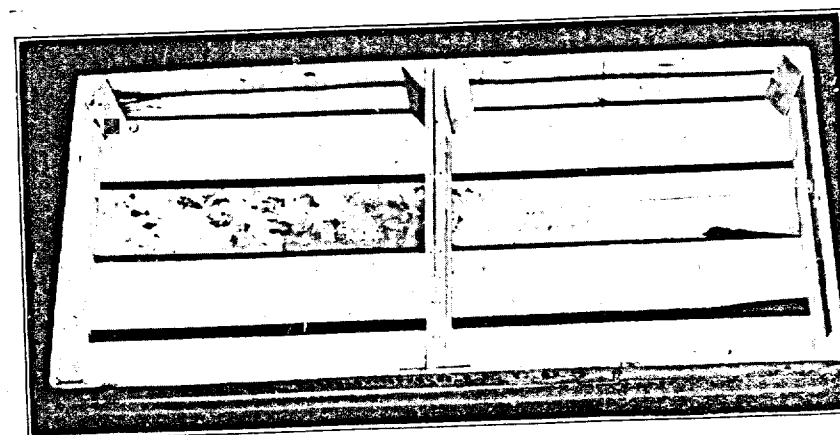


FIG. 3.—An Irish 60-dozen Non-returnable.

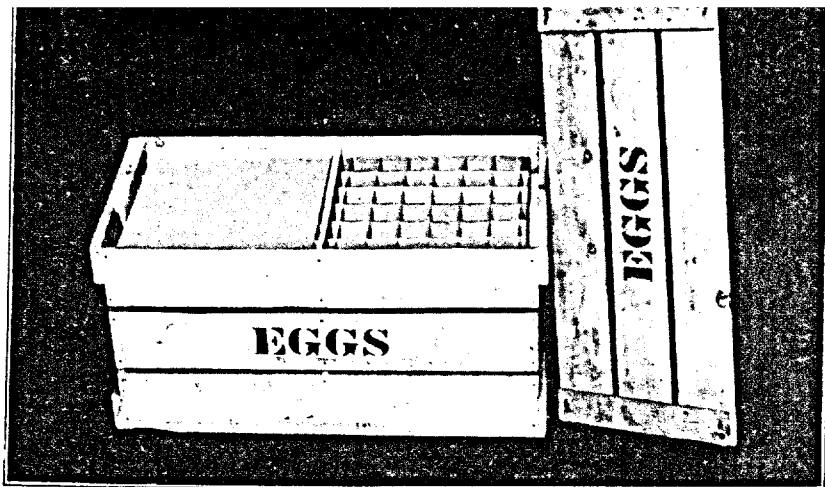


FIG. 4.—An English *Non-returnable*.

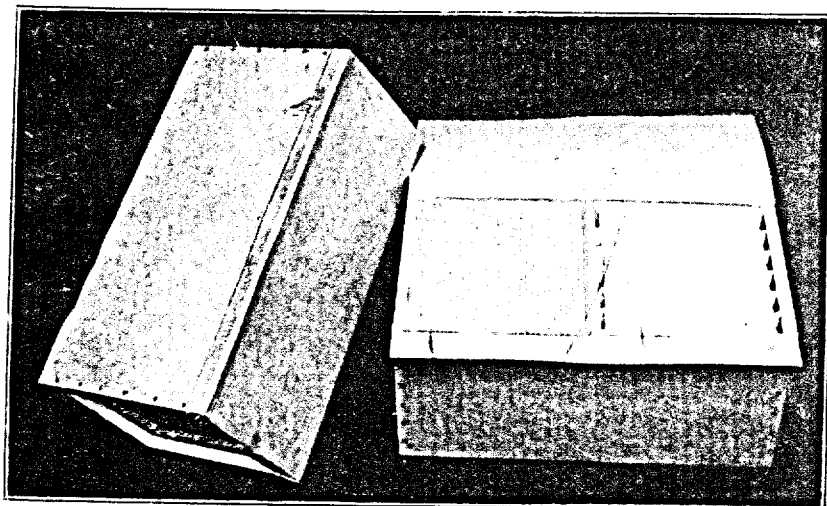


FIG. 5.—A fibre-board *Non-returnable*.

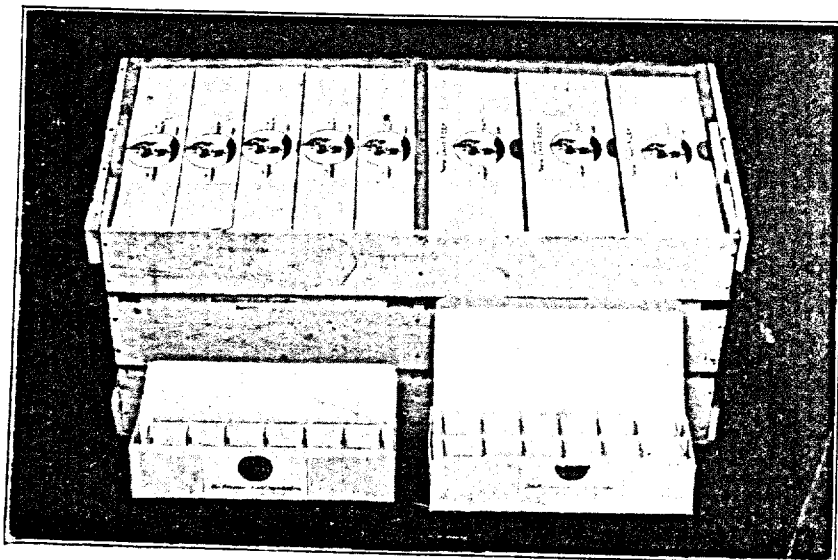


FIG. 6.—A *Non-returnable* with *Cartons*.

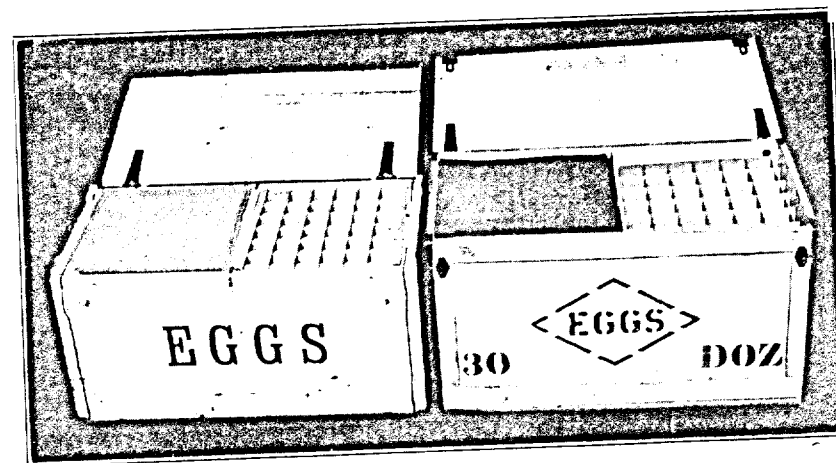


FIG. 7.—Two typical *Returnable* boxes.

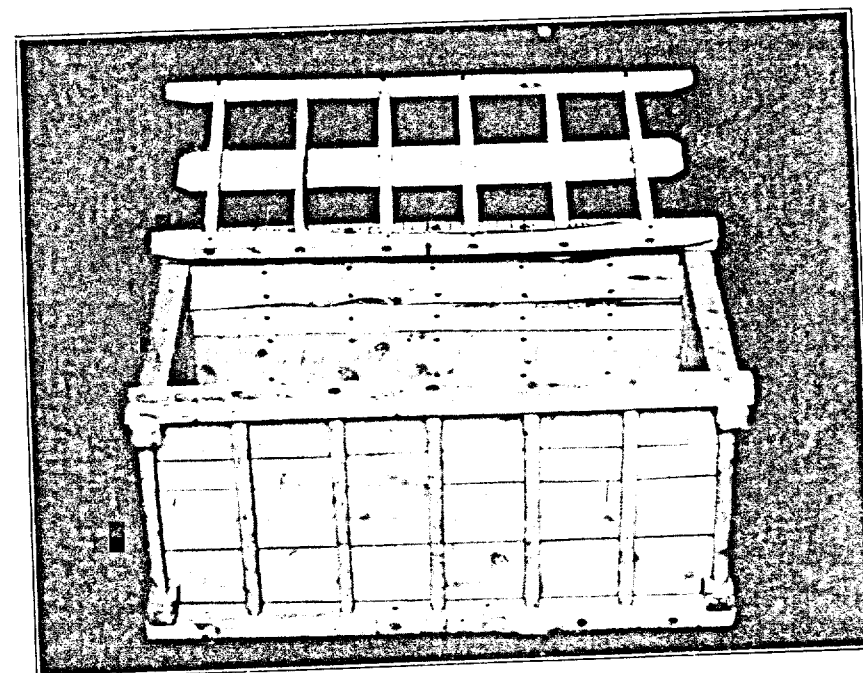


FIG. 8.—A "ped"; used in the Heathfield district of Sussex.

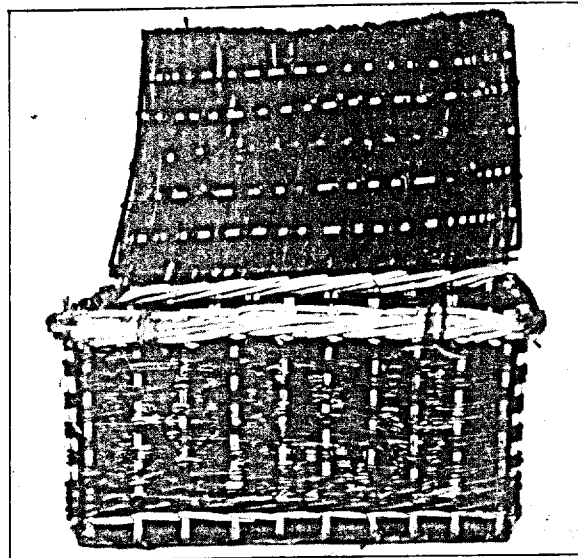


FIG. 9.—A typical dressed-poultry hamper.

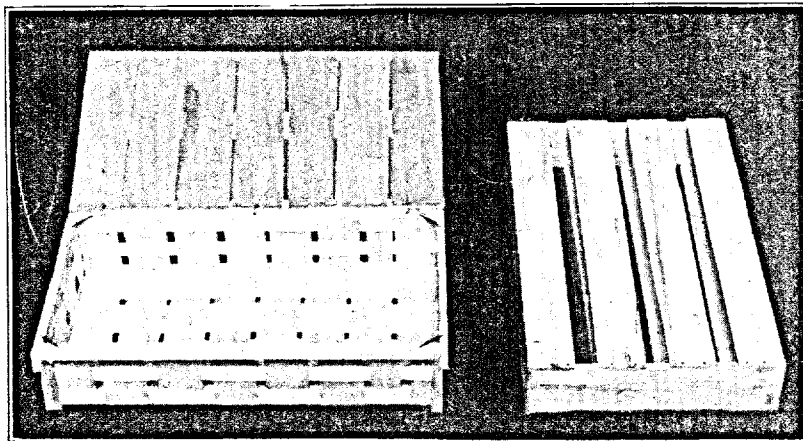


FIG 10.—Chip and Wooden Non-returnables recommended for dressed poultry.

must be done, and done quickly, to introduce a non-returnable package which will improve the position of the English egg on the wholesale markets of this country. In the United States, the expense, trouble, annoyance, and waste of time caused to the distributive trade by having to recover, sort, store and return cases to senders was such as to bring into use a cheap case which could be *given away* with the eggs. This, moreover, was not for an export trade, but for a *domestic* trade. What the American producer and packer have done to save time, trouble, and inconvenience in a market which is practically secured to their own product must also be done here as a matter of urgent necessity if home produce is not to lose ground in competition with imports.

The following resolution, which was passed in April, 1927, by the Joint Egg-Marketing Committee of the National Farmers' Union and National Poultry Council is, therefore, of special interest :—

That the National Farmers' Union and the National Poultry Council, in conjunction with the Ministry of Agriculture and the Railway Companies, agree to a standardized, non-returnable package which could be recommended for adoption by packers of English eggs.

Types of Non-returnables Examined.—The Committee examined 12 wooden boxes and one fibre-board case of the non-returnable type, 30-dozen in capacity, fitted with fillers and flats; Irish 60-dozen and 30-dozen cases with wood-wool packing; a Cornish 50-dozen case packed with straw; a wooden box from Northern Ireland, holding 30 dozen, fitted with one-dozen and half-dozen cartons in the place of fillers and flats; also cardboard containers holding 15 dozen eggs packed in fillers and flats.

Comparative Costs of Returnables and Non-returnables.—For the purpose of comparing the cost to the packer of returnables and non-returnables, the following boxes were selected :—

(1) A returnable box, costing 8s. 6d., of the customary 30-dozen type with fillers and felt flats. Similar boxes are used in the West of England in large quantities with satisfactory results. (Fig. 1.)

(2) A non-returnable box of cheap construction such as is used for the Irish trade and is obtainable in that country at as low a price as 1s. 9d. (including fillers and flats) when ordered in quantities "in shooks." The lowest English estimate is 2s. 0d. "made up." (Fig. 2.)

(3) A Cornish 50-dozen case, which, originally designed as a non-returnable, is now commonly used as a returnable. This box, without straw for packing, costs 1s. 7d.

(4) An Irish 60-dozen non-returnable case which can be manufactured in Ireland "in shooks" for as little as 2s. 1d. in large quantities. This price does not include the cost of the wood-wool for packing. The lowest English estimate is 2s. 9d. "in shooks," or 3s. 2d. "made up." (Fig. 3.)

The following table gives an analysis of the cost of each of these packages to the packer per 120 eggs per journey :—

Type of box and packing material	Weight	Cost without packing material	Cost of case and packing material	Cost to packer of case and packing per journey	Cost to packer of case and packing per 120 eggs per journey
	lb.	s. d.	s. d.	s. d.	d.
Returnable (30-doz.). Fillers and flats ..	24.5	4 0	8 6	0 7†	2.3
Non-returnable (30-doz.). Fillers & flats	12	1 0‡	1 9	1 9	7
Cornish (50-doz.). Straw	18*	1 7	2 0	2 0	4.8
Irish(60-doz.). Wood- wool	29*	2 1‡	3 0	3 0	6

* Without straw or wood-wool. 5 lb. should be added for straw and 12 lb. for wood-wool.

† This figure (the actual cost per journey allowing for losses, renewals, and repairs) is quoted by a large firm in the West of England. It is confirmed by independent figures supplied by a firm operating in the Home Counties.

‡ Purchased "in shooks"; the price does not include delivery. Cost of making up is about ½d. per 120 eggs.

It is clear that, on prime cost, returnables are cheaper to the packer than non-returnables, even when minimum Irish prices are taken for the latter. Having regard, however, to the fact that a 30-dozen returnable case is, generally, about 12 lb. heavier than a non-returnable, being more substantially constructed, a certain saving, estimated at not less than 2d. per 120 eggs, in transport costs on the outward journey is effected when comparable non-returnables are used. Taking this into consideration, a returnable 30-dozen case may be said to cost the packer a little over 4d. per 120 eggs as against 7d. for a non-returnable of a similar type, 4.8d. for a Cornish 50-dozen case, and 6d. for the Irish 60-dozen, plus cost of assembling the cases.

These are the ultimate comparative costs, but there are other factors to be taken into consideration which cannot be precisely measured. For instance, when non-returnables are used, less capital is required; the packer does not have to consider whether he will have sufficient empties available for his next consignment, and he is saved the trouble of putting cases into a fit condition for another journey and of

replacing damaged or soiled fillers and flats; he is also saved cost of collecting empties from station.

On the distributive side, the non-returnable saves time and worry at every turn. It also saves expense; the cost of returning the empty, which may be reckoned as averaging out at 4d. a journey, is saved, and it is usually possible to realize anything from 3d. to 6d. for the package as firewood.

Thus, while both sides are saved worry and trouble, the use of non-returnables involves the *packer*, whether producer or country wholesaler, in an additional charge of 3d. per 120 eggs (30-dozen case) and 2d. per 120 eggs (60-dozen case), excluding cost of assembling the cases, whereas the *retailer*, for his part, stands to benefit to the extent of about 3d. per 120 eggs.

Although it is less a question of whether packers can afford the extra cost of non-returnables than whether they, in the interests of their market, can afford to continue *not* to use them, it would nevertheless be only equitable if retailers agreed to make some concession in price for home-produced eggs so packed. A difference in price of, say, 4d. per 120 eggs, or 1s. for a 30-dozen case, or 3d. per 120 eggs, or 1s. 6d. for a 60-dozen case, would reimburse the packer for his additional expenditure.

A number of associations have recently passed the following resolutions bearing directly on this point :—

(1) *The Metropolitan Grocers', Provision Dealers' and Oilmen's Association.*

"That this Association, being anxious to encourage any action calculated to improve the marketing of home-produced eggs, and realizing the commercial disadvantages to the home industry of the returnable package system, recommends members :—

- To give a preference, where practicable, to home-produced eggs packed in non-returnable cases, quality and other considerations being equal, and
- To recognize the saving to the trade in time, labour, expense and trouble, when non-returnable cases are used by offering a slightly higher price over current market rates for eggs so packed."

(2) *West of England Egg and Poultry Merchants' Association.*

"With a view to removing the handicap which the use of returnable packages admittedly imposes on the English egg trade when in competition with imported supplies, this association recommends its members to send eggs in non-returnables whenever distributors are prepared to make a reasonable concession in price in consideration of non-returnables being used.

"This association further advocates legislation compelling the adoption of a non-returnable case to be used once only."

(3) *National Federation of Dairymen's Associations.*

"Declared itself to be in favour of the packing of eggs in non-

returnable cases, notwithstanding the fact that the use of such cases might slightly increase the price."

(4) *National Federation of Retail Fruiterers, Florists and Fishmongers.*

"This federation, being impressed with the urgency of improving the marketing of home-produced eggs in view of the competition of supplies from overseas sources, and believing that one step in the right direction would be the use of non-returnable packages, and further that there are ways in which the distributive trade would be willing, in the interests of the home country, to help to that end, recommends members:—

- (a) to give a preference, where practicable, to home-produced eggs packed in non-returnables, quality and other considerations being equal, and
- (b) to recognize the saving to the trade in time, labour, expense and trouble when non-returnables are used by offering a slightly higher price over current market rates for eggs so packed."

Types of Non-returnables Recommended.—The Cornish case is the cheapest per 120 eggs, but, owing to its construction, damage to the contents is frequent, and the Committee were unable to recommend its general adoption. The preponderance of opinion in the trade is in favour of 30-dozen non-returnable cases fitted with fillers and flats, although a number of merchants favour the 60-dozen divisible case packed with wood-wool. Packing is said to be more rapid in fillers and flats than in wood-wool, but the difference, if any, is negligible when the packers are skilled. Under certain conditions, the use of wood-wool may, of course, be impracticable; as, for example, when collectors are accustomed to pack for dispatch while on their rounds. The Committee, therefore, recommended the adoption of both types of non-returnable, *i.e.*, the 30-dozen and 60-dozen divisible cases, and the use of either fillers and flats or wood-wool at discretion; they also recommend that only *new* cases should be used, and expressed the view that if a large number of representative packers of English eggs used *only* new cases, the remainder would have to fall into line.*

As the statutory specifications of the Irish 30-dozen and 60-dozen cases (*see* Appendix) are regarded as satisfactory by

* Attention is called to the fact that the railway companies will only accept eggs for conveyance at carriers' risk provided they are contained in substantial wooden boxes or cases, whether returnables or non-returnables, in which the eggs are efficiently and securely packed, and provided also that each egg is placed in a separate compartment and efficiently and securely packed therein. Eggs packed in the boxes recommended by the Committee would not comply with this requirement unless each egg were separately wrapped and placed securely in each compartment.

the trade, the Committee considered that they might be followed, with advantage, in this country, but with the reservation that the specification for the Irish 30-dozen case with fillers and flats is only suitable for eggs weighing $15\frac{1}{2}$ lb. per 120. The Committee therefore suggested that a special 30-dozen case should be used for 17-lb. eggs, of the same general specification as for the ordinary size, except that both compartments of the case should be $12\frac{1}{2}$ in. $\times$ $12\frac{1}{2}$ in. instead of $11\frac{1}{2}$ in. $\times$ $11\frac{1}{2}$ in., the depth being the same, *i.e.*, $13\frac{1}{2}$ in. in both instances. Machine-made fillers to hold 17-lb. eggs are available to fit this larger case, the dimensions of each compartment of the filler being $1\frac{1}{4}$ in. square and the filler being $12\frac{3}{4}$ in. over all. A case and fillers of these dimensions would also be suitable for duck eggs.

For cold-storage purposes, an egg package should be well ventilated to prevent the absorption of odours by the eggs and to reduce mould growth. The 30-dozen case (Irish specification) recommended meets this requirement, and has, of course, the advantage of being suitable for transport. Although experience seems to show that the ordinary fillers are not unsuitable when used in the Irish type of 30-dozen case, special fillers for cold storage are available at little or no extra cost. Wood-wool is less suitable for cold store than fillers and flats, and straw packing is definitely unsuitable.

As already stated, no box-makers in Great Britain have, so far, quoted rates as low as those quoted in Ireland for boxes of the above standards (Fig. 4), although if the demand arose competition amongst box-makers in Great Britain would presumably lead to more favourable quotations. The lowest English quotations received were:—

	s.	d.
30-dozen case (including fillers and flats)	..	2 0
60-dozen case "in shooks"	..	2 9
60-dozen case "made up"	..	3 2

(These quotations are for large quantities.)

Interest attaches, therefore, to a fibre-board 30-dozen box, with wood frame ends, which is on the market and costs 2s. with fillers and flats (Fig. 5). Boxes of this type have the advantage that they pack flat when empty and are easily assembled. They are from 4 lb. to 5 lb. lighter than non-returnable wooden boxes of the same capacity and their use would, therefore, save something in transport charges.

Cartons.—In the questionnaire referred to on page 224, wholesalers were asked to express an opinion on the use of cartons in place of fillers and flats (Fig. 6). Replies showed that

while some merchants could see no reason why cartons should not be successful, the majority were opposed to the idea.

The advantage of the carton lies in its convenience as a consumer-package. It is popular in the domestic trade of the United States and Canada. A packing firm in Northern Ireland is now sending 30-dozen cases containing eggs in sealed cartons to consuming centres in the North of England, each egg being separately wrapped in soft packing paper and each carton containing a guarantee slip with the number of the packer and a request that complaints be notified to the address given. A few English packing firms also regularly supply eggs in cartons. The cost of a sufficient number of cartons to fill a 30-dozen case, in lieu of fillers and flats, amounts to 3s. (or 1½d. per dozen eggs) for half-dozen cartons and a little over 2s. 1d. (or under ¾d. per dozen eggs) for cartons of the one-dozen size, or, say, 1d. and ½d. more per dozen eggs respectively than new fillers and flats.

There are also objections to the use of cartons from the standpoint of the retail trade. There is the dislike of retailers to handling a branded article; this could probably be got over, to some extent, if the name of the retailer were printed on the carton—a common trade practice as regards other commodities. There is also the objection—which in the present state of the home-egg trade is admittedly serious—that if, as would normally be intended, the cartons are sealed at the dispatching point, a retailer would be unable to examine the contents before sale. Finally, there is the question of expense, although experience shows that the additional cost of cartons is usually recovered in the improved prices which consumers are ready to pay for eggs so packed.

Notwithstanding the objections, the Committee considered that cartons would play an increasing part in the trade in home-produced eggs. No doubt, cartons could be used with advantage even now, particularly for a special grade of eggs, but the Committee look forward to the time when, in the areas of surplus production, more producers and country wholesalers would take in hand the organization of packing stations at convenient centres where eggs can be assembled in bulk, and tested, graded, packed and dispatched under a guarantee of quality to the centres of demand. Cartons, sealed at the time of packing, could then be used to bring the trade-mark of individual packing stations to the notice of consumers; a brand on a 30-dozen case can never, of course, be effective in

the same way. If a group of neighbouring packing stations combined to use the same trade-mark, with the same implications of quality and reliability, then the exported produce of a whole area, say Suffolk, or Wiltshire, or Cornwall, would become identifiable on the market. Extending the idea a stage farther, if packing stations throughout the country used the same mark, then a national trade-mark would be created for home produce and national advertising becomes possible. The importance of this at the present time is obvious, but the effective use of cartons bearing an area or national trade-mark involves organization and a measure of voluntary control the details of which would have to be carefully worked out. Certainly, the possibilities of increasing consumption by the supply of high-grade eggs in attractive and convenient packages are, as yet, hardly explored. There is the further point that propaganda directed towards stimulating the consumption of home-produced eggs could be carried to the very homes of the people by means of slips of printed matter inserted in the cartons explaining the food value of eggs, giving recipes for their use and so on. This is a recent innovation in Canada.

(b) **Returnables.**—The Committee examined some 24 specimens of returnable egg boxes (Fig. 7), and made a number of criticisms and suggestions which have been communicated to the manufacturers concerned.

PACKAGES FOR DRESSED POULTRY.

The difficulty encountered in any attempt to compare the unit cost of different types of poultry packages, both returnable and non-returnable, is the fact that a container will hold different numbers according to the class of bird, *i.e.*, fowl, duck, goose or turkey, and the size packed. For the purpose of the inquiry it was, however, considered sufficient to compare the cost of the packages to the packer per lb. of poultry carried per journey when used for fowls. It was assumed that any decision as to the relative merits of returnables and non-returnables for poultry would have to be based on general principles rather than on specific instances. The question of the different weights of the various packages and their effect on the cost of transport and thus on the cost to the packer was excluded as introducing too many confusing factors.

The packages to be considered were peds, hampers, wooden boxes, chip or veneer boxes, cardboard boxes.

Peds and hampers, on account of their cost, are returnable; wooden, chip and cardboard boxes can be manufactured at so

small a cost that their use as non-returnables is, *prima facie*, practicable.

(a) **Non-returnables.** *Comparative Costs.*—During the course of its investigation into the marketing of poultry, the Ministry obtained estimates from various firms for *wooden* boxes to hold one dozen fowls of the following weights per bird: 3 lb., 3½ lb., 4 lb., 5 lb. and 5½ lb. respectively. For assembled boxes, purchased in lots of 1,000, the lowest quotations were 8½d., 8¾d., 10d., 11d. and 1s. 0¼d. respectively, delivered London; this quotation was from a London firm. The same firm quoted for “sets” as follows: 6½d., 6¾d., 8d., 8¾d. and 10¾d. respectively. *Chip* or *veneer* boxes of the same capacities as the wooden boxes referred to above were quoted at 8½d., 9½d., 10¼d., 11d. and 1s. 1d. respectively, if purchased by the gross. Quotations for *cardboard* boxes of two kinds were received. The boxes are comparable with the wooden and chip boxes already referred to. The prices are 7d., 8d., 9d., 9½d. and 10d. and 4d., 4½d., 5d., 5½d. and 6¼d. respectively. The cheaper variety of cardboard boxes have wooden ends.

The following table compares the cost to the packer per lb. of poultry per journey of the three kinds of non-returnables:—

Boxes				Cost to packer	
				Cost of package	Total weight of birds carried* of package per lb. of poultry
				d.	lb. d.
Wooden (in sets)					
1	..	..	..	6.5	36 .18
2	..	..	..	6.75	42 .16
3	..	..	..	8.0	48 .17
4	..	..	..	8.75	60 .15
5	..	..	..	10.75	66 .16
Wooden (assembled)					
1	..	..	..	8.5	36 .24
2	..	..	..	8.75	42 .21
3	..	..	..	10.0	48 .21
4	..	..	..	11.0	60 .18
5	..	..	..	12.75	66 .19
Chip or veneer					
1	..	..	..	8.5	36 .24
2	..	..	..	9.5	42 .22
3	..	..	..	10.25	48 .21
4	..	..	..	11.0	60 .18
5	..	..	..	13.0	66 .20
Cardboard					
1	..	..	..	7.0	36 .19
2	..	..	..	8.0	42 .19
3	..	..	..	9.0	48 .19
4	..	..	..	9.5	60 .16
5	..	..	..	10.0	66 .15

Cardboard with wooden ends

1	..	..	..	4.0	36	.11
2	..	..	..	4.25	42	.10
3	..	..	..	5.0	48	.10
4	..	..	..	5.5	60	.09
5	..	..	..	6.25	66	.09

* One dozen per box.

From this it will be observed that the cost to the packer of packages of the non-returnable type is less than ½d. per lb. of poultry carried.

(b) **Returnables.** *Ped* (Fig. 8).—A “ped” holding 24 birds weighing 4 lb. each costs 8s. 9d. and weighs 15-16 lb. It is usually supplied by the producer or fatterer, who also bears the cost of the return journey. A “ped” is strongly made and capable of many journeys; taking into consideration losses and repairs, a fair estimate of the cost per journey is 2d., excluding transport. Peds are used exclusively for the trade in “Surreys” and are only found in the Heathfield district of Sussex. Of recent years the transport of poultry from that district has passed from the railway to motor-haulage contractors, who charge 1d. per bird per journey, including the return of the empty peds.

Hampers (Fig. 9).—Hampers are more widely used. There are many sizes of hamper, but, for the purpose of this Report, one holding 24 fowls of 4 lb. weight was taken; such a hamper weighs roughly 13 lb. and costs about 7s. 6d. The cost per journey, allowing a life of 50 journeys, would be about 2d. Hampers are still largely conveyed by rail. When empties are returned by special goods rate, the cost per cwt. for a journey of 50-100 miles is 1s. 2d., with a minimum charge of 8d. This means that, whereas eight empty hampers of the size and weight quoted above could be returned for 1s. 2d., or a little over 1½d. each, one empty hamper would cost 8d. Hampers are, however, usually returned two or three at a time, tied together, and an average cost per return journey for one empty hamper has been taken as 4d., which is possibly on the low side; an examination of a commission salesman’s invoices shows charges for the return of single hampers ranging from 7d. to 1s. 6d.

For the purpose of comparison, the cost of returning a “ped” by rail was taken as the same as that for a hamper. On this basis, the cost of a “ped” or hamper per lb. of poultry carried per journey, assuming 24 birds weighing 4 lb. each are carried, works out at .06d.

Comparative Cost of Returnables and Non-returnables.—The following table compares the cost per lb. of poultry per journey of non-returnables and returnables:—

	Cost per packer per lb. of poultry per journey*
Ped	d. -06
Hamper	-06
Wooden box (in sets)	-17
„ „ (assembled)	-21
Chip or veneer box	-21
Cardboard box	-19
Cardboard with wooden ends	-10

* It has been assumed that the packer bears the cost of the return journey.

From these figures, it is evident that, whilst the non-returnable is roughly three times as expensive as the returnable, its cost compared with the value of the poultry carried is low and should be no obstacle to its introduction, if necessary, in the interests of the home industry.

Non-returnables Recommended in Principle.—Passing from finance to other aspects of the problem, it was noted that salesmen on the wholesale markets show less enthusiasm for the idea that non-returnables should be used for English poultry than was evidenced as regards eggs. Apart from one or two districts, supplies of English poultry arrive on the wholesale markets in ungraded lots packed in hampers or large boxes, from which the buyer selects the birds suited to his particular requirements. This selection may entail considerable handling, which causes a loss of “bloom” and depreciates value; after the best buyers have taken their choice, the birds left over are sold at lower prices. Because of this loss of “bloom” and value, salesmen admit that the introduction of non-returnables would be a great advantage, but they fail to see how it would be practicable in the present state of the industry, when very few consignors of dressed poultry have sufficient birds available at any time to grade and pack in lots of one dozen closely graded birds which could be sold in the boxes as packed. The remedy of course lies with the industry itself, and it is suggested that conditioning and packing stations at which live birds could be assembled in large numbers from neighbouring farms and markets for conditioning, killing, plucking, dressing, grading and packing should be set up in areas of surplus production, either

by private enterprise or co-operatively. At these stations sufficient supplies would be handled to make uniform grading practicable, and, from the stations, the birds could be dispatched to the wholesale markets, neatly and effectively packed in one-dozen non-returnable boxes, bearing the brand of the station concerned. Suggestions as to the grades to be adopted have already been put forward by the Ministry* for the consideration of the industry.

Having regard, therefore, to the fact that imported poultry mostly arrives in non-returnable boxes holding one dozen birds, and is bought at sight, often without opening the boxes, certainly without handling the birds, the Committee had no hesitation in advocating the use of non-returnable packages whenever practicable for English supplies, although there may be comparatively few packers who can, as yet, use non-returnables to advantage.

The ped seems to serve its purpose for “Surrey” fowls in the Heathfield district, and will probably prove difficult to dislodge from its position. There is, however, no reason why wooden or chip boxes should not be substituted for the ped as the existing supply needs replacing. The number of birds of even size passing out of the hands of individual fatteners in the district affords an excellent opportunity for the introduction of standardized boxes in this part of England.

Types of Non-returnables Recommended.—As stated above, four types were available for consideration. The Committee rejected the cardboard containers on the ground that, if they got wet during transit, their appearance would prejudice sales and the contents might become tainted. On the other hand, the use of both chip and wooden boxes was recommended (Fig. 10). The chip container is pleasing to the eye and has important possibilities, especially for those who wish to give a distinctive appearance to their consignments.

The decision to recommend the use of chip and wooden boxes holding one dozen birds has been endorsed by salesmen on the wholesale markets of London and Manchester, and it is believed that the introduction of these packages would be favourably received throughout the country. The London Wholesale Poultry and Game Salesmen's Association recently passed the following resolution:—

That this council is in favour of the use of non-returnable cases for the packing of home-produced poultry, recognizing saving of expense and trouble by the use of such cases, and is

* *Marketing of Poultry* (Economic Series, No. 11).

prepared to recommend the adoption of same to its members. The council gives preference to chip boxes.

These chip and wooden boxes would require to be made in sizes suitable for packing one dozen birds of weights varying from $\frac{1}{2}$ lb. to 7 lb., in the case of fowls, and greater weights in the case of other poultry; the Committee recommended that the Ministry of Agriculture and Fisheries should take the opportunity of ascertaining the approximate sizes required when more varied supplies of poultry are on the market than were available at the time of the Committee's inquiry.

The wooden boxes would require to be of the lightest possible construction compatible with strength, and to be prepared from low-priced material; they should be made with spaces of about 1 in. between the boards on the top and bottom. The boxes would, as a rule, be put together by the poultry-keeper or merchant, who would buy the "sets" in bulk.

When naturally cooled poultry is packed in chip or wooden non-returnables, the birds should be wrapped in unglazed paper; for chilled poultry the packages should be lined with straw or other insulating material. If the packing station idea develops, the paper used for the wrapping of each bird could bear the trade-mark of the packing station and, possibly, in due course an area trade-mark and a distinctive mark indicating British goods.

APPENDIX: NON-RETURNABLE EGG BOXES.

(1) 30-DOZEN (FILLERS AND FLATS.)

(To hold 360 eggs weighing $15\frac{1}{2}$ lb. per 120.*)

Description.—The case should be made in two compartments, each compartment to take 180 eggs packed in fillers, with flats between the fillers. The wood should be well seasoned, clean, dry, and free from bark, wane, feather, large knots or pronounced odour.

Internal Dimensions			Timber Dimensions (To be not less than)				Fillers	
Each compartment			Top, bottom and side boards		End and centre boards		Each division to be	
Length	Width	Depth	Wide	Thick	Wide	Thick	Deep	Square
$11\frac{1}{2}$ in.	$11\frac{1}{2}$ in.	$13\frac{1}{2}$ in.	3 in.	$\frac{1}{4}$ in.	3 in.	$\frac{7}{8}$ in.	$2\frac{1}{2}$ in.	$1\frac{1}{2}$ in.

* For eggs weighing 17 lb. per 120 a case would be required of the same general dimensions as those set out for $15\frac{1}{2}$ -lb. eggs, but having each compartment $12\frac{1}{2}$ in. square instead of $11\frac{1}{2}$ in.; the depth would be the same as the ordinary case, i.e., $13\frac{1}{2}$ in. Fillers with each compartment $1\frac{1}{2}$ in. square would be necessary; they should be $2\frac{1}{2}$ in. deep and not exceed $12\frac{1}{2}$ in. over all. These cases and fillers would be suitable for duck eggs.

Ends.—Each end should be not less than $13\frac{1}{2}$ in. $\times$ $11\frac{1}{2}$ in. $\times$ $\frac{7}{8}$ in. If made of two or more boards, the boards should be fixed upright; no end board should be less than 3 in. wide. The end boards should be nailed to cross battens measuring not less than $12\frac{1}{2}$ in. $\times$ 2 in. $\times$ $\frac{7}{8}$ in., two on each end, fixed externally, one across the bottom of the end boards and the other as close to the tops of the end boards as the construction of the lid permits. The battens should be flush with the outer sides of the side boards.

Centre Division.—Each board should be not less than $13\frac{1}{2}$ in. $\times$ $11\frac{1}{2}$ in. $\times$ $\frac{7}{8}$ in. The division should be fixed in the centre of the case, secured by nails driven through the side and bottom boards.

Sides, Tops and Bottoms.—Each board should be not less than $\frac{1}{4}$ in. thick and not less than 3 in. wide.

Spacing.—The spacing between any two adjoining boards throughout the case should nowhere exceed $\frac{1}{2}$ in. When spacing is provided between any two side boards, it should be arranged so as to prevent any of the flats working through and the eggs coming in contact.

Nails and Nailing.—It is recommended that cement-coated wire nails be used; as far as possible nails should be driven askew the grain of the wood. Not less than two nails should be used in each end of each board, with an additional nail at each end of a board for every 3 in., or part of 3 in., by which the board exceeds 5 in. in width. The nails for making up this case should not be less than $1\frac{1}{2}$ in. of 14 gauge.

Fillers.—The fillers should be of suitable material $2\frac{1}{2}$ in. in depth; the extreme width of a filler should not exceed $11\frac{1}{2}$ in. A flat of the same material should be placed between each filler, and a layer of corrugated paper or felt should be placed underneath each lowest, and above each uppermost, filler.

(2) 60-DOZEN (WOOD-WOOL).*

(To hold 720 eggs weighing not more than $17\frac{1}{2}$ lb. per 120.)

Description.—The case should be made in two compartments. The ends and sides of the case should consist of two boards spaced horizontally; it should also have eight angle posts. The wood should be well seasoned, clean, dry, and free from bark, wane, feather, large knots or pronounced odour.

Internal Dimensions			Timber Dimensions (To be not less than)						
Each compartment			Top and bottom boards		Side boards		End and centre boards		Corner angle posts
Length	Width	Depth	Wide	Thick	Wide	Thick	Wide	Thick	
26 in.	23 in.	8 in.	4 in.	$\frac{3}{8}$ in.	3 in.	$\frac{3}{8}$ in.	3 in.	$\frac{1}{2}$ in.	2 in. sq., cut dia- gonally†

* A 30-dozen (wood-wool) case would be of the same general dimensions as the 60-dozen, but would have only one compartment.

† Square-cut corner posts should not be used.

The spacing between any two adjoining top, bottom, side and end boards should nowhere exceed 1 in. ; a saw space not exceeding $\frac{1}{4}$ in. should be provided between centre division boards.

Ends and Centre Divisions.—The case should have two centre divisions, each consisting of two boards ; no board should be less than 23 in. $\times$ 3 in. $\times$ $\frac{3}{4}$ in. If end boards of greater thickness than $\frac{3}{4}$ in. are used, care should be taken to ensure that the internal length of each compartment is not less than 26 in.

Sides.—The side boards should be of the full outside length of the case, not less than 3 in. wide and $\frac{3}{4}$ in. thick. They should be so fixed that the top edges of the upper boards, and the bottom edges of the lower boards, will be level with the top and bottom edges respectively of the end boards.

Tops and Bottoms.—Top and bottom boards should be not less than 4 in. wide and $\frac{3}{4}$ in. thick. The outer edges of the outside top boards and bottom boards, when nailed on, should be flush with the outer sides of the side boards. The top and bottom boards should be of the full outside length of the case, and nailed into the end boards.

Nails and Nailing.—It is recommended that cement-coated wire nails be used ; so far as possible nails should be driven askew the grain of the wood. They should be of sizes not less than the following :—

For nailing sides to ends and tops and bottoms to ends and centre division boards 2 in. and 1 $\frac{1}{2}$ in. nails respectively of 13 gauge ;

For nailing corner posts to ends and sides to corner posts 1 $\frac{1}{2}$ in. nails of 14 gauge.

Not less than two nails should be used in each end of each board, with an additional nail at each end of a board for every 3 in., or part of 3 in., by which the board exceeds 5 in. in width. This also applies to the nailing of the centre division boards. Each end of each side board should be secured by at least two nails driven into the end boards and at least one nail driven into the corner post. In nailing top and bottom boards to centre division boards, care should be exercised to place the nails in rows with at least $\frac{3}{4}$ in. space between the rows so as to allow for the free working of a saw when the case is being divided.

Wood-wool.—Six pounds of wood-wool should be used for each 30 dozen eggs in a case ; it should be evenly spread between each layer of eggs and at the bottom, top, sides, and ends of the case in sufficient thickness to prevent any layer of eggs moving in the ordinary course of transit. Only white wood-wool not less than $\frac{1}{4}$ in. in calibre should be used.

N.B.—A list of box-makers who have signified their readiness to supply non-returnable egg and poultry packages of the dimensions recommended by the Committee can be obtained from the Ministry on application.

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HERBAGE SEED PRODUCTION IN NEW ZEALAND: I—WHITE CLOVER

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IN the arable-grass farming of New Zealand, the harvesting of seed crops takes a prominent place in the rotation ; these crops, moreover, constitute a very important cash-producing commodity which adds materially to the earning capacity of the farm.

In addition to perennial rye-grass, crested dogstail, cocksfoot and red clover,* which have long been harvested in New Zealand, primarily for use in that country and for export to Australia and to Europe, in recent years, white clover, lucerne and, to a less extent, *Lotus hispidus* and *Lotus major* have become quite important seed crops.

Distribution.—It is only in comparatively recent years that white clover has been extensively used in the seeds mixtures employed in New Zealand. The seed would, however, have been introduced into the country in the earliest days, partially as an impurity in the rye-grasses and red clovers and other seeds, including cleanings and tailings, advisedly used by the earliest settlers, and later, of set purpose, in some of the mixtures. To-day, white clover has become firmly established over wide areas. It behaves in a precisely similar manner as in this country—just like an indigenous plant in fact. It occurs freely on many of the best pastures ; it volunteers abundantly on the temporary leys and has made an unsown entry on to the native tussock grasslands, especially where these abut on tended grasslands and are grazed by animals having access now to the tended and now to the natural grasslands.

Seed Production in Relation to Habitat.—The white clover crop from which seed is harvested in New Zealand is almost invariably a volunteer crop, that is to say, the seed is not deliberately sown for the purpose of producing a saleable crop. Speaking broadly, the crop arises in one of three ways : (1) By excessive and immediate colonization on a wheat, barley, oat, or pea stubble ; seed harvested from such a plant is known as "stubble white clover." (2) By colonization on a rye-grass-red clover ley, when by a third or fourth

* Chewing's fescue and brown top (*Agrostis vulgaris*) are also largely harvested in New Zealand ; these two species are, however, chiefly exported for lawn purposes.

harvest year the ley may consist predominantly of white clover. A crop of seed may be taken as early as the fourth harvest year or, exceptionally, in the third harvest year, and, if leys are left standing, white clover may be harvested when the ley is anything up to, or even exceeding, 10 years old. (3) By colonization either on prepared grasslands that are left permanently to grass or on natural grasslands. Seed harvested from the former swards may be taken from fields that have been down to grass for upwards of 20 years and, in extreme cases, for upwards of 30 years; while from the latter the original colonization may have commenced five, 10, 20, or even more years ago.

Stubble White Clover.—Most of the stubble white is harvested in the Canterbury and Marlborough districts. In the latter district, the rapidity and completeness with which it dominates the stubble, after the corn harvest, is a remarkable and noteworthy phenomenon.

It would appear as if the seed does not germinate to any very considerable extent until the corn is harvested. The autumnal conditions are, however, very favourable to germination and establishment—so, in effect, this may be regarded as an autumn-sown crop from which seed is harvested in the following (= the first harvest) year.

The fields are usually shut up in October (spring) and a seed harvest is taken in December; it is not an unusual practice for the fields again to be shut up and a second crop of seed taken in March. Stubble crops have been known to yield as much as 600 lb. per acre, and 400 lb. is usually expected; a second crop will be about half of a first crop. The crop is cut with a reaper to which a metal follower is attached, from which a man rakes off the produce. This is immediately horse-raked into wind rows. The crop is normally not again handled, and may be carried within a week of cutting. If rain intervenes, the wind rows are lightly turned and, when sufficiently dried, the crop is carried.

The stubble crops are, usually, decidedly pure, being far freer from suckling clover than the sward crops, and yield seed of good colour and size and of high germinating capacity. After a crop has been harvested, and particularly if two crops have been harvested in the same year, the white clover usually gives place to suckling clover, a plant which has become even more strongly secondarily indigenous and aggressive in New Zealand than white clover itself. If, however, the land is top-dressed with superphosphate and well harrowed

immediately after the seed harvest, the white clover can be retained in good amount for a second harvest year, and this is a practice which is now adopted by some of the chief growers.

Temporary Ley White.—The crop is usually handled in a similar manner to the stubble crops, the seed being most generally harvested in the fourth to seventh harvest years. The yield may amount to about 330 lb. per acre. After a harvest, unless the ley is well top-dressed and harrowed as on the stubbles, the white clover tends to give place to suckling clover.

Old Sward White.—This is now not infrequently harvested with a stripper with special small chain beaters which “gather” the closely growing heads. Much of the seed off the older swards and the more natural grasslands, tends to be of a somewhat brown colour and not of attractive appearance, and this fact has undoubtedly reacted against the seed from the oldest swards contributing largely to the lots exported to this country. The value of seed from the older swards is, however, coming to be more generally realized in New Zealand, both for use in that country and for export; and considerable developments are to be anticipated in the direction of making greater use of this valuable source of supply of the best strains of white clover.

The average yield per acre of white clover, derived from all sources even for the most favoured districts, seldom exceeds about 250 lb., while it frequently does not exceed about 130 lb. for the country as a whole.

Marketing Practices.—In view of the fact that viability and purity are important characteristics of seeds, especially for export trade, it is not unnatural that bulking is largely adopted in New Zealand. It follows, since stubble white is usually a fine bold seed of high viability and relatively free from suckling clover, that this particular type very largely contributes to such consignments of white clover as are exported to this country. It is, of course, perfectly right and proper that suckling clover (which is cheap and of less value than white clover) should be regarded as a serious impurity in white clover. It is, however, to say the least of it, unfortunate, for reasons that will be emphasized in the next section, that this fact tends to favour stubble white and handicap sward white in connexion with the export trade to this country.

The white clover seed crop amounted to about 388 tons in 1922-23, and to about 218 tons in 1924-25. In 1925 about 32 tons were exported—in the proportion of about one-third to Australia and two-thirds to the United Kingdom; it is probable, however, that an appreciable amount of that reaching this country was re-exported.

Characteristics and Agricultural Usefulness.—An examination of old swards (10 years and upwards) in New Zealand indicates that much of the white clover approaches very closely in characteristics to the indigenous wild white of this country, although, on many pastures, the plants are not quite so dense and appear to be larger-leaved. Having regard to the mixed nature of white clover in respect of strain, and the effect of selective influences on restricting the types which colonize habitats, long-treated in any particular manner, this is, of course, what would be expected.* It would presumably be the more perennial and closer-growing strains which would persist on the older grasslands and, consequently, when white clover is harvested from the older leys and from the older swards in New Zealand, just as in this country, the seed would tend prominently to represent those strains which approximate in character most closely to the properties we have come to associate with the trade designation "Wild White Clover."

"Stubble" white, however, is harvested under conditions which tend inevitably to select the quicker-growing, shorter-lived strains. To "sow" in the autumn and to take a crop of seed the following year represents a very short period for establishment and growth, favourable only to the quick-growing strains. To take a second crop in the same year is further to select those strains which can pick up and grow very quickly—to select, that is to say, from a mixed population, types which predominantly consist of plants having, in the main, the characteristics which we have come to associate with "Commercial White Dutch."†

* It is significant in this connexion to observe that in samples of white Dutch clover, plants with the characters of wild white are frequently to be found, while in samples of the oldest sward wild white, plants with the characteristics of white Dutch are not infrequently met with. Adams in her studies on white clover has also remarked upon this phenomenon (see Adams, F. M. J., "Some Observations on White Clover." *Ann. App. Biol.*, Vol. XIII, 3, 1926)

† The truth of the above generalisation will be strikingly supported in a subsequent article dealing with perennial rye-grass, which in New Zealand is sown in the autumn in certain districts and in the spring

It has been realized in this country that much of the white clover emanating from New Zealand does, in fact, behave in a manner approximating far more closely to wild white clover than to white Dutch. The various commercial lots, however, behave very differently, an appreciable number giving results almost indistinguishable from those of ordinary commercial white Dutch.

Trials in Wales.—Trials conducted at the Welsh Plant Breeding Station are interesting in this connexion, for they give a measure of the degree of variability of New Zealand white clover, and afford material for estimating the value of the best New Zealand lots compared with genuine Kentish wild white.

Briefly stated, the results so far obtained are as follows:—

Trials, 1920-21.—Fourteen New Zealand lots were tested. A few of the lots gave drills nearly as dense as wild white. In most cases, the plants were rather more straggling and with larger leaves, and these in some cases were higher yielding than wild white. A few lots resembled very closely the Lodino white. The wild white and New Zealand lots gave the highest positive reaction to the cyanophoric test.

Trials, 1924-26.—Two New Zealand lots were tested in field plots against one commercial white Dutch, a wild white and a wild white once grown. The forage yields of white clover in lb. per acre for the two harvest years together were as follows:—

Wild white	Wild white once grown	White Dutch	New Zealand (1)	New Zealand (2)
2,890	2,890	1,410	2,660	1,630

At all stages, the once grown wild white was indistinguishable from the old sward wild white, while at all stages the white Dutch and New Zealand (2) were practically indistinguishable, neither plot giving a good sward of white clover. The New Zealand (1) made a dense sward, the plants, however, being somewhat larger-leaved than wild white and somewhat more lax. The productivity was at all times high.

Trials, 1926-27.—Four New Zealand lots, four wild whites and two white Dutch were sown in drills and in field plots

in other districts. All the researches in progress at Aberystwyth relative to "ecotypes" and "ecotypical" selection conclusively prove, moreover, that the longer-lived and persistent strains of all herbage species are those which grow slowly and "pick up" slowly.

in 1926. The density and amount of growth and size of leaves were estimated in April, 1927. The results were as follows:—

	Density	Amount of	Size of leaves
	Max. 10	growth	
		Max. 10	
Wild white	8.9	4.5	Small
Commercial Dutch	1.5	1.5	Large
New Zealand	7.4	6.7	Intermediate

The New Zealand lots differed amongst themselves, one lot in particular having comparatively small leaves and, in every respect, more closely resembling wild white than did the other three lots. It is to be noted that the average results for the four lots resembled much more closely the behaviour of wild white than of commercial white Dutch.

Trials in New Zealand.—Mr. Deem, Agricultural Instructor for the Taranaki district, has experimented extensively with white clover, and the writer had the opportunity of examining some of his plots. At Waverley, a field had been sown eight years ago with a mixture including 3 lb. of Kentish wild white clover; the sward was a remarkable one and a dense mat of clover. At Marton, Mr. Deem had large plots sown respectively with Kentish wild white, Kentish wild white once grown in the Marlborough district of New Zealand, old sward Canterbury white, and ordinary white Dutch. The poorness of the white Dutch was in marked contrast to the other three plots. There was no apparent difference between the “once grown” Kentish and that direct from Kent, but these two plots were probably slightly superior to Canterbury white, the difference, however, not being very striking or material. There was, however, a higher proportion of larger-leaved plants on the Canterbury plots than on the wild white plots.

Taking the evidence from the Welsh trials and from those of Mr. Deem together, it would appear that, for the formation of a dense and lasting sward, the genuine British wild white is a superior (and in Britain quite definitely superior) product to the best New Zealand white; but that the best New Zealand white, although having larger leaves, does, in fact, approximate very appreciably to the more important characteristics of our genuine wild white clover. The Welsh trials also show conclusively that the poorest of the New Zealand lots reaching this country are in effect nothing but ordinary commercial white Dutch.

General Recommendations.—The evidence brought forward in this article shows that the state of affairs relative to New

Zealand white clover is less satisfactory than could be wished; this is the more unfortunate since a large proportion of the New Zealand harvest represents a product of the greatest possible usefulness.

It would be a great advantage if the New Zealand growers and exporters would categorize the seed and not blend “stubble” with sward lots. Those in this country who offer New Zealand white clover to the farmer—and those farmers who sow New Zealand seed are looking for the longer lived strains—are looking in fact for a seed which will, to some extent, take the place of wild white clover. This is obvious indeed from the price ruling for New Zealand white clover, which always stands considerably higher than ordinary White Dutch. It follows, therefore, that, as long as New Zealand clover is marketed merely as “Colonial” or New Zealand white, our importers should, as a precaution, and at all events until abundant evidence pointing in a contrary direction has been collected, insist on a guarantee that the seed is “sward” white and, of course, the older the sward the better. “Stubble white” may, of course, be presumed to have a value and a usefulness just for those purposes for which commercial white Dutch has a value and a usefulness, and in some cases may consist of a good proportion of relatively long-lived strains, but this seed coming on to our market without qualification, and at the same high price as old sward white, introduces a serious element of uncertainty, and tends to bring New Zealand white clover into disrepute with our farmers.

The whole position is intimately connected with suckling clover, for, as has been shown, it is the seed from the older swards (and therefore the most desirable seed) which contains the most suckling clover. The presence of suckling clover in fair amount is therefore an index of the desirability of a sample. It is unfortunate that the provision in the Seeds Act, demanding the declaration of suckling clover in white clover, has been largely misunderstood by practical men. There is no implication that suckling clover is an injurious weed seed, or that it is harmful—it is merely of less value than white clover and, as such, affects the legitimate price of the seed; consequently the purchaser in his own interests needs to be informed of the amount present. The amount should, however, be considered not only as such but as a valuable index of the reliability of the sample for sward formation.

The germination figure should also be considered in the

light of the fact that, generally speaking, old sward white clover is of a somewhat brown appearance and consequently has not such a good viability as stubble white or as ordinary White Dutch: reasonably good germination (upwards of 80 per cent.) should therefore be deemed quite satisfactory.

As matters stand at present, farmers purchasing New Zealand white clover usually do so entirely in the dark; they may be giving up to 6s. per lb. for an article only equal in value to White Dutch (about 2s. 6d.) or they may be acquiring seed approximating more closely to the value (12s. 6d.) of wild white. Despite the results of tests, and the undoubted value of the best New Zealand white clover, it must be emphasized that disappointment will frequently follow the use of this seed. It is much to be desired therefore that those who are interested in the sale of this important and valuable product will take the necessary steps to put the marketing of the seed on a really satisfactory pedigree basis, supported by properly authenticated tests as to the genuineness and reliability of the strains. It cannot be assumed that all old sward white clover from New Zealand necessarily and always has the desired properties of persistency and longevity, and it is, therefore, important that seed collected from characteristic districts should be subjected, along with stubble white harvested under different conditions, to thorough test both in this country and in the Dominion.

Thanks are due to Captain Williams, M.Sc., and to Mr. Wm. Davies, M.Sc., for particulars and data relative to the Aberystwyth trials with white clover.

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CORRIEDALE SHEEP IN GREAT BRITAIN

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History and Description of the Corriedale Breed.—The idea of crosses between long-woolled sheep and Merinos was not new when the original experiments which led to the foundation of the Corriedale breed were conducted in New Zealand about 60 years ago. At first, there was considerable antipathy to the development of a type of sheep which would provide simultaneously good wool and good mutton, but it was soon recognized that there were distinct possibilities in the breeding of Romney Marsh-Merino cross-breds. In 1878, the flock, which had been founded about 10 years previously by selection of

breeding stock from this cross, was dispersed, but this and the following decades saw the beginning of a series of similar experiments involving the use of long-woolled breeds other than the Romney Marsh. The most popular breed was the Lincoln, but English Leicester, Border Leicester, and Romney Marsh rams were used on Merino ewes in some of the original flocks with the idea of reaching a type of sheep which would be hardy, would produce a heavy fleece of good wool, and, at the same time, provide a useful lamb for fattening purposes. Rigorous selection was practised in all the flocks, the succeeding generations being inbred, and only in some cases was blood introduced from crosses other than the original. A record of the experiments was begun in 1903, and in 1916 flocks were accepted for registration by the New Zealand Sheepbreeders' Association on the condition that the flocks should be the progeny of 15 years' continued inbreeding of the half-bred stock of Merinos and any pure breed of long-wool. The desired type has since been carefully selected and drastic culling enforced by inspection, with the result that a considerable uniformity of type has been attained.

The chief consideration has been the dual-purpose utility of the required type so that the general body conformation of Corriedale sheep to-day is essentially that of a typical mutton breed in that the shoulders and brisket are wide and deep, the ribs well sprung and filling up well behind the shoulders; a level back with a broad loin and the thighs deep with gigots of good form. The legs are straight, set square on the body, with good bone of moderate length; the head is broad, hornless, and carried on a well-developed neck. The fleece extends to cover the legs and to give a pronounced woolly topknot on the head; over the body the fleece is very dense and evenly distributed, yielding a large proportion of 56's wool. The crimp is very definite and even throughout the length of the staples.

Corriedales in Great Britain.—Corriedale sheep were shown in this country at the Wembley Exhibition, and at the close of the exhibition the two rams and three ewes, born in September-October, 1924, were acquired by Mr. James Piper, of The Grange, Burntisland, Fife, who was also negotiating for the shipment of a number of Corriedales to this country for the purpose of conducting experiments on wool improvement. These sheep, 10 rams and 20 ewes, born in September-October, 1925, were released from quarantine in the beginning of July, 1926, and the writer wishes to express here his most

grateful appreciation of the very complete facilities which are being afforded by Mr. Piper for the full observation of his flock by the Animal Breeding Research Department.

The Wembley Exhibition sheep were unshorn on their arrival in Fife in October, 1925, but were partially clipped then; the fleece was about $5\frac{1}{2}$ -6 in. in length, and, of this, about 4 in. were removed preparatory to placing the sheep under their winter conditions. It is the policy to test sheep under precisely similar conditions of management to those under which the commercial flock exists, but for about 10 days after this partial shearing the sheep were housed at night and afterwards allowed the free run of a small field, with the use of a shed if desired. Later, the sheep were on the hill, running up to 700 feet and much exposed. Extra food in the form of a few turnips was given. The winter was particularly bad with much changeable weather, and at one time the sheep had to be dug out of snowdrifts, but they stood the climate remarkably well.

The ewes were lambed down in a sheltered paddock, and the first lamb to be born, on April 5, 1926, was a pure Corriedale. This lamb was carefully examined and a photograph (Plate I) taken on April 15. A close study of the types of lambs' coats is important in all sheep-breeding work, and it was found that the pure Corriedale lamb possesses a dense, fine coat of great uniformity over the surface of the neck and body. Regularly disposed throughout the fine coat are numbers of coarser kempy fibres such as occur in the coats of the lambs of many breeds of sheep, and which may persist or may be completely shed as in the Merino. In the early stages of the lamb's post-natal existence, these fibres constitute a coat which is of great value in providing resistance to the weather, and, as such, are of considerable survival value and economic importance. These fibres increase markedly in relative numbers on the legs, and exist also on the head, but, while the general appearance, particularly of the legs, is hairy, the fine woolly undercoat which is in evidence later is well developed. In the Corriedale, this kempy protective coat is rapidly shed, leaving a dense, uniform fleece of excellent quality extending well over the head and legs. In all, three pure Corriedale lambs have been obtained from the three Corriedale ewes; these lambs are of an excellent type, well boned, standing square, with good shoulders and well-sprung ribs.

As yet, there has been no opportunity of examining closely Corriedale wool grown under natural conditions in this country.

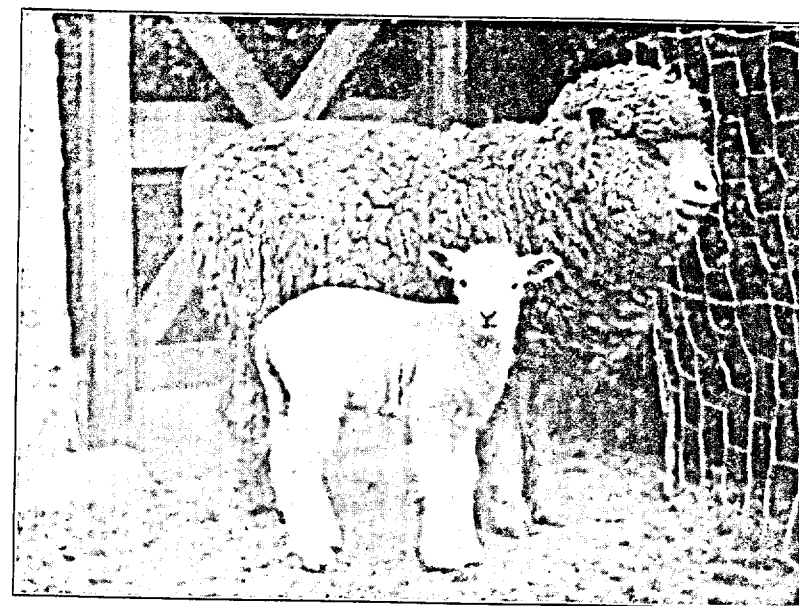


FIG. 1.—Corriedale Ewe and lamb.

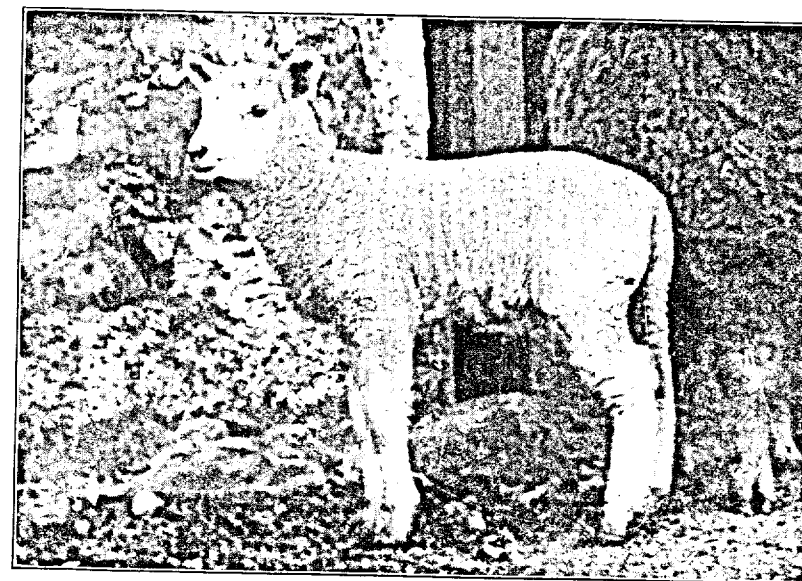


FIG. 2.—Corriedale and Cheviot lamb.

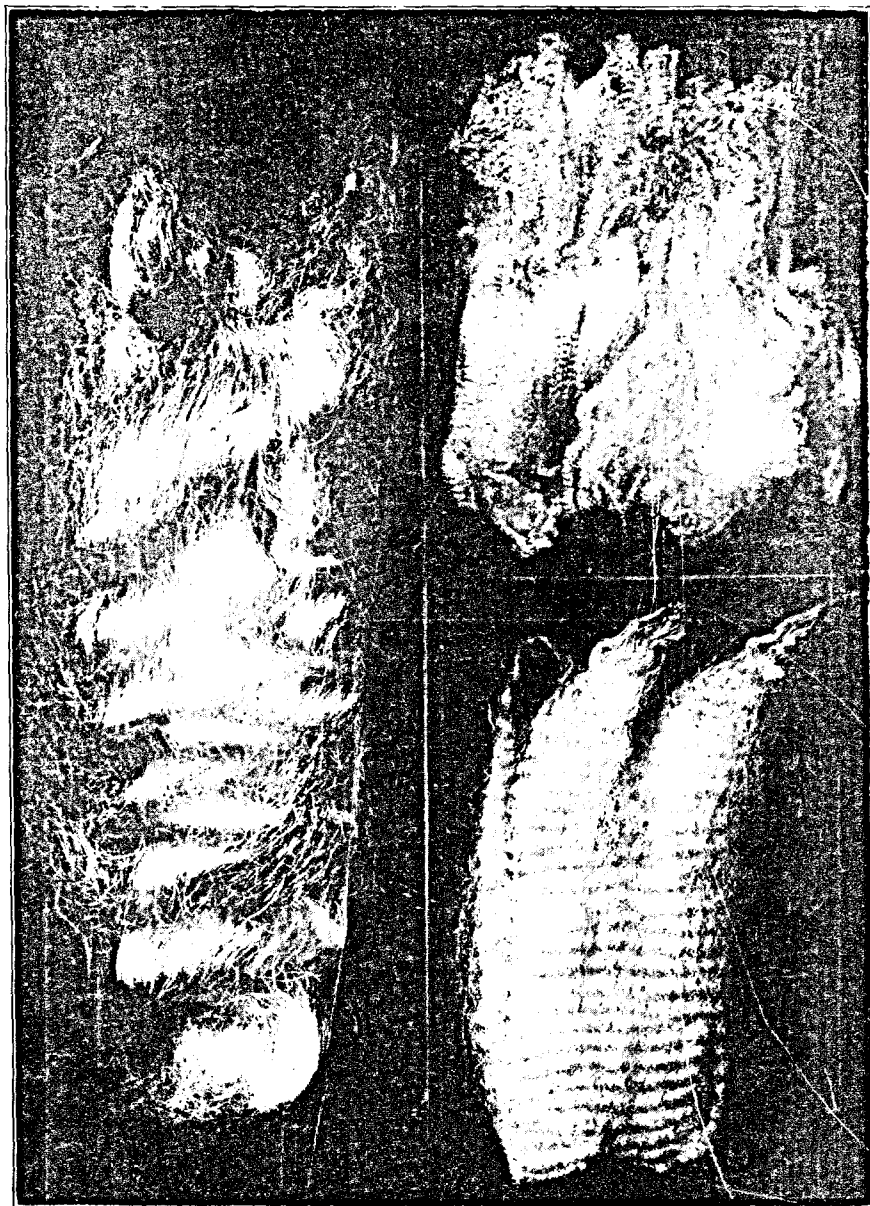


FIG. 3.—Lincoln. 36s.

EXAMPLES OF STAPLES.

FIG. 4.—Merino. 66s.

,, 5.—Corriedale Lamb: 8 months fleece.

Reproduction $\times 1$.

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The fleeces of the sheep exhibited at Wembley had been considerably mutilated by constant handling, and the sheep newly imported were subjected to much immersion by sea water during a stormy Channel passage, followed by 28 days' close confinement in quarantine; these latter sheep have, notwithstanding these unfavourable experiences, clipped fleeces of $5\frac{1}{2}$ in. for about eight months' growth, and averaging 9 lb. for the rams and $9\frac{1}{4}$ lb. for the ewes. The wool is of good quality (New Zealand Corriedale fleeces contain a good proportion of 56's quality, ranging to 46's on the britch), very elastic, and the fleece is of great density throughout, the uniform compactness of the fleece being preserved by a regular network of binding fibres traversing the staples, together with an exceedingly regular crimp, which is well defined throughout the complete length of the staples. Plate II shows typical staples from the imported sheep compared with Lincoln and Merino staples.

When shorn, the sheep display their excellent mutton type, being squarely built and handling well; in the clipped condition, it can be seen that the fleece tends to split up along definite cleavage lines into irregular polygonal-shaped staples such as are typical of the Merino. This stapling is peculiar to very dense fine-woolled sheep and can serve as a useful indication of these characters.

Crosses with other Breeds.—The intention is primarily to examine the possibilities of the Corriedale as a pure breed, and, as such, the experiment here outlined is well worthy of serious attention and consideration by all sheepbreeders; but the rams were also allowed to run with a number of ewes of various sorts, and a description of the cross-bred lambs is of interest, particularly when it is realized that observation of the behaviour of pure breeds in crosses is of great use in assessing the value of the pure-bred itself so far as mutton-producing qualities are concerned.

The cross lambs were examined on June 25, 1926, being then on the average 6 to 8 weeks old; by the Corriedale ram 5 North Country Cheviot ewes had produced 6 lambs; 10 Border Leicester $\times$ Cheviot (half-bred) gimmers, 11 lambs; 1 Border Leicester $\times$ Cheviot ewe, 2 lambs; 5 Dorset Horn ewe lambs, 5 lambs; and 22 Border Leicester $\times$ Blackface ewes, 37 lambs. The lambs were all of good mutton type with well-developed gigots, and, while the Dorset Horn cross lambs appeared small owing to their being the offspring of ewe lambs, they were particularly promising as mutton sheep.

It is proposed to keep all the lambs until their first shearing, since the experiment is primarily concerned with wool characters.

In the Cheviot cross, there are distinct traces of the neck folds—a character of the Corriedale derived from the marked folds of the Merino. The fleece extends farther down the legs than in the pure Cheviot and a woolly forelock is more or less developed. All the lambs showed traces of the kempy outer coat still persisting, and while, in general, the individual coats were fairly uniform over the whole body, in some cases a distinct kempiness was noticeable, particularly in the lower thigh region. In these cases, the crimp was not at all well defined throughout the fleece, but, on the whole, a fine crimp appears typical of this cross, although the crimp is not so definite or regular as in either the Corriedale or the Cheviot. The natal spiral formation of the locks was distinct, the spirals being small and close, while, in general appearance, the coat showed certain indications of the peculiar Merino type of stapling to which reference has been made. Compared with the Corriedale × Cheviot cross, the half-bred cross lambs have a slightly better developed woolly forelock, a very uniform coat with fine wool well down the legs, and a typical Corriedale crimp.

The lambs from the Border Leicester × Blackface ewes by the Corriedale ram are interesting in that, while the coat is coarser than in the other crosses, with considerable hairiness on the thighs, there is a well-defined Merino type crimp throughout the uniformly dense coat. This crimp is particularly well marked on the shoulder, and there is distinct improvement on the normal Border Leicester × Blackface fleece.

The Dorset Horn cross lambs are the most interesting in many ways. On casual inspection, it is noticeable that the neck folds are here as well developed as in the pure Corriedale, if not more so, and the close, dense coat presents also the appearance of the Merino stapling. Since both these characters are peculiar to the Merino, it would appear that there is, in this cross, some considerable evidence in favour of the view, which has not been disproved by records, that there are traces of Merino blood in the present-day Dorset Horn breed. While the coat has a distinct similarity to that of typical Down lambs, the crimp is not well defined. The head and legs are well covered with fine wool; slight scurs were found on some of the lambs.

As judged by the lambs' coats, it would appear that the Corriedale can contribute towards improvement of wool characters; the hardness of the newly born lamb, as evidenced by the presence of the protective kempy coat, is not interfered with, since the Corriedale itself possesses traces of such a coat, and any tendency towards shedding this as the lamb grows—a desirable character of economic importance—is preserved. While in some cases, as in the Corriedale-Border Leicester × Blackface cross, there may be a reduction in amount and coarseness of this protective layer, such reduction would appear to be amply compensated for by the facts of increased density of the fleece and of well-marked natal spirals with a more definite crimp, resulting in a more compact coat, which is, in effect, a better protection against adverse climatic conditions than a longer and more open hairy coat.

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CHARACTERS WHICH DETERMINE THE ECONOMIC VALUE OF GRASSES

IV. PERSISTENCY AND AGGRESSIVENESS

(Conclusion.)

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WITH reference to all but the shortest duration leys, a fundamental property for a herbage grass is to be persistent and aggressive—to hold the ground well and to compete successfully against undesirable plants.

Persistency depends on the ability of individual plants to become long-lived perennials despite the influences of the environmental factors—biotic, soil and climate—as a whole. Aggressiveness implies an ability to spread and win more and more ground at the expense of other species.

Aggressiveness.—A plant can only be highly aggressive if it has either the power of spreading by the development of runners, root stocks or suckers, or of freely setting seed and developing established seedlings despite the methods of management. The great majority of our valuable herbage grasses are not creeping plants, consequently, in the case of most species, the individual plants are necessarily “spot bound.” Within certain limits, however, “spot bound” plants can be aggressive, inasmuch as the area covered by each plant will be large in proportion to the amount of tillering. Plants, like perennial rye-grass and cocksfoot, may, however, be relatively aggressive compared with other plants if, as a

result of a higher persistency, they can withstand the conditions better, and hold their own against truly aggressive competitors.

Vegetative Aggressiveness.—Wild white clover is the outstanding example of a highly valuable pasture plant capable of winning ground by vegetative means—the development of runners. Many of the bent grasses and smooth-stalked meadow grass are aggressive by the same means. Unfortunately, however, in this country these latter species do not rank high as pasture plants. The same is true of the creeping red fescues. The strains of meadow foxtail vary considerably in their capacity for creeping, but even the best cannot compare with some of the bents in this respect.

Seeding Aggressiveness.—The extent to which pasture plants maintain themselves on the oldest permanent swards, by seeding and the production of seedlings, is an exceedingly important problem which has never received the critical study it deserves. That the great majority of plants are aggressive, at least to some extent, by this means can hardly be doubted. Critical herbage analyses, by the method of teasing out the plants from selected turves, frequently show the presence of a very considerable number of seedlings. Italian rye-grass, rough-stalked meadow grass, timothy (particularly in a cereal crop) and wild white clover, for example, are not infrequent arable land weeds, and following soon after sward afford evidence of seeding. The early unsown entry of wild white clover, rough-stalked meadow grass and crested dogtail, on swards in many districts, is again evidence of abundant seeding in a previous sward. That seedlings can establish themselves in very considerable quantities on swards is shown, for example, by the manner in which Yorkshire fog and yellow rattle become exceedingly aggressive on meadows which, year after year, are cut rather late for hay. Perhaps an almost better example is the annual yellow suckling clover which, in some districts, is an important element in the herbage even on comparatively dense swards. The aggressiveness of annual plants is purely a matter of ability to produce an abundance of seed, a fair proportion of which will develop seedlings.* Annuals, as aggressive pasture plants, assume very great importance in dry and relatively dry regions in Australia, where little clovers, with excellent seeding properties, like *Trifolium glomeratum*, *T. striatum*, and *T. tomentosum*, rank as very valuable herbage plants.

*Subterranean clover is the outstanding example of an aggressive annual—a plant which is endowed with particularly favourable seeding habits.

Under pasture conditions, seed can only be developed if some proportion of the flowering heads are either totally neglected or not grazed by stock until the seed is ripe. The seed may then be distributed by natural shedding or by passing through the animals. It is generally supposed that cattle are better seed distributors than sheep, though it is certain that seed can to some extent pass through sheep without losing its powers of germination. It is true that cattle are more prone to eat inflorescences than are sheep, so that sheep grazing favours natural shedding more than cattle. Sheep do not, however, entirely neglect inflorescences, and there is some evidence for thinking that they perhaps prefer flowering heads, bearing ripe seed, to immature heads. It is probable, too, that the establishment of naturally shed seed is more favoured on sheep than on cattle pastures, since, sheep being in greater number than cattle, the amount of trampling by the sheep must contribute very materially to the chances of seedlings, developed on the surface, obtaining a hold on the ground.

Crested dogtail is the outstanding example of a plant which is very largely allowed by stock to produce an abundant seed harvest, the seed heads being almost entirely neglected, and its aggressiveness on pastures must be attributed to this fact, accompanied by an ability for seedling establishment. The same is very largely the case with the bent grasses, the abundance of which is, probably, due as much to seeding aggressiveness as to anything else. Wild white clover is another plant which, to some extent at all events, is usually allowed to produce ripe seed, and its aggressiveness is probably as much due to natural shedding, and dispersal through cattle in particular, as to its powers of vegetative propagation.

A fair proportion of ripe seed spikes of perennial rye-grass, also, are usually to be found on old pastures. Speaking broadly, however, we know far too little as to the extent to which all kinds of stock graze inflorescences and at what precise stage of ripening these are taken.

Having regard to the fact that old pastures are, to some extent, reinforced by seedling establishment, it is somewhat remarkable that renovating mixtures on established swards are so seldom a real success. This may be due to the fact that much of the seed, naturally produced on pastures, would be over-ripe and "hard" before distribution and would, therefore, germinate over a very long period, thus affording

the seedlings the widest possible range of conditions for establishment.*

Seeds which have passed through animals would also be "sown" together with a medium in which to germinate and establish themselves, and would probably be more favourably placed than those broadcast in a renovating mixture. The possible importance of harrowing and rolling takes on a new aspect if seedling establishment is really an important factor in pasture management. The desirability of using a tined implement would, however, seem to be suggested, since this would do so much more to make for conditions favourable to establishment than merely the chain harrow.

In the management of range pastures in America, and that of much bush-burn country in New Zealand, "spelling" on a rotational basis of an adequate number of years, or allowing the grass to grow on and produce ripe seed at regular intervals, is recognized as an important means of maintenance.

"Spelling" has never been a general grassland practice in this country, but, as a possible method of rejuvenating old swards, it is worthy of experimentation—much of course depending upon the personnel of the sward and on the after-treatment. "Spelling" is obviously not incompatible with taking the mowers over pastures at about hay time to remove inflorescences and to maintain a leafy growth. From the point of view of seed production, a pasture would only need to be occasionally spelled and in a year favourable to seed production; that is to say, in a dry year (for example, such as 1911 or 1921) when a fair proportion of bare ground would result in the autumn and when the spelling, as such, would have largely militated against the effects of the drought.†

Persistency.—The persistency of grasses is influenced by a large number of factors. Bruce Levy,‡ in New Zealand, whose work on grasslands has added a great deal to our knowledge of the problem, recognizes the following as the more important factors: (1) soil fertility; (2) soil moisture content; (3) intensity of light and shade; (4) climate; (5) growth form

* "Hard" is here used rather in the sense of "dormancy." There is no doubt that, in general, seeds over-ripened are capable of longer periods of dormancy than seed under-ripe. This is known to be the case with crested dogtail, for example.

† See Stapledon, R. G., "Pasture Problems: Drought Resistance." *Journ. Agric. Science*, Vol. V, No. 2, 1912.

‡ Levy, E. Bruce, "The Grasslands of New Zealand: Preliminary Ecological Classification of Species." *N.Z. Journ. Agric.*, Vol. XXX No. 6, June, 1925.

of plant; (6) seasonal growth of the plant; (7) palatability of the plant. It follows that the persistency of plants can only be judged in relation to the sum effect of all the environmental factors. No single species of grass is therefore persistent or not persistent—each will be persistent under one set of conditions and short-lived and soon annihilated under another set of conditions. The recognition of this obvious fact is fundamental—a fact which has, however, been largely overlooked and probably in no respect more than in relation to soil fertility. Each species, Bruce Levy insists, has its very definite fertility requirements. It is of no avail to sow species with high fertility requirements on soils completely lacking in this respect. On a poor habitat, it is far better to have sheep's fescue, bent and Yorkshire fog than perennial rye-grass and cocksfoot. Having regard to the importance of leaf development, and presupposing proper management in relation to that leaf development, there is not the least doubt that, on a very poor soil, a sward, consisting of robust plants of bent and sheep's fescue and fairly robust plants of Yorkshire fog, would produce more leaf per acre per annum than starved and stunted plants of perennial rye-grass and cocksfoot. It is, therefore, of particular importance to recognize the fertility requirements of the different species: especially is this so in reference to the selection of long-duration seeds mixtures.

Bruce Levy's classification, in so far as a number of the grasses of importance in this country is concerned, is given in the table at the top of the next page.

His very low fertility class is chiefly filled by grasses of no application in this country, while he points out that, generally speaking, both annual grasses and annual clovers are associated mainly with the low and very low fertility classes.

If the classification is taken to apply to grazed pastures rather than to meadows, and this is what Bruce Levy has in mind in the main, the grasses would seem to behave in this country much as they do in New Zealand. Tall fescue has not, however, such high fertility requirements as the New Zealand classification suggests, while neither timothy nor meadow fescue acquit themselves well on soils of average fertility. Cocksfoot in this country could also be extended into the high-fertility class and perennial rye-grass into the extremely high-fertility class, while, with us, bent and sheep's fescue would be the most important grasses in the very low fertility class.

Name of pasture plant	Extremely high fertility	High fertility	Moderately high fertility	Average fertility	Moderately low fertility	Low fertility	Very low fertility
Meadow foxtail ..	+	+	+	-	-	-	-
Rough-stalked meadow grass	+	+	+	-	-	-	-
Tall fescue ..	+	+	+	-	-	-	-
Timothy ..	+	+	+	+	-	-	-
Italian rye-grass	+	+	+	+	-	-	-
Meadow fescue ..	-	+	+	+	-	-	-
Perennial rye-grass	-	+	+	+	-	-	-
Yorkshire fog ..	-	+	+	+	+	+	-
Cocksfoot ..	-	-	+	+	+	-	-
Crested dogtail ..	-	-	+	+	+	-	-
Bent (<i>A. vulgaris</i>)	-	-	-	+	+	+	-
Heath grass (<i>Tridachna decumbens</i>)	-	-	-	-	-	+	+

It follows that the ability of a grass to withstand adverse treatment, such as extra heavy grazing, will largely depend on whether it is satisfied as to fertility, soil moisture, climate and other environmental factors. A grass may survive moderately well if but one of a number of more or less essential factors are operating against it, while if several factors are so operating it cannot be expected long to survive.

This is well seen, for example, in the case of lucerne in the Marlborough district of New Zealand, where, on a soil ideal for lucerne production if aided by phosphatic manures and proper treatment, the crop is able to survive heavy and almost continuous winter grazing right into the crowns, an abuse which it could not tolerate under less favourable conditions. Equally, on soils of very high fertility, timothy may sometimes survive in considerable quantity as a pasture grass, while, on soils of even high fertility, it is seldom really abundant except on meadows.

It is well, however, again to insist that, because a plant does survive under the effect of some one adverse condition, by virtue of the extreme suitability of all other conditions, it is not to say that the plant is not lowered in aggregate productivity by the continued operation of the one unfavourable factor.

In so far as the light or shade requirements of the grasses are concerned, it must always be remembered that this is a

factor largely under control. Heavy and continuous grazing will tend to favour the light demanders or, at least, the light tolerators rather than the shade demanders, and, amongst the former, are undoubtedly to be classed relatively undesirable grasses like bent and sweet vernal grass.

Within limits, too, fertility is under control, and, as far as is economically possible, the endeavour should be, as Bruce Levy has said, to raise the fertility of our pasture-bearing lands up to the minimum standard demanded by thriving perennial rye-grass plants.

The effect of palatability on the extent to which grasses are defoliated, under pasture conditions, has already been referred to. In this connexion, it should be emphasized that in the case of all the more valuable grasses, with the exception of meadow foxtail and smooth-stalked meadow grass (if this is a really valuable grass), the "crowns" are situated at or above ground level.*

It has been pointed out, by Stapledon and Davies,† that early spring grazing, at a time when grasses are starting into growth, but before they have attained to really rapid development, has the most injurious effect on the earlier and more rapid-growing grasses. The bent grasses are late in starting and are neglected at this period, while, when they attain to a more critical stage, growth is so abundant that they are again largely neglected in favour of more palatable species.

This is a sequence of events which is largely responsible for the rapid spread of bent, especially on soils of a fertility class not sufficiently good to help perennial rye-grass, timothy and cocksfoot to stand up against the heavy differential grazing. Although bent is often fairly abundant, on Leicestershire and Romney Marsh fattening pastures, for example, it seldom, if ever, dominates such pastures. On these pastures, not only does the soil fertility tend to favour perennial rye-grass, but the best practice does not countenance heavy early spring grazing.

The influence of seasonal growth stage in relation to persistency is equally well exemplified by the behaviour of tall oat-grass on pastures. This is one of the earliest grasses to start growth in the spring. It is heavily grazed while in this succulent stage and, consequently, on pastures regularly

* There are indications, however, that the different strains of some of the more important species vary somewhat widely in this respect.

† See Stapledon, R. G., and Davies, Wm. Advisory Bull. No. 1. Univ. Coll. of Wales, Agric. Dept., Aberystwyth.

subjected to early spring grazing, it is a grass that is but seldom met with; indeed it is very quickly killed out of temporary leys subjected to this treatment.

To sum up then, it is evident that persistency is a matter very largely amenable to the control of the farmer. The biotic factor—the grazing animal—is or should be entirely under the farmer's control; the fertility factor is largely under his control; while in the formation of new pastures the selection of a seeds mixture, and the character of the after management, are subject absolutely to the will of the farmer.

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ELECTRICITY IN AGRICULTURE.—II

(Conclusion.)

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The Use of Energy.—The previous article dealt with the question of supply of electricity from the point of view of the supplier. His ideal, it was seen, is to deliver a maximum quantity of his product, to have the radius of his delivery as short as possible and to be able to spread the supply as evenly as possible over the whole twenty-four hours. We will now suppose that he has found his ideal, not fully, but sufficiently realized, and that we have a supply of energy awaiting us at the terminals on our own premises, to be used when required. Our immediate and ultimate object is to use this energy to our best advantage.

The electrification of the farm-house will probably be the first consideration. As its requirements in this respect differ in no material degree from those of any other dwelling-house, there is no need to go into the question here. But when it comes to electrifying the farm, two questions at once arise: how to set about it? is it going to make any difference in the existing methods of working? On the practical solution of the former question will depend the answer to be given to the latter.

If the substitution of electric for the older forms of power is to be successful, there must be kept in view, not only the question of cheaper running, which depends on the local cost of energy, but the other inherent characteristics of electrical operation, which lead, of course, to economies themselves. These are chiefly, flexibility, which permits of the

use of portable motors and apparatus, and of the arrangement of remote controls of machines and apparatus, cleanliness and silence of running, reliability and robustness, precision and efficiency. Any change-over to electric drive should be carried out with a view to taking the best advantage, eventual if not immediate, of each of these points.

The change need not necessarily be violent or drastic. If a farmer is building new premises or considerably altering his old, he can of course so dispose his machinery and equipment as to secure the best results from electrical operation. But we will suppose that the farm considered is already equipped with some form of engine, the usual line of shafting, and belt drive to the various machines—chaff-cutter, grinding machine, cake-breaker, etc.—such being the condition which is most usually found. It may not be desirable to undertake any considerable outlay in structural alterations or re-disposition of the various machines. In this case, the obvious method will be to replace the engine by an electric motor.

Here it must be remembered that no form of engine or motor is perfectly efficient, using “efficient” in the technical sense. That is to say, that no form of engine or motor reproduces, as work done, the full amount of the energy put into it. But the electric motor, even under ordinary conditions, is a more efficient machine than its rivals, and, when care and thought are taken to secure what are, for it, the most favourable conditions, it may become a very efficient servant indeed, giving us back in work a maximum percentage of the units of energy for which we pay. We must now consider what these conditions are and how they are to be reproduced on the farm.

Suppose the existing barn machinery to consist of a grinding machine, requiring 5 h.p. to drive it, a chaff-cutter requiring 3 h.p., a cake-breaker requiring 2 h.p., all driven from a common line of shafting: suppose, too, that the shafting is continued through to the dairy to drive the appliances there, which take, say, 1 h.p. The heaviest single machine to be driven from the power system is the grinder, taking 5 h.p., so that the electric motor, which drives the shafting, must be at least of 5 h.p. rating. With such an arrangement it would not be possible to run any of the other machines while the grinding machine is running—this need not be a disadvantage—but it would be possible to run any two of the others simultaneously, as well as any of them singly.

The ordinary electric motor is now built to run at its

maximum efficiency, say 85 per cent., when it is working in the region of its full load, and the efficiency of working falls as the load is taken off.* That is to say, that the 5 h.p. will have its maximum efficiency when working at the rate of 5 h.p., but it will not be so efficient at 3 h.p., 2 h.p., or 1 h.p. In fact, when working at 1 h.p. rate (driving the dairy appliances alone), that is, at one-fifth of full load, the efficiency may be as low as 50 per cent. This latter figure means that, when working at the rate of 1 h.p., we are purchasing energy equivalent to working at the rate of 2 h.p.; thus the dairy work, when running alone, is costing more for power than it need. The same applies, in a modified degree, to the case in which the 3 h.p., or the 2 h.p., machine is working separately. It is seen that the one-motor system—or group-drive system—does not produce the most efficient results; in other words, it fails to secure minimum running costs and thus reduces the advantage to be obtained from the use of electrical power.

The ideal way, to get such results, is to fit each separate machine with a motor, suited to its own power and speed requirements, and independently controlled. Then each motor can run separately at its maximum efficiency and running costs will be at a minimum. The disadvantage of this lies in the increased first cost of the extra motors and equipment; consequently, the most usual method is to compromise between the two systems by having several arrangements of group-drive.

For instance, a 5 h.p. motor might be used as required to drive either the grinder or the chaff-cutter; a separate 1 h.p. motor might be permanently installed in the dairy for its sole use; a portable 2 h.p. motor could be used for driving the cake-breaker and any other similarly powered machines, root-cutters, circular saws, etc.

Existing installations on farms are carried out on lines similar to the systems here indicated, but there is another factor which may influence the future trend of equipping and running the farm electrically. As mentioned earlier, the type of load which the supply engineer prefers—and which he is often willing to give special tariff rates to encourage—is a steady load over a long period. If each individual farmer can develop such a load, he will eventually reap the benefit in the form of reduced tariff rates. This has a more direct appeal to consumers whose fixed charge is based, not on the

* What is here described is not peculiar to the electric motor. It is common to all forms of motive power.

rateable value of the premises, but, as in some cases, on their "maximum demand." The "maximum demand" of any consumer is the largest load (rate of using energy) which he puts on the system at any one time, irrespective of the total amount of energy he uses. In the example given, where the one 5 h.p. motor is used, the "maximum demand" would be 5 h.p., although the average demand might only be 2 or 3 h.p.

The size of the distribution and supply lines depends on the "maximum demand"—not on the total energy consumed—and thus it will pay both the supply company and, eventually, the consumer to keep down the "maximum demand," at the same time making the total consumption as high as possible. Since the total consumption is the product of the rate of working and the time during which this rate is maintained, the required condition is obtained by working at a low, steady rate over a long period.

This condition would be met by limiting the maximum power of any single machine to, say, 3 h.p. Where any one of the machines already in use on the farm is much larger, it would be advisable to substitute a smaller machine, but this would not necessarily require to be done at once, and the farmer would have time to feel his way and develop the new system gradually. The work which the older machine accomplished, say, in two hours, might take three or four hours with the new; thus, while the actual amount of energy consumed would be the same, the "maximum demand" would be reduced. It would be an easy matter to arrange that no more than one machine should be run at one time; the various operations would thus be successive and separate, and the work spread out over the day. Such operations as water pumping and low-rate water heating could be started up automatically after midnight, and automatically stopped before the day loads come on.

It may be objected that, unless this method of working is begun right away, the advantage is lost because the overhead lines will have already been erected to cope with the old "maximum demand." This objection would be valid enough if only immediate needs were to be considered. But there is future development to be thought of. If a certain number of farmers act as pioneers, gradually developing the method, and learning to operate it successfully, they will set an example for new consumers, who will be able to start off confidently on the right lines from the first. This will mean that the supply company will be able to serve many new consumers

without any alteration to the existing transmission lines. The financial burden of these lines will then be shared by the new consumers and, thus, the original consumers will benefit by a reduction of tariff.

The method outlined, of low "maximum demand," is, from the technical as well as the economic point of view, the ideal method of employing electrical power. Whether it is possible for the farmer so to plan his daily work as to adopt this method in its entirety is a question that can be solved only by extended experience on the part of such farmers, as are in a position to modify their present programme, for a period long enough to subject the new method to a thorough test.

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JUNE ON THE FARM

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Seasonal Notes.—June was "the dry month" of our Anglo-Saxon ancestors, and in most years it is characterized by abundance of sunshine, little effective rainfall and a tendency to dry and bake the soil. On the average of many years, June stands third in the order of dryness in the rainfall records of England and Wales, April and May having less rain. It is noteworthy, however, that the average figure for June (2.33 in.) is almost identical with that (2.34 in.) for February, which has the opposite reputation. Other old names for June, having agricultural significance, were Woed-monath, or weed month, and Braeck-monath, which probably refers to summer-fallowing operations.

Vegetative development is very rapid under the conditions of soil, light and temperature, typical of June. Pasture herbage grows faster than the normal number of cattle can consume it, with the result that some parts of the fields are allowed to run to seed while the cattle prefer to graze where the sward is shorter and more nutritious. Under the new system of pasture management, the excess produce of June is to be mown for winter fodder. In this month also, meadow grasses throw up their flower stalks; clovers, beans and peas come into bloom, and corn comes into ear towards the end of the month. Weeds are equally active in growth: those among root crops necessitate the constant use of the hoe, which may or may not be beneficial to the condition of the soil according to circumstances; but, generally, hoeing does good, apart from its effect on weeds, if carried out in June. Weeds among

corn crops at this stage are less easily attacked. Charlock in bloom may be very completely destroyed by spraying; docks and thistles may be pulled; but weeds of the grass species must for the most part be left till after harvest. As regards thistles, there is an old saying that "If you cut your thistles before St. John (June 24), you will have two in place of one," but this does not apply to pulling. Moreover, on pastures, several times cutting in the one season is the most effective method so far found for eradicating the common or creeping thistle.

Root Crops.—The singling of mangolds, sugar beet, and in northern districts, swedes, an occupation which absorbs much of the labourers' time in June, is commonly not begun early enough; but the emphasis which has recently been laid on this point, in connexion with sugar beet growing and the experimental results quoted for that purpose, has impressed on farmers the desirability of early spacing of the seedlings. Where it is necessary to choose between crops that are all requiring singling at the same time, probably priority should be given to that with the thickest braird, which would usually be sugar beet. Swedes, being capable of more rapid recovery than mangolds and sugar beet in the early stages after singling, may suffer less than mangolds from delay in thinning. Sometimes it is best to go over the crop rapidly at the first operation, leaving the plants in bunches, which may be thinned to single plants later. The actual singling is best done by hand; but, where the hoe is used, the surplus plants should be cut out without removing too much soil from the roots of the plant left. Sometimes the singled seedlings are so much exposed as to wilt and topple over after the operation. On the other hand experiments on hand versus hoe singling of swedes at Cockle Park in the years 1905-7 were, on the whole, slightly in favour of the hoe.

As regards the best width between drills and spacing in the rows, experiments with mangolds and swedes have shown that within reasonable limits, width of spacing has not a great effect on yield. With 24 inch drilling, there is little to be gained by leaving the plants closer than 10 inches apart in the rows. The spacing of sugar beet under British conditions is now under experiment, but the results of trials carried out at Garforth (Yorks.) last year may be mentioned. The trial was conducted in triplicate and the figures reported are averages of the three sets. As regards widths between drills on the flat, heavier yields of washed beet were obtained

from rows 24 in. apart than from rows 20 in. or 16 in. apart. It will be interesting to observe whether further trials confirm this result, but many growers in this country are of opinion that the close rows recommended on Continental experience are not, under British conditions, better than the widths ordinarily adopted for root crops. Possibly, however, closer rowing will be practicable when further light has been thrown on the effect of the horse hoe, particularly late horse hoeing.

As regards different spacings of the plants in the rows, as might be expected, the results varied according to the widths of the spaces between the rows. On the 24 in. spacing, the yield of washed sugar beet was 10.1 tons per acre with 8 in. singling, and 9.7 tons with 12 in. singling. On the 20 in. spacing, the best singling distance was 10 in., and on the 16 in. spacing the yield was best with 12 in. singling. Probably further experience and experiments will point out the desirability of varying the singling distance according to other circumstances. Ordinarily it is advisable to give more room to early sown plants on well prepared soils than could be made full use of by crops sown later and under less favourable soil conditions.

June is the ordinary month for sowing common turnips in the northern half of England, while swedes are not drilled before June in the midland and southern counties. In districts where swedes can be drilled in May without great risk of mildew, they are a more valuable crop than common turnips drilled a month later; but the softer turnips are better adapted for land that requires prolonged cleaning and working before it can be sown, as they are both deeper rooting and quicker in growth. On farms where the turnip crop is grown for feeding on the land with sheep, moreover, it is advisable to provide a succession of the different kinds of turnip, *viz.*, greystones for feeding first and yellows for consumption in November, before swedes are sufficiently ripe to be safely fed to sheep. Yellow turnips, owing to their abundant top growth, are a good cleaning crop and, in spite of their low content of dry matter, they favourably affect the yield of milk when thrown out to cows at pasture.

Haymaking.—The haymaking season begins with the trefoil crop, which, in the southern counties, is commonly cut before the end of May; rotation hay in the earlier districts commences to be mown about the middle of June, while farther north and in our upland districts, where grassland does not freshen until after the end of April, little grass is cut

until the beginning of July. In recent years, however, as a result of the emphasis that has been laid on the nutritive value of early-cut hay, and the general superiority of June as compared with July weather, there has been a notable tendency to start mowing at an earlier date. Early mowing is also a means of eradicating yellow rattle.

The case for an attempt to secure dry fodder of a nutritive value, similar to that of short leafy pasture grass, was advocated by the writer in an article in this JOURNAL in June, 1924; and research work carried out at Cambridge in 1925 and 1926 has shown that the dry matter of pasture grass has a protein content and starch equivalent nearly equal to that of a balanced dairy cake. Many farmers will, therefore, be interested in the attempt that is to be made to make grass cake by artificial drying, while some propose to test the possibility of drying and harvesting cuts of short leafy herbage by ordinary haymaking processes. Their chief difficulty will be that of getting the hay dry enough for safe stacking. Ensilage is another and perhaps more likely possibility.

As a rule midland farmers prefer to lead the hay direct from the windrow instead of putting it into cock; and the use of the hay loader is another consideration in favour of not cocking. On the other hand, when heavy morning dews, not to say rain, have to be encountered, the labour of heaping in the evening may be well repaid. Hay in large cocks develops sufficient warmth to keep out dew, and the carting of hay so heaped may begin perhaps two hours earlier in the day than is possible where it has been left in windrow over night.

Mowers.—The beginning of June may not be the proper time for overhauling mowing machines, but it is the time when many farmers remember to send their machines to the smithy. Unfortunately, many local smithies have closed down in recent years, and the overhauling and readjustment of farm machines is becoming more a matter for the implement dealer and for the farmer himself. In the case of the mowing machine, most of the troubles met with in the working of the mechanism may be traced to faults in the cutting parts; and the recognition of these faults may be a means of preventing others developing and, meanwhile, ensuring both better work and easier draught. Heavy draught, side draught, rapid dulling of the knife, refusal to cut close, and failure of the grass to fall over the knife as it should, are all indications of inefficient cutting parts.

The principle of the cutting mechanism is simple. The edge of the knife section is one side of a pair of shears and the edge of the finger plate is the other. Just as a pair of shears can cut only when its two edges are in actual contact, so it is essential that the knife section shall bear upon the finger plate. All the finger plates in the finger bar must be in correct alignment, which is often not the case, especially when new fingers have been inserted, or when a finger has been accidentally bent. The edges of the finger plate become worn and rounded, especially if allowed to corrode with rust during the winter. These edges must be filed to an angle. Sometimes also when a connecting rod has been broken, the new or repaired rod is slightly different in length from the original, with the result that the blade sections do not move from centre to centre of the fingers as they should. Another cause of this fault is the lag of the finger bar, due to wear at its hinges.

Warble Fly.—It is common knowledge that cattle are most troubled by the warble fly in hot sunny seasons,* and Dr. Walton of Bangor has shown that more warbles appear in the animals' backs after a relatively dry summer than after a season of high rainfall. Doubtless the warble pest does more damage in the drier and sunnier eastern counties than in the more humid western districts. The Bangor figures also show that absence of shade—as in upland districts—increases the risk of infestation. Three heifers on a hill farm were, in March, 1926, found to have 21, 65, and 48 warbles respectively, while another three were quite free from larvae; the latter group had grazed during the preceding summer in exceptionally shady and well watered fields in the lowlands, while the other three had become heavily infested by grazing on the open mountain slopes.

There is now ample evidence of the effectiveness of a number of dressings for killing the warbles; and the general adoption of warble destruction is much to be desired, but the individual farmer who wishes to protect his cattle from infestation may do so by walking them through a narrow bath of sheep dip, or otherwise dressing their heels and legs with a suitable insecticide. When the above suggestion was made in these notes two years ago, actual experimental evidence of the utility of this method was not available. Since then it has been tested and reported upon † as

* Walton, *Welsh Journal of Agriculture*, Vol. III.

† Innes, *Journal of Parasitology*, September, 1926.

undoubtedly preventing heavy infestation and as being both practical and economical for use on farms. The fluid used in the walking troughs was a 2 per cent. solution of coal tar creosote dip. This solution probably prevented infestation by repelling the fly, as other experiments have proved the effectiveness of a creosote spray for keeping flies off cattle. In the latter trials, one pint of tar oil to one gallon of waste engine oil was used. The fly does not confine itself to the heels, but lays also on the hind legs and the flanks, so that complete protection could not be ensured by the trough method alone.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named and are net cash for prompt delivery.

Description	Average price per ton during week ending May 11				Cost per unit at London
	Bristol	Hull	L'pool	London	
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½%) ..	13 15	13 15	13 5	13 12	17 7
" " Lime (N. 13%) ..	..	..	..	11 15†	18 1
Sulphate of ammonia :—					
Neutral (N. 20.6%) ..	12 6*	12 6*	12 6*	12 6*	11 11
Calcium cyanamide (N. 19%) ..	9 16*	9 16*	9 16*	9 16*	10 4
Kainit (Pot. 14%) ..	3 2	2 17	2 17	2 15	3 11
Potash salts (Pot. 30%) ..	4 17	..	..	4 10	3 0
" (Pot. 20%) ..	3 12	3 2	3 9	3 2	3 1
Muriate of potash (Pot. 50.53½%) ..	9 10	8 5	8 13	9 7	3 6
Sulphate " (Pot. 48.51½%) ..	11 10	10 5	10 16	11 5	4 5
Basic Slag (T.P. 32%) ..	..	..	..	3 11§	2 3
" (T.P. 30%) ..	..	3 2§	3 1§	3 9§	2 4
" (T.P. 28%) ..	..	2 11§	2 10§	..	..
" (T.P. 26%) ..	..	2 7§	2 6§	..	..
" (T.P. 24%) ..	..	2 2§	..	2 11§	2 2
Ground rock phosphate (T.P. 58%)					
Very fine grade ¶ ..	2 15	..	..	2 15d	0 11
Fine grade || ..	2 10	..	..	2 12d	0 11
Superphosphate (S.P. 35%) ..	3 9	..	3 12	3 7	1 11
" (S.P. 33%) ..	..	..	3 9	..	..
" (S.P. 30%) ..	3 2	2 15	3 5	3 2	2 1
Bone meal (N. 3½%, T.P. 45%) ..	8 15	8 10	8 10	8 0	..
Steamed "bone flour (N. ½%, T.P. 60.65%) ..	6 0†	6 5†	6 5	5 17	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

§ Fineness 80% through standard screen of 14,400 holes to the square inch (120 mesh sieve).

¶ Fineness 80% through standard screen of 10,000 holes to the square inch (100 mesh sieve).

‡ Price for 4-ton lots f.o.r. at Northern London Stations. At G.W.R. and S.R. London Stations the cost to purchasers is 2s. 6d. per ton extra.

NOTES ON FEEDING STUFFS FOR JUNE

E. T. HALNAN, M.A.,

Animal Nutrition Institute, Cambridge University.

The Composition and Digestibility of Maize.—Maize, either as a grain or in the form of a meal, is a common constituent of most animal dietaries. As is well known, many varieties of maize exist, these varying considerably in colour, shape and size. White, yellow, and purple varieties, and intermediate shades of these colours, are known, the chief varieties of the English markets being either white or yellow. In shape, two chief forms are recognized, these being round and flat. The chief maize-producing countries are America, Rumania, Hungary, Italy, Russia, Argentina, Mexico, and Africa. A considerable bulk of the maize imported into this country comes from America, Argentina, and Africa, and, in view of the differences in varieties and countries of origin, it becomes of interest to ascertain whether these differences in variety and origin are associated with differences in feeding value. Russia and South Africa chiefly produce white varieties of maize, and Argentina and America yellow varieties.

Work carried out in America with pigs, in connexion with which meal from yellow varieties of maize was tested against meal from white varieties of maize, gave a slightly more favourable result in the case of meal from the yellow varieties. In this test, the maize meal bulked largely in the ration, and the difference recorded was attributed to the higher vitamin content of the yellow meal, a difference that would vanish under conditions of English feeding practice, where the rations fed to pigs generally contain enough vitamins to satisfy growth requirements without considering the vitamin content of the maize meal included in the ration. In addition to this, yellow maize meal is disliked by bacon curers on the ground that the yellow maize meal tends to give rise to a yellow oily fat in the carcass.

This important question of differences in feeding value of different varieties of maize has received considerable attention in Germany, and facts of interest have emerged from this work. O. Hagemann, working on maize of African and American origin, showed that, not only is there little or no difference in the chemical composition of American and African maize, but that the digestibility coefficients are also

similar. The figures obtained by this worker, quoted below, bring this point out very clearly :—

		Composition of maize		Percentage digestibility	
		American	African	American	African
		per cent.	per cent.	per cent.	per cent.
Moisture	.. ..	12.68	12.68	—	—
Organic material	.. ..	85.84	86.19	—	—
Crude protein	.. ..	10.04	9.68	54.12	54.50
Crude fat	.. ..	4.12	3.48	78.36	69.70
Sol. carbohydrate	.. ..	68.76	70.94	85.15	86.16
Crude fibre	.. ..	2.92	2.09	—	—
Ash	.. ..	1.48	1.13	—	—

Feeding experiments, carried out with hens, also showed no difference between American and African maize so far as egg production was concerned.

Further experiments on the possible varietal differences in feeding value of maize have been carried out at Rostock research station by F. Honcamp, W. Schramm and H. Wiessmann. For the purpose of these experiments, two sheep were used, and the maize was supplied in a roughly ground condition, the experimental diet consisting of 500 g. meadow hay, 100 g. linseed cake and 200 g. maize. In this experiment yellow maize was tested against white maize. Calculated on the dry matter, the compositions of the two varieties were as follows :—

		White maize		Yellow maize	
		per cent.		per cent.	
Organic material	.. ..	98.83	98.83	98.45	98.45
Crude protein	.. ..	10.23	10.23	10.95	10.95
True protein	.. ..	10.11	10.11	10.40	10.40
Sol. carbohydrates	.. ..	82.55	82.55	80.95	80.95
Crude fat	.. ..	4.37	4.37	4.93	4.93
Crude fibre	.. ..	1.68	1.68	1.62	1.62
Ash	.. ..	1.17	1.17	1.55	1.55

It will be noticed that the chemical compositions of the two types of maize are practically identical. The digestibility coefficients obtained by these workers were as follows :—

		Percentage digestibility	
		White maize	Yellow maize
Organic material	.. ..	81.2	83.8
Crude protein	.. ..	39.0	56.4
Sol. carbohydrates	.. ..	87.5	88.8
Crude fat	.. ..	63.0	77.2

Fair agreement is shown between these figures obtained with yellow and white varieties of maize and those previously obtained by O. Hagemann for American and African varieties, particularly as regards the chief constituent, the starch or soluble carbohydrates. On the basis of the above figures, the

starch equivalent of white maize works out at 81·47, and that of yellow maize 85·13, and the conclusion is reached that there is practically no difference in feeding value between white and yellow maize. Taken in conjunction with O. Hagemann's work, we are led to the conclusion that, on a dry matter basis, all maize is similar in feeding value from a farm value standpoint.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follow:—

	Starch equivalent	Protein equivalent	Per ton £ s.
Per cent.	Per cent.	£ s.	
Barley (Imported)	71	6·2	10 10
Maize	81	6·8	8 2
Decorticated ground nut cake	73	41·0	11 5
„ cotton cake	71	34·0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2·48 shillings, and per unit protein equivalent, 1·17 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	9 10
Oats	60	7·6	7 18
Barley	71	6·2	9 3
Potatoes	18	0·6	2 5
Swedes	7	0·7	0 18
Mangolds	7	0·4	0 18
Beans	66	20·0	9 7
Good meadow hay	31	4·6	4 2
Good oat straw	17	0·9	2 3
Good clover hay	32	7·0	4 8
Vetch and oat silage	13	1·6	1 14
Barley straw	19	0·7	2 8
Wheat straw	11	0·1	1 7
Bean straw	19	1·7	2 9

DESCRIPTION	Price per qr.		Price per ton	Manu- rial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Pro- tein equiv.
	s. d.	lb.	£ s.	£ s.	£ s.		s. d.	d.	%
Wheat, British.. ..	—	—	12 7	0 15	11 12	72	3 3	1·74	9·6
Barley, British feeding	—	—	10 10	0 12	9 18	71	2 9	1·47	6·2
„ Canadian No. 3 Western	40 0	400	11 3	0 12	10 11	71	3 0	1·61	6·2
„ Persian	35 0	—	9 17	0 12	9 5	71	2 7	1·38	6·2
Oats, English, white	—	—	9 13	0 13	9 0	60	3 0	1·61	7·6
„ „ black and grey	—	—	9 7	0 13	8 14	60	2 11	1·56	7·6
„ Scotch white	—	—	10 13	0 13	10 0	60	3 4	1·78	7·6
„ Canadian feeding	26 9	320	9 7*	0 13	8 14	60	2 11	1·56	7·6
„ American	23 9	—	8 7†	0 13	7 14	60	2 7	1·38	7·6
„ Argentine	27 3	—	9 10	0 13	8 17	60	2 11	1·56	7·6
„ Chilian	27 9	—	9 15	0 13	9 2	60	3 0	1·61	7·6
Maize, Argentine	34 6	480	8 2	0 12	7 10	81	1 10	0·98	6·8
Beans, English winter	—	—	10 10	1 10	9 0	60	2 9	1·47	20
Peas, Japanese	—	—	22 10||	1 6	21 4	69	6 1	3·26	18
Dari, Egyptian	—	—	11 5	0 14	10 11	74	2 10	1·62	7·2
„ Persian	—	—	10 15	0 14	10 1	74	2 9	1·47	7·0
Millers' offals—									
Bran, British	—	—	7 10	1 6	6 4	42	2 11	1·56	10
„ broad	—	—	8 7	1 6	7 1	42	3 4	1·78	10
Middlings, fine, imported	—	—	9 17	1 1	8 16	69	2 7	1·38	12
„ coarse, British	—	—	8 10	1 1	7 9	58	2 7	1·38	11
Pollards, imported	—	—	7 10	1 6	6 4	60	2 1	1·12	11
Meal, barley	—	—	11 0	0 12	10 8	71	2 11	1·56	6·2
„ maize	—	—	9 7	0 12	8 15	81	2 2	1·16	6·8
„ „ germ	—	—	8 15	0 18	7 17	85	1 10	0·98	10
„ „ gluten feed	—	—	8 15	1 5	7 10	76	2 0	1·07	19
„ locust bean	—	—	8 10	0 11	7 19	71	2 3	1·20	3·6
„ bean	—	—	12 0	1 10	10 10	66	3 2	1·70	20
„ fish	—	—	20 10	4 1	16 9	53	6 3	3·35	48
Maize, cooked flaked	—	—	9 17	0 12	9 5	85	2 2	1·16	8·6
Oilcakes—									
Linseed	—	—	18 0	1 9	16 11	119	2 9	1·47	19
„ cake, English 12% oil	—	—	11 15	1 16	9 19	74	2 8	1·43	25
„ „ „ 10% „	—	—	11 7	1 16	9 11	74	2 7	1·38	25
„ „ „ 9% „	—	—	11 2	1 16	9 6	74	2 6	1·34	25
Soya bean „ „ 6% „	—	—	11 5*	2 11	8 14	69	2 6	1·34	36
Cottonseed „ „ 5½% „	—	—	6 5	1 13	4 12	42	2 2	1·16	17
„ „ „ Egyptian 5½% „	—	—	6 0	1 13	4 7	42	2 1	1·12	17
Decorticated cottonseed meal, 7% oil	—	—	10 0	2 11	7 9	74	2 0	1·07	35
Coconut cake, 6% oil	—	—	9 0	1 9	7 11	79	1 11	1·03	16
Ground-nut cake, 6·7% oil	—	—	8 15*	1 14	7 1	57	2 6	1·34	27
Decorticated ground-nut cake, 7% oil	—	—	11 5*	2 12	8 13	73	2 4	1·25	41
Palm kernel cake, 6% oil	—	—	8 10	1 2	7 8	75	2 0	1·07	17
„ „ „ meal, 6% oil	—	—	9 0*	1 2	7 18	75	2 1	1·12	17
„ „ „ meal 2% oil	—	—	7 17	1 3	6 14	71	1 11	1·03	17
Feeding treacle	—	—	6 5	0 9	5 16	51	2 3	1·20	2·7
Brewers' grains, Dried ale	—	—	6 17	1 2	5 15	49	2 4	1·25	13
„ „ „ porter	—	—	6 7	1 2	5 5	40	2 2	1·16	13
„ „ „ Wet ale	—	—	0 16	0 8	0 8	15	0 6	0·27	4·8
„ „ „ „ porter	—	—	0 11	0 8	0 3	15	0 2	0·09	4·8
Malt culms	—	—	6 5	1 12	4 13	43	2 2	1·16	16

Prices at London except where otherwise stated.

* At Hull.

† At Bristol.

‡ At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of April and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manual value is £12s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manual value per ton figures are calculated on the basis of the following unit prices: N, 12s. 0d. P₂O₅, 3s. 10d.; K₂O, 3s. 0d.

MISCELLANEOUS NOTES

ONE of the most interesting features in the Ministry's Agricultural Meteorological Scheme is the series of annual Conferences at which those engaged on the study of various aspects of the work discuss the results of their investigations. At the Conference held last year, a full report on which has just been issued, the following papers were read:—

The Influence of Summer Rainfall on the Fruiting of Apples (Mr. A. H. Lees, Long Ashton Research Station). *Meteorological Conditions and the Growth of Barley* (Dr. F. G. Gregory, Plant Physiology Research Institute, Imperial College of Science). *Essentials of Theory and Points of Practice in Crop Weather Work* (Mr. L. F. Engledow, Cambridge Plant Breeding Institute). *Technique of Crop Observations* (Mr. T. Eden, Rothamsted Experimental Station). *Solar Radiation* (Mr. R. Corless, Meteorological Office). *The Effect of Solar Radiation on Plant Growth* (Professor V. H. Blackman, Plant Physiology Research Institute, Imperial College of Science). *The Value of Co-ordination in Phenological Observations* (Mr. J. E. Clark, Royal Meteorological Society). *The Value of Phenological Observations in Practical Agriculture* (Mr. A. Roebuck, Midland Agricultural and Dairy College).

A limited number of copies of the report may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1.

The papers which will be read at the Conference arranged for September 22 and 23 of the present year are as follows:—

The Week as a Phenological Unit (Sir W. Napier Shaw).

The Effect of Climate on the Growth of Vegetables (Mr. M. C. Vyvyan, Cambridge Horticultural Research Station).

The Effects of Temperature and Humidity on the Changes in Weight of Crops in Storage (Mr. H. J. Page, Rothamsted Experimental Station).

The Effect of Temperature on the Keeping Quality and Bacterial Content of Milk (Mr. H. Barkworth, South-Eastern Agricultural College).

Rothamsted Temperature Records (Mr. T. N. Hoblyn, Rothamsted Experimental Station).

The Effect of Meteorological Conditions on the Amount and Nutritive Value of Pasture and Hay. (Professor R. G. Stapledon, or a member of the staff of the Welsh Plant Breeding Station).

The Effect of Meteorological Conditions on the Rate of Growth of Pasture Grass (Dr. H. E. Woodman, Cambridge Animal Nutrition Institute).

Temperature and the Food Requirements of Animals (Professor T. B. Wood, Cambridge Animal Nutrition Institute).

The Effect of Ultra-Violet Light on Animal Nutrition (Dr. J. B. Orr, or a member of the staff of the Rowett Research Institute).

Meteorological Factors affecting Sheep (Mr. J. E. Nichols, Animal Breeding Research Department, University of Edinburgh).

The Conference will be open to all those interested in agricultural meteorology.

Those who desire to attend should notify the Secretary, Agricultural Meteorological Committee, Ministry of Agriculture, 10 Whitehall Place, London, S.W. 1.

* * * * *

AN account of the introduction of the scheme for providing short courses on clean milk production at Agricultural Colleges, for the special benefit of Sanitary Inspectors, appeared in this JOURNAL for April, 1926. Since then the scheme has made considerable progress, and this further account may, therefore, be of interest.

It will be recalled that the courses aim at bringing to the notice of Sanitary Inspectors, in as short a time as possible, the main points concerned in the production and handling of milk on up-to-date lines, in the light of the most recent knowledge. The scheme was introduced by the Ministry in conjunction with Agricultural Colleges, after the matter had been discussed and cordially approved by the Sanitary Inspectors' Association. Nearly all the provincial Agricultural Colleges have provided, or are prepared to provide, special courses of this nature, the syllabus being based generally on a scheme prepared and issued by the Ministry in conjunction with the National Institute for Research in Dairying, Reading. In addition to lectures and demonstrations on various aspects of clean milk production, the courses usually include visits to typical dairy farms, bottling establishments, etc.; they may last for four or five days, or be held on one or more days or evenings a week for a number of weeks. A fee, sufficient to cover the cost of the course, is charged by the College and is normally in the neighbourhood of £2. The Inspectors must, of course, provide their own accommodation and travelling expenses.

The following statement shows the courses which have been held to date, and the attendance at each :—

Centre	Attendance	Duration
Leeds University	16	Eight days
	15	Nine consecutive Thursday evenings
	14	Eight days
	25	Nine consecutive Monday evenings
Reading Dairy Research Institute	15	Five days
	14	Five days
	17	Four days
University College, Bangor	13	Six days
	12	Four days
Bristol University	12	Two weeks : afternoons only
	14	Two weeks : evenings only
Seale Hayne College	11	Five days
	18	Four days
Armstrong College	41	Eight consecutive Fridays
	17	Six consecutive Fridays
University College, Aberystwyth	21	Five days
Midland College	12	Six days
	3	Five days
Harper Adams College	6	Five days
Wye College	8	Six days
	15	Five days
Manchester University	138	Seven consecutive Thursdays
East Anglian Agricultural Institute	24	Eight days
Moulton Farm Institute	12	Seven Thursdays
Rodbaston Farm Institute	25	Six consecutive Friday afternoons
Reaseheath Farm Institute	8	Three days
Total attendance	526	

Although the scheme is only of recent introduction, its value is already generally recognized, and there is little doubt that, as time goes on, it will do much to foster the spirit of co-operation between those who are concerned with what may be termed the educational and control aspects of clean milk production. The Milk and Dairies Order of 1926, which superseded then existing regulations governing the production of milk, reflects the view, which is now generally held, that methods of production are of at least equal importance with the provision of satisfactory milking and handling accommodation. It is all to the good, therefore, that facilities have now been provided in most parts of the country whereby the officials who are concerned with the administration of the

Order may keep in close touch with the most up-to-date knowledge on the question of clean milk production, and may be brought into association with those who are interested in helping producers to improve their methods. The value of co-operation between educational officers and local control officials was emphasized by the Ministry of Health in the circular letter (No. 757) dated January 20, 1927, issued to Local Authorities on the subject of the Milk and Dairies Order, 1926. Incidentally, this letter commended the clean milk courses for Sanitary Inspectors to the notice of Sanitary Authorities, and stated that such Authorities might, in the opinion of the Minister, legally incur the reasonable expenditure involved by the attendance of Inspectors at the courses.

As an illustration of the value of the courses to the Sanitary Inspectors who attend them, the following extract may be quoted from a report* by a Sanitary Inspector who attended a recent course at Reading :—

"The knowledge that is imparted in these lectures is of such interest and so clearly given that I feel confident no one attending them can fail to be greatly benefited thereby, and I am more than ever convinced that it is of paramount importance that all inspectors, whether engaged in questions of milk supply or not, should be given an opportunity of attending future courses. . . . I repeat that no finer opportunity has been given to the public health service than the opportunity to attend the courses of lectures at Shinfield."

In conclusion, it may be said that, should Sanitary Inspectors in any area find it difficult to attend a course at the nearest Provincial College, the Ministry will be glad to endeavour to arrange a course at a Farm Institute or some other centre more easily accessible. A few such decentralized courses have already been held, and others are in course of preparation.

* * * * *

THE Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examination for the National Fream Memorial Diploma in Agriculture, has been won this year by Mr. Cecil E. Elms, a student of the Seale-Hayne Agricultural College and Reading University. The value of the prize this year is about £7, which is to be devoted to the purchase of books.

* The *Sanitary Journal*, April, 1927 : Clean Milk Course—Shinfield, near Reading, February 15-18, 1927.

NUMBER and declared value of animals, living, for breeding, exported from Great Britain and Northern Ireland in the three months ended March, 1927, compared with the corresponding period in 1926. (From returns supplied by H.M. Customs and Excise.)

Country to which exported	January to March, 1927		January to March, 1926	
	Number	Declared value	Number	Declared value
CATTLE		£		£
Argentina	168	72,808	136	23,130
Brazil	0	0	8	1,800
Canary Islands ..	0	0	23	475
Chile	0	0	30	2,670
Denmark	9	344	1	120
Uruguay	32	7,026	31	7,436
Australia	0	0	35	6,421
British India ..	7	730	6	350
Falkland Islands ..	0	0	10	361
Irish Free State ..	1,250	29,416	1,663	30,363
Kenya	8	389	5	300
Union of South Africa ..	0	0	7	350
Other countries ..	10	1,007	10	1,147
Total of Cattle ..	1,484	111,720	1,965	74,923
SHEEP AND LAMBS				
Argentina	310	6,571	141	4,135
Brazil	4	210	3	52
France	14	43	0	0
Peru	30	360	0	0
Switzerland	0	0	8	120
Uruguay	20	600	11	147
Australia	0	0	2	367
Irish Free State ..	79	248	121	310
Other countries ..	2	83	4	65
Total of Sheep and Lambs	459	8,115	290	5,196
SWINE				
Argentina	4	160	2	65
Belgium	0	0	6	240
France	2	73	15	342
Germany	9	405	3	70
Italy	3	150	0	0
Russia	0	0	180	3,646
Serb-Croat-Slovene State ..	0	0	40	1,250
Irish Free State ..	264	1,414	155	810
Other countries ..	6	188	4	87
Total of Swine ..	288	2,390	405	6,510

THE general level of the prices of agricultural produce was maintained in April at the same figure as in the previous month. On the average, prices were 43 per cent. above those in the corresponding month of 1911-13, as compared with 52 per cent. in April, 1926. The seasonal downward movements in the prices of milk, eggs, and butter continued on normal lines. Cattle and sheep prices improved slightly, while pigs were inclined to cheapen.

In the following table are shown the percentage increases, as compared with pre-war prices, each month since January, 1922 :—

Month	Percentage Increase compared with the Average of the corresponding month in 1911-13					
	1922	1923	1924	1925	1926	1927
January	71	67	60	71	58	49
February	75	63	61	69	53	45
March	73	59	57	66	49	43
April	60	54	53	59	52	43
May	69	54	57	57	50	—
June	64	49	56	53	48	—
July	67	50	53	49	48	—
August	68	52	57	54	49	—
September	59	52	61	55	55	—
October	61	50	66	53	48	—
November	63	51	66	54	48	—
December	61	55	65	54	46	—

Grain.

Wheat averaged 11s. 6d. and barley 10s. 10d. per cwt., the former being 2d. and the latter 1d. per cwt. cheaper than in March, but, whereas the index figure for wheat declined 5 points to 52 per cent. above pre-war, the relatively greater fall in the price of barley in the corresponding period of the base years caused the index figure for this commodity to rise 3 points. Oats appreciated in price by 3d. per cwt. to 8s. 4d. per cwt., and the index figure was 4 points higher at 18 per cent. above 1911-13. As compared with prices a year ago, wheat was 5d. and oats were 7d. per cwt. cheaper, but barley was 1s. 9d. per cwt. dearer.

Live Stock.

After falling for several months, the prices of fat cattle rose slightly in April, but the increase was relatively rather less than in the base years, and the index figure declined by 1 point to only 25 per cent. above pre-war, as against 39 per cent. a year ago. Dairy cows and store cattle also continued at low prices, though they were slightly higher on the month, the index

export of infested cherries, and admit of the export of clean fruit needed for consumption in this country.

As the result of these representations, the French Government have drawn up a scheme which places the whole export of cherries to this country under the control of a National Syndicate. The export of cherries highly susceptible to the Fruit Fly is prohibited; the members of the Syndicate bind themselves to export only clean fruit, and French Inspectors will carry out an examination before consignments are shipped. Every package passed for export will bear a special label officially stamped as an indication that its export has been authorized by officers of the French Phytopathological Service.

The Importation of Raw Cherries Order of 1926 has, therefore, been revoked and replaced by the Importation of Raw Cherries Order of 1927. The new Order prohibits the entry of any cherries shipped from a French port unless accompanied, in the case of French cherries, by a certificate of an officer of the French Phytopathological Service to the effect that examination of the consignment has not revealed the presence of the pest in any stage of its existence, and that the packages bear the label of the Syndicate on which is an official stamp indicating that they have been examined and that they have been exported in accordance with the Syndicate's regulations. Consignments of cherries not grown in France but shipped from a French port must be accompanied by a certificate of origin.

Copies of the Order may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W. 1.

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THE following Press notice was issued on May 3: In view of the discovery of the Potato Moth in consignments of potatoes imported this season from the

Importation of Potatoes (Canary Islands) Order of 1927—Canary Islands, the Minister of Agriculture and Fisheries has made an Order under the Destructive Insects and Pests Acts 1879 and 1907 prohibiting the landing in England and Wales of any

potatoes grown in the Canary Islands unless they are accompanied by the certificate of health prescribed in the Destructive Insects and Pests Order of 1922. The Order came into operation on May 2, but it allows for the landing of potatoes shipped from the Canary Islands prior to that date.

Farm Workers' Minimum Wages.—A meeting of the Agricultural Wages Board was held on April 25 at 7 Whitehall Place, S.W. 1, the chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions.

Cumberland and Westmorland.—An Order continuing from June 5 until further notice the operation of the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers. The minimum rates in the case of male workers of 21 years of age and over are 38s. per week of customary hours in the case of workers hired by the month or longer period, 31s. per week of 48 hours in winter and 32s. 6d. per week of 54 hours in summer for other male workers except in the case of casual workers, where the minimum rate is 8d. per hour. The overtime rate for all classes of male workers of 18 years of age and over is 8½d. per hour. In the case of female workers of 18 years of age and over the minimum rate is 5½d. per hour for all time worked.

Dorset.—An Order fixing special differential rates of wages for overtime employment of male workers on the hay and corn harvests, the rate in the case of workers of 21 years of age and over being 10d. per hour.

Durham.—An Order fixing minimum and overtime rates of wages for male and female workers to come into operation on May 14, when the existing rates are due to expire, and to continue in force until May 13, 1928. The minimum rates in the case of male workers of 21 years of age and over are: Horsemen who are householders, 32s. per week of 50 hours, and in addition 7s. per week to cover all time customarily spent in attention to horses; horsemen who are not householders and who are not in receipt of board and lodging, 31s. per week of 50 hours, and in addition 3s. 6d. per week to cover all time customarily spent in attention to horses; horsemen who are in receipt of board and lodging, 31s. per week of 50 hours, and any additional time customarily spent in attention to horses; stockmen or shepherds who are householders, 43s. per week for hours customarily spent in attention to stock; stockmen or shepherds who are not householders and who are not in receipt of board and lodging, 36s. 10½d. per week for hours customarily spent in attention to stock; stockmen or shepherds who are in receipt of board and lodging, 35s. per week for hours customarily spent in attention to stock; and other male workers 31s. per week of 50 hours. These rates represent a reduction of 1s. per week in all cases except those of horsemen, stockmen, and shepherds who are householders. The overtime rates in the case of all classes of male workers of 21 years of age and over are 10d. per hour in respect of overtime employment on Sunday and after 12 noon on Saturday and 9d. per hour for other overtime employment. In the case of female workers of 18 years of age and over the minimum rate is 2s. 6d. per day of eight hours with overtime at 4d. per hour.

Essex.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to come into operation on May 1, when the existing rates are due to expire, and to continue in force until October 31, 1927. The

minimum rate in the case of male workers of 21 years of age and over is 30s. per week of 50 hours in summer and 48 hours in winter, with overtime at 9d. per hour on weekdays and 10d. per hour on Sundays (instead of 9d. per hour for all overtime employment as at present). The minimum rate in the case of female workers of 21 years of age and over is 5½d. per hour (instead of 6d. per hour as at present) for all time worked.

Herefordshire.—An Order varying as from May 1 the minimum and overtime rates of wages for male and female workers. The minimum rates in the case of male workers of 21 years of age and over are 36s. per week for all time customarily spent on the immediate care of animals (not exceeding 60 hours) in the case of bailiffs, waggoners, stockmen and shepherds, and 31s. per week of 53 hours in summer and 48 hours in winter (instead of 52 hours in summer and 48 hours in winter as at present) for other male workers. The overtime rate in the case of all classes of male workers of 21 years of age and over is 9d. per hour. In the case of female workers of 18 years of age and over the minimum rate is 4½d. per hour for a week of 46½ hours, with overtime at 6d. per hour (instead of 4½d. per hour for all time worked as at present). The rates as varied will continue in force until April 30, 1928.

Lancashire.—An Order varying as from May 2 the minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to continue in force until April 30, 1928. The minimum rates in the case of male workers of 21 years of age and over are: In the Southern area 37s. per week of 52½ hours in the case of stockmen and teamsmen and 33s. 6d. per week of 50 hours in the case of other male workers; in the Eastern area 42s. per week of 60 hours in the case of all classes of male workers; and in the Northern area 40s. per week of 60 hours for stockmen and teamsmen and 37s. 6d. per week of 60 hours in the case of other male workers, overtime being payable at 11d. per hour in all cases. In the case of female workers of 18 years of age and over the minimum rate is 6d. per hour for all time worked.

Oxfordshire.—An Order continuing as from May 1 until further notice the operation of the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers. The minimum rate in the case of male workers of 21 years of age and over is 30s. per week of 48 hours in winter and 50 hours in summer, with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays. In the case of female workers of 18 years of age and over the minimum rate is 6d. per hour for all time worked.

Somerset.—An Order fixing special differential rates of wages for overtime employment of male workers on the hay and corn harvests, the rate in the case of workers of 21 years of age and over being 10d. per hour.

Wiltshire.—An Order fixing special differential rates of wages for overtime employment of male workers on the hay and corn harvests, the rate in the case of workers of 21 years of age and over being 9d. per hour.

Merioneth and Montgomery.—An Order continuing as from May 2 until May 1, 1928, the operation of the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers. The minimum rates in the case of male workers of 21 years of age and over are 34s. 6d. per week of 60 hours for stockmen, teamsters, carters and shepherds, and

31s. 6d. per week of 54 hours for other workers, overtime in each case being payable at 9d. per hour. The minimum rate in the case of female workers of 18 years of age and over is 5d. per hour for all time worked.

Radnor and Brecon.—An Order to come into operation on May 1, when the existing rates are due to expire, and to continue in force until October 31, 1927, fixing minimum and overtime rates of wages for male and female workers. The minimum rate in the case of male workers of 21 years of age and over is 31s. per week of 54 hours in summer and 48 hours in winter (instead of 30s. as at present) with overtime at 9d. per hour. In the case of female workers of 18 years of age and over the minimum rate is 5d. per hour with overtime at 6½d. per hour on weekdays and 7½d. per hour on Sundays.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

Special Minimum Rates of Wages for the Hay Harvest.—Special rates of wages for employment on the hay harvest in 1927 have been fixed by five Agricultural Wages Committees, *viz.*, Derbyshire, Devonshire, Dorset, Somerset and Wiltshire. In every case, except Wiltshire, similar rates were fixed last year. In the case of Hertfordshire, where special rates were fixed last year, no proposal in regard to harvest rates has yet been issued.

The rates apply to male workers only, and in each case there are special differential rates of wages for overtime employment on harvest work, the rates for workers of 21 years of age and over being 10d. per hour in Devonshire, Dorset and Somerset and 9d. per hour in Derbyshire and Wiltshire. Lesser rates are fixed for younger workers.

In the areas where the Agricultural Wages Committees have not fixed any special rates for hay harvest, employment on such work must, of course, be paid for at not less than the ordinary minimum and overtime rates.

Enforcement of Minimum Rates of Wages.—During the month ending May 15 legal proceedings were instituted against ten employers for failure to pay minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases are as follows :—

County	Court	Fines			Costs			Arrears of wages			Workers concerned
		£	s.	d.	£	s.	d.	£	s.	d.	
Devon ..	Exeter ..	2	2	0	4	5	6	22	11	6	4
" ..	Holsworthy ..	0	10	0	0	5	0	29	6	9	1
Dorset ..	Wimborne ..	—	—	—	—	—	—	—	—	—	1
Salop ..	Shrewsbury ..	1	0	0	0	12	0	19	0	0	4
" ..	" ..	1	0	0	0	8	0	11	15	9	2
" ..	" ..	1	0	0	0	5	0	2	16	4	1
Derby ..	Belper ..	0	10	0	—	—	—	13	0	0	1
Cornwall ..	Launceston ..	—	—	—	1	19	0	15	10	0	2
" ..	Liskeard ..	2	0	0	—	—	—	20	0	0	1
Cheshire ..	Northwich ..	6	0	0	2	17	0	147	10	9	6
		£14	2	0	£10	11	6	£281	11	1	23

With regard to the case dismissed at Wimborne, it transpired in Court that the worker was not in the service of the employer concerned on the particular day to which the summons related. The employer, however, intimated that he did not propose to withhold from the worker on account of a legal technicality the arrears of wages which might be due, and the Ministry therefore decided not to pursue the matter further.

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Foot-and-Mouth Disease.—No outbreak of disease has been confirmed since that at Ellel, Lancashire, which was discovered on April 6 last, and was referred to in the May issue of the JOURNAL. All restrictions in connexion with that outbreak were removed on May 4, and the position is that, as from that date, no general movement restrictions in connexion with foot-and-mouth disease remain in force in any part of Great Britain.

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Instruction in Seed Testing.—A course of training in seed testing will be held at the Official Seed Testing Station for England and Wales, Cambridge, from June 28 to July 26, 1927. It will be followed by an examination in seed testing on July 27 and 28. The fee for the course and examination is £6 6s., and for the examination only £1 1s. Full particulars can be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

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Prosecution under Tuberculosis Order, 1925.—A farmer in Durham was recently prosecuted by the County Council for failing to report tuberculosis in one of his cows. The local Bench of Magistrates dismissed the case, but the Local Authority appealed to Quarter Sessions, who convicted the owner, imposing a fine of £20, and ordering him to pay the costs of appeal, which were stated to be £78. The Chairman of the Quarter Sessions, in remarking upon the case, said that so serious was the offence of keeping a cow which gave tuberculous milk that, in addition to the other penalties, the farmer ought not to receive any compensation under the Tuberculosis Order for the loss of the animal.

It is fairly well known now by farmers that those who have cows which appear to be suffering from tuberculosis of the udder, indurated udder or other chronic disease of the udder, or from tuberculous emaciation, or which have a chronic cough, and show definite clinical signs of the disease, are required by law immediately to report such cases to the police, with a view to the animals being slaughtered by the local authority under the Tuberculosis Order, provided of course that the veterinary examination instituted by the local authority shows them to be suffering from the disease. Compensation is paid for animals so slaughtered at the rate of three-quarters of the market value in non-advanced cases, and one-quarter in advanced cases, subject to a minimum of 45s.

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Sale of Plants.—The Minister of Agriculture and Fisheries has issued an Order entitled "The Sale of Diseased Plants Order of 1927," which takes the place of the Sale of Diseased Plants Order of 1922,

and the American Gooseberry Mildew Order of 1919. It came into force on April 25, 1927, and copies may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1. The effect of the Order is to prohibit the sale, or exposure for sale, of any plant which bears evidence of having been substantially attacked by the Apple Capsid, or of any trees, shrubs, seeds, tubers, bulbs, layers, cuttings or any other parts of a plant which are substantially attacked by the following pests: Fruit Tree Cankers, American Gooseberry Mildew, Silver Leaf, Black Currant Mite, Woolly Aphis, all Scale Insects, Brown Tail Moth, Rhododendron Bug, and Powdery or Corky Scab of Potatoes.

The reason for the Order is the serious complaints which have been made to the Ministry, during the past few months, of the increase of the Capsid Bug on apple trees in certain districts. The need for a drastic Order was strongly urged, and the Ministry, after full consideration of the advice of its Horticultural Advisory Council, decided that the most practicable method of dealing with the matter was to add the pest to the Schedule to the Sale of Diseased Plants Order. The opportunity was taken of making other small amendments of the regulations, and the new Order is the result.

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NOTICES OF BOOKS

Farmers of Forty Centuries; or, Permanent Agriculture in China, Korea and Japan. By F. H. King. (London: Jonathan Cape, 1926. pp. 379. Price 12s. 6d. net.)

The late Professor King, when at Wisconsin, carried out a number of investigations on soil physics—and particularly on the movements of water in the soil—which about 25 years ago were about the best work then being done in a field that was but little explored. Later, he went to Washington to the Department of Agriculture, but a disagreement as to the policy regarding research on soil problems led him to resign and to carry out a long-felt desire to examine the soils and agriculture of China and Japan. King died before he had quite completed the record of his observations, and the book, which was prepared for press by his widow, was first published in 1911.

For the Western reader, it is a fundamental book—the first statement of a secular system of agriculture and soil conservation that demands the earnest consideration of everyone who is thinking of the future of agriculture and the maintenance of the food supply of the world.

The conditions permitted to King no more than a hasty survey of a vast area, and the more recent penetration into China of American men of science and the development of agricultural science in Japan have doubtless led to a revision of some of King's statements, but the book perhaps gained more than it lost from the speed with which it was compiled: King saw the wood even if some of the trees are out of perspective.

The central fact that emerges is the density of the population that is maintained by the land in these Eastern countries. The English population is the densest in Europe, averaging 701 to the square mile, yet, as we know, at least four-fifths of it lives in towns and cities. King reports that in Chungming, at the mouth of the Yangtse River, there is a density of 3,700 per square mile, with only one city in the total area of 270 square miles. Western agriculture requires 2 to 2½ acres to produce the food for one unit of population; King shows that these Eastern peoples live on one-tenth of that area. It is accomplished

in the first place by minute and careful farming, with an excessive ratio of labour to production, compared with which our market gardening is extensive and wasteful of land. Soil fertility is maintained by the return to the land of the elements drawn from the soil; human urine and excreta are preserved and constitute the chief fertilizer. The universal drink is tea and the boiling of the water obviates the risk of disease. The second condition is a reduction of the standard of living to the minimum—the cash equivalent of the earnings of the cultivator may be estimated at less than 6d. a day. A corollary is the ever-present danger of famine in districts where the population live thus on the bare edge of subsistence. Space does not permit of any discussion of the book in detail, but it is eminently readable and it is worth reading; and it must compel the reader to think about certain world problems which have seemed very remote to us, but may soon become pressing. The population of the world is always increasing. Will the pressure thus generated force the Western peoples into as intensive farming and as low a standard of living? If, by limitation of the rate of birth, the Western nations insist on their standard of living, how will they maintain themselves commercially against the races on their flank with so low a standard? Lastly, what is going to be the effect both upon China, and by reaction upon ourselves, if these vast hardy and toilsome populations become infiltrated with the explosive doctrines of modern Russia?

The National Farmers' Union Year Book, 1927. (Published by the Union at 45 Bedford Square, London, W.C. 1. Price 5s. net.)

The N.F.U. Year Book for 1927 summarizes the multifarious activities of the Council and its several Committees in the past year. A glance at the various Committee reports shows at once the comprehensiveness of the work undertaken by this powerful organization in the interests of its members and of the agricultural industry. But the book is more than a record of effort and achievement; it is a work of reference indispensable to the farmer who would be well-informed in matters of education and legislation affecting his occupation. Chapter 1 outlines the co-ordinated scheme of agricultural education and research now in force throughout the country and indicates the source to which a farmer should apply if he desires to take advantage of any of the educational facilities provided through the County Councils, Colleges or Research Institutions.

In a brief note, the Director of Rothamsted, Sir John Russell, deals with the application of science to agriculture, mentioning as the outstanding feature of 1926 the great development of the manufacture of nitrogenous fertilizers from the air. One result of the greatly increased production that will appeal to the farmer has been a lowering of price, so that sulphate of ammonia is now cheaper than it has been for the past seven years. Various new compounds of synthetic nitrogen will shortly be on the market, substances which have certain important advantages over ordinary mixed fertilizers. They are much more concentrated, and the whole of their nitrogen and phosphorus is soluble and available.

Professor Gaiger describes the results of recent research in animal nutrition, *e.g.*, the effects of ultra-violet rays, vitamins and minerals; and also discusses the progress made in connexion with animal diseases, such, for example, as the vaccine treatment for the prevention of tuberculosis.

Plant Pests and Diseases in 1926 are described and discussed by the well-known authorities, Messrs. Fryer and Pethybridge. Incidentally,

they make an earnest appeal for the co-operation of the practical farmer, so that, by comparing the variation in insect abundance with other changing factors, such as weather, parasites, farming practice, etc., they should be able to get at the reasons why certain pests are prevalent in some years and almost entirely absent in others. Such information might lead to satisfactory measures of control. For instance, in 1926, the frit fly caused less injury to oats than for many years past. While it may be that the oats that year got a good start and so evaded attack, there is evidence that the flies themselves were actually scarcer, and the chances are that spring oats should be relatively safe this year.

In regard to matters of legal interest, Mr. C. H. Tolley contributes a very useful article on Farmers' Income Tax, which is followed by a summary of the legislation affecting agriculture in 1926, together with a helpful index to Acts of Parliament dealt with in previous issues of the Year Book.

Chapter 4 is devoted to a statistical review of wages, prices and supplies; and in Chapter 5 the official agricultural programmes of the three political parties are briefly and effectively analyzed and compared. There follows a miscellany of information for tenants and owner-occupiers on matters of recurrent incidence, such as Agricultural Returns, boundary fences and trespass, improvements, disturbance, tenancy agreements, rating and so on. A further chapter catalogues the Government Departments, with their principal officers, concerned in matters affecting agriculture.

The Physiology of Reproduction in the Cow. By J. Hammond, M.A. (Cambridge University Press. Price 21s. net.)

An understanding of the principles underlying the scientific breeding of farm stock has been greatly handicapped for many years by the absence of a reliable book of reference, embodying the observations of breeders, and the results of research into what has, until lately, been regarded as a recondite subject. Various phases of the physiology of reproduction in the cow have been recorded by veterinary clinicians, various workers in the biological field, and observant breeders of cattle; but there has been no comprehensive attempt to co-ordinate this mass of information and supplement it by controlled investigation of the oestrous cycle.

Mr. Hammond has essayed this task with a large measure of success, and the resulting book, based on very careful experimental work, and a critical survey of the scattered literature of the subject, will prove a valuable book of reference and text-book, not only to Veterinary and Agricultural students, but to anyone engaged in elucidating the very varied problems of genetics in the cow.

The author has kept the comparative aspect of the subject well to the fore. This method of treatment makes the text more interesting, and adds materially to the value of the opinions expressed. The experimental work has been carried out at the Field Laboratories of the University of Cambridge.

As the introduction states, this work is intended to have a direct bearing on herd management, calf-rearing, and milk production. The opening section on the breeding season summarizes what is known regarding breed variations and seasonal fluctuations, and shows that, although the reproductive force is at its maximum in the summer and at its minimum in the winter, yet there is an optimum temperature governing the length of time between calving and the next fertile service. The oestrous cycle is then fully discussed. The study of it

was ingeniously facilitated by the use of a vasectomized bull, which, being unable to eject spermatozoa, did not interfere with the course of oestrus in the animals under observation. It was found that the length of the cycle and the duration of oestrus were correlated, and were uninfluenced by drugs, the proximity of the male or coitus. The ovarian, uterine, and vaginal changes during the cycle are described in detail, and illustrated by very fine photographic illustrations. Plate I admirably illustrates the "wax and wane" of the follicles and corpora lutea. A little more explanatory description on some of the plates themselves would have enhanced their value.

The diagnosis of pregnancy is discussed. Reference is made to palpation of the foetus through the flank, and here the author has rather confused "symptom" with "method." The disposition, size, and consistency of the uterus and foetus in succeeding months of pregnancy, as disclosed by rectal examinations, are given in detail. As an indication of pregnancy, one can hardly agree that one of the methods, viz., hooking the os and pulling it back into the vagina, in order to examine the mucous secretion, is a safe procedure, or one that could be recommended as a routine practice.

The development of the mammary gland during a first pregnancy is described in all its stages, and the influence of the internal secretions considered. The view, accepted by many, that secretion of milk at birth is due to the removal of an inhibitory factor (foetus or placenta), does not receive support from the experiments conducted, and an interesting alternative theory is put forward.

The book concludes with a section on sterility. The author in his references has rather overlooked the activities of British veterinarians, in dealing with sterility due to persistent corpus luteum and cyst formation. Interesting theories are advanced regarding the interrelation between the corpora lutea and the maturation of the Graafian follicles in the ovary. The view is put forward that absence of heat is due to the formation of large single cysts, and that nymphomania is due to multiple small cysts. Further post-mortem work on known cases of these conditions is required to substantiate this. The difficulty of differentiating between multiple small cysts and normal follicles is admitted. Several causes of sterility are not mentioned, but the section is mainly devoted to a general consideration of the various factors responsible. The views advanced by a number of authorities are also recorded and discussed.

The format of the book is excellent, and a very complete bibliography is appended for the use of those who intend to go more deeply into an absorbingly interesting subject.

Principles of Plant Growth—An Elementary Botany. By Wilfred W. Robbins. (Chapman & Hall, Ltd. Price 11s.)

This is a comprehensive and well-written book, which aims at presenting, in non-technical language, some of the fundamental principles of plant growth. In this sense, it has fulfilled its purpose. It will be welcomed by the grower who, while desirous of understanding basic principles, is averse from the study of structural details.

The book is also designed as an elementary text-book in secondary schools. In the sense that it links up botany with practice in the farm and garden, it is superior to the general run of school text-books, but 11s. is a rather high price for parents to face nowadays.

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THE JOURNAL OF THE MINISTRY OF AGRICULTURE

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NOTES FOR THE MONTH

THE means of interesting agriculturists in the practical results of research work and securing their support for its development is a matter that rightly commands a good deal of attention. Of the methods hitherto adopted by the research institutions themselves, one of the most interesting is the Fellowship of the National Institute of Agricultural Botany. This was instituted a few years ago to enable everyone, who has at heart the improvement of farm crops and the success of British agriculture, to keep in close touch with the development of the Institute's work, and, through their representation on its Council, to assist in its direction. There are already more than 400 Fellows, including Their Royal Highnesses the Prince of Wales and the Duke of York, also many of our statesmen and of the leaders of the agricultural world. There must be many more agriculturists who would wish to participate by this means in the Institute's work, and for this reason the Ministry desires to bring the Fellowship to the notice of farmers and others who may be interested. (See also the announcement of the N.I.A.B. on p. i.)

The aim of the Institute is to improve the yield and quality of farm crops by encouraging the use of better varieties and better seeds. It is endeavouring to discover which are the most remunerative crops and which the most remunerative varieties for each district, and to ensure that pure, viable and healthy seed of the best varieties is readily available. The significance of this undertaking can be measured from the facts that the difference in value between two varieties often amounts to over 20 per cent. and that an addition of 3 per cent. to the yield would increase the value of the corn and potato crops by over a million pounds a year.

The present work of the Institute falls into three branches. One, the Crop Improvement Branch, is equipped with a trial

ground at Cambridge, and five sub-stations in other parts of England, for accurate field testing of old and new varieties of agricultural plants. It is also prepared to undertake the introduction of new varieties of merit by arrangement with breeders. A second branch, the Official Seed Testing Station for England and Wales, tests some 25,000 seed samples a year for purity and germination, and, at a nominal fee, insures farmers against the loss entailed by sowing dead or dirty seeds. The investigation of seed-borne diseases, and of the numerous problems that seeds present to agriculturists, are other important features of the Station's work. The Station is operated by the Institute on behalf of the Ministry. At the third branch, the Potato Testing Station, Ormskirk, the official Wart Disease Immunity Trials are carried out for the Ministry, and the Institute conducts the Lord Derby Gold Medal Trials (with the aid of the local Committee) and yield and maturity trials of leading potato varieties. In order to prevent old varieties being marketed under new names, at high prices, the Potato Synonym Committee reports annually on the stocks entered for the Immunity Trials. The latest development is a field investigation of the virus diseases that are now believed to reduce the country's potato crop by something like a million tons a year.

Copies of the last annual report, with full particulars of the Institute's activities and of the Statutes of Fellowship, can be obtained by writing to the Secretary, N.I.A.B., Huntingdon Road, Cambridge. Both the Ministry and the Council of the Institute believe that the facilities given to Fellows to keep in touch with the development of its work will be of value to them. At the same time the hope that readers of this JOURNAL will become associated with the Institute by becoming Fellows is based not on the advantages to themselves but on the strength given to the Institute by their moral and financial support, and their continuing interest in the work.

* * * * *

It may be recalled that a grant of £40,000 a year for five years was made by the Empire Marketing Board for the purpose of carrying out further investigations into the marketing of home-grown agricultural produce and for demonstrating improved methods. An account was given in this JOURNAL for March, 1927, p. 1073, of the various activities of the Ministry which had been undertaken

up to December 31, 1926, with the aid of this grant. A further brief report of progress for the quarter ended March 31, 1927, may prove of interest.

Publications.—One report in the Economic Series was issued during the quarter, namely, No. 15 (*Fruit Marketing in England and Wales*). With the aid of the grant this report was issued at 6d. net; its sales up to March 31 amounted to 2,340 copies. The price of Reports Nos. 7 (*Wool Marketing*) and 9 (*Marketing of Potatoes*) was reduced at the end of the quarter from 1s. 6d. to 6d. The largest sales of individual reports in the Economic Series up to March 31, 1927, were as follows:—

No. 1: <i>Co-operative Marketing</i>	1,921	(Published April, 1925).
No. 4: <i>Co-operative Marketing</i>	1,018	(„ June, 1925).
		<i>in U.S.A.</i>
No. 8: <i>Agricultural Credit</i>	1,377	(„ Feb., 1926).
No. 10: <i>Egg Marketing</i>	4,511	(„ Jan., 1926).
No. 11: <i>Marketing of Poultry</i>	4,896	(„ Oct., 1926).
No. 12: <i>Marketing of Pigs</i>	2,180	(„ Oct., 1926).
No. 15: <i>Fruit Marketing</i>	2,340	(„ Mar., 1927).

Marketing Investigations.—Investigations are in progress in regard to the marketing of cattle, vegetables, butter, cheese and cream. A report on the fluid milk market has been completed, and will be issued as No. 16 in the Economic Series. Reports on the marketing of cereals and pig products are well advanced, as also is the second volume of *Markets and Fairs in England and Wales*—the first volume was published on April 13 as No. 13 (*Markets and Fairs in England and Wales, Part I, General Review*). A report dealing with marketing problems of individual fruits (apples, pears and plums) is in preparation.

Marketing Demonstrations.—The practical demonstration of improved methods of marketing is an essential feature of the Ministry's scheme, and, as already announced in this JOURNAL, arrangements have been made for staging such demonstrations at a number of agricultural and other shows during the present year. The subjects being dealt with at the summer shows are eggs, poultry, fruit, pigs and pig products.*

Egg Marketing Poster.—A large poster calling attention to the points to be observed when marketing eggs has been prepared and distributed to those responsible for the conduct of country markets. This poster is meeting a long-felt want and has been very favourably received. It has been translated into Welsh for distribution in the Principality, and is everywhere in keen demand.

* The nature and scope of the demonstrations are explained on pages 316 *et seq.* of the present issue of the JOURNAL.

Packages for Eggs and Dressed Poultry.—The Committee which has been considering this subject held several sittings during the quarter and completed its inquiries.†

Marketing Leaflets.—Two of the leaflets reproduced in this JOURNAL for December, 1926 (*Hints on the Marketing of Eggs* and *Hints on the Marketing of Poultry* respectively), have also been translated into Welsh.

Grants-in-Aid.—A grant of £100 to the Cottenham Growers, Ltd., has been sanctioned, to enable that society to employ a manager capable of keeping proper cost accounts to show the details of the expense of running an apple grading and packing station. These accounts are to be placed at the Ministry's disposal for publication if necessary.

Negotiations are in progress in respect of the loan by the Ministry of grading plant and equipment (estimated to cost about £400) to enable an apple grading station to be set up at Terrington St. John's, near Wisbech. One of the conditions of the arrangement is that cost accounts shall be kept and placed at the Ministry's disposal.

A grant of approximately £700 a year has been made to the Agricultural Economics Research Institute at Oxford in aid of detailed investigations into marketing problems of particular localities. Steps have been taken to ensure that these investigations will be brought into due relation with the general marketing work of the Ministry.

Displays of Empire Produce.—Empire shopping weeks and exhibitions of Empire produce are being organized under the aegis of the Empire Marketing Board in various parts of the country. The Ministry is taking all possible steps to ensure that home produce receives effective representation in these schemes. Details of the displays of home produce at the British Industries Fair (February, 1927) and at the Ideal Homes Exhibition (March, 1927) have already appeared in this JOURNAL.

FARMERS generally, and all concerned with the marketing of home produce, will watch with interest the progress of the Cheshire Cheese Federation's scheme which is designed to raise and standardize the quality of English Cheshire cheese and to advertize the standardized product. A trade mark consisting of three "C's" intertwined ("Choicest Cheshire

† Report since issued as Marketing Leaflet No. 5. See JOURNAL for June, 1927, pages 223 to 238.

Cheese") has been adopted, and any producer in the area whose dairies conform to the Milk and Dairies Order 821, 1926, and whose cheese satisfies a certain standard on examination, will be authorized to imprint the trade mark on his produce. The standard specified is high.

The Federation has appointed a grader to inspect the premises of applicants for membership and to analyze samples of their cheese. The grader will also, from time to time, make similar inspections of members' premises and analyses of their produce in order to ensure that the standard is maintained. It is understood that about a hundred farmers have already applied for registration, and the grader is dealing with these applications as expeditiously as possible.

The first consignment of graded cheese was offered for sale at the Chester Cheese Fair on June 1. It is satisfactory to record that there was a keen demand, and 1d. a lb. more was realized than the highest price recorded for the ungraded product. At Whitchurch Cheese Fair on June 8, graded cheese realized 8½d. a lb. against 8d. a lb. for best ungraded.

The income of the Federation is derived from a registration fee of from £1 to £2 (according to size of farm), plus an output levy of 2d. per cwt. As, however, this experiment in marketing reform cannot fail to prove of value, not only to the cheese industry, but to other branches of British agriculture, the Ministry is helping to overcome initial financial difficulties by making a grant to the Federation of a sum not exceeding £1,500, to be spread over the first two working years of the scheme; the grant will be made from the funds placed at the Ministry's disposal by the Empire Marketing Board.

* * * * *

THE Institute has recently endeavoured to effect an improvement in its publications by merging the two quarterly reviews previously published under the titles of *The International Review of the Science and Practice of Agriculture* and *The International Review of Agricultural Economics* into one publication entitled *The International Review of Agriculture*. The idea underlying this change is to present, in one publication, a more general view of the work of the Institute. This new review is being published monthly, and the first issue relates to February, 1927. In addition to information regarding economic and social questions affecting agriculture, and the science and

practice of agriculture in various countries, the review contains sections dealing with agricultural statistics and legislation, and the current activities of the Institute. Only the most important statistical information is included, however, and the *International Crop Report and Agricultural Statistics* will continue to be published monthly as before.

As a result of a resolution passed at a meeting of the International Conference on Tropical Agriculture held in Paris last year, and of decisions taken at the last meeting of the General Assembly, the Institute has decided to form a separate Bureau for Colonial and Tropical Agriculture. Arrangements have been made to hold a meeting of the "Tropical Agriculture" Committee of the International Scientific Council in June, to discuss the best way in which the Institute can act in this matter, and the subject will be further discussed at the full meeting of the International Scientific Council in November.

The International Conference of Wheat Experts, organized by the Institute at the invitation of the Italian Government, was held at the Institute's headquarters from April 25 to 30, and was attended by representatives of 37 States, including those of all countries in the British Empire adhering to the Institute. The Conference was divided into two parts, (a) scientific, (b) economic and commercial, and the general results were contained in a series of resolutions which will in due course be printed and circulated with all the relevant documents. It was decided to hold another Conference in 1929 or 1930, and the Institute was asked to form a special section for the study of questions relating to wheat and also to establish a separate sub-committee attached to the International Scientific Council.

* * * * *

THE PRODUCTION REQUIREMENT OF FATTENING SHEEP

T. B. WOOD, C.B.E., F.R.S.,

Drapers' Professor of Agriculture, and Director of the Animal Nutrition Research Institute, School of Agriculture, Cambridge University.

IN 1924, the writer propounded a new method of computing rations for cattle, sheep and pigs.¹ The essential point of the method depends upon the separate computation of the requirement for maintenance and for the desired amount and kind of production, usually in the form of increased live-weight. The method is on the same lines as that which had been used for dairy cows for some time with great success. Its proposed extension to other kinds of animals presupposes accurate knowledge of maintenance requirements and of production requirements. By production requirement is understood the amount of food, measured in starch equivalent or in calories, which is required to produce 1 lb. of live-weight increase.

The idea is exactly similar to that used in rationing milch cows, in which case it is generally accepted that 2½ lb. of starch equivalent is the production requirement of 1 gallon of normal milk. It is, however, well known that the requirement per gallon of milk varies according to the composition of the milk. In the same way, the production requirement per lb. of live-weight increase must be expected to vary within wide limits. In the case of very young animals, live-weight increase consists for the most part of water, and is, therefore, produced by the consumption of very little food. The writer has shown,² for instance, that, in the young pig, 600 calories, or less than ¼ lb. of starch equivalent, can produce 1 lb. of live-weight increase. In the last stages of fattening adult animals, the increase consists almost entirely of fat. Consequently it may require as much as 4,300 calories, or 4 lb. of starch equivalent, to produce 1 lb. of live-weight increase. The production requirement of live-weight increase per lb. may, therefore, vary from ½ to 4 lb. of starch equivalent.

Accurate data for the maintenance and production requirements of the pig from weaning to factory weight have been published by the writer.³ With Capstick,⁴ the writer has also

¹ "Animal Nutrition"; University Tutorial Press, London, 1924.

² *Jour. Agric. Sci.*, Vol. XVI, 1926, 426.

³ *Jour. Agric. Sci.*, *loc. cit.*

⁴ *Jour. Agric. Sci.*, Vol XVI, 1926, 326.

published a series of recent determinations of the maintenance requirement of sheep. The present communication is concerned with the production requirement of sheep. It is hoped in the near future to publish similar data on the production requirement of cattle.

There are three obvious methods of finding the production requirement of animals :—

- (1) Statistical examination of the records of past feeding trials.
- (2) Examination of the results of feeding trials designed specially for the purpose in view.
- (3) Comparative slaughter investigations.

Methods 1 and 2 depend on the assumption that the metabolism of animals obeys the laws of the conservation of matter and energy—in other words that the starch equivalent, or net energy, in the ration consumed by the animals is completely used up by them in maintenance and in production. Method 3 also depends on an assumption, namely, that there is a constant ratio between the calories contained in live-weight increase and the starch equivalent, or net energy, required to produce that increase. Kellner showed that, in fattening cattle, 1 lb. of starch equivalent produced an amount of live-weight increase containing 1,070 calories. It is probable that a similar ratio would hold in fattening sheep. The justification of these two assumptions is discussed below.

Method 1: Statistical Examination of Feeding Trials.—

The writer hoped to find ample material for such an examination in Ingle's valuable tabulation of the records of sheep feeding trials.⁵ Ingle's tables present, in convenient form, particulars of breed, age, live-weight, live-weight increase per week, and ration per week, of over 200 feeding trials, being all the trials recorded in British agricultural literature up to the year of publication. At the writer's suggestion, Mr. P. E. Graves examined the whole series by the following method. The recorded ration per week was calculated into starch equivalent, Ingle's calculation of starch equivalent having been made on an entirely incorrect basis. The starch equivalents used by Mr. Graves were those given in "Rations for Livestock."⁶ The maintenance requirements were then read off from the curve, reproduced in Fig. 1, which was calculated by the two-thirds power law from Capstick and Wood's recent determination.⁷

⁵ *Trans. Highland and Agric. Soc.*, 1910.

⁶ *Min. of Agric., Misc. Pub.*, No. 32, Fifth Edition, 1927

⁷ *Jour. Agric. Sci.*, *loc. cit.*

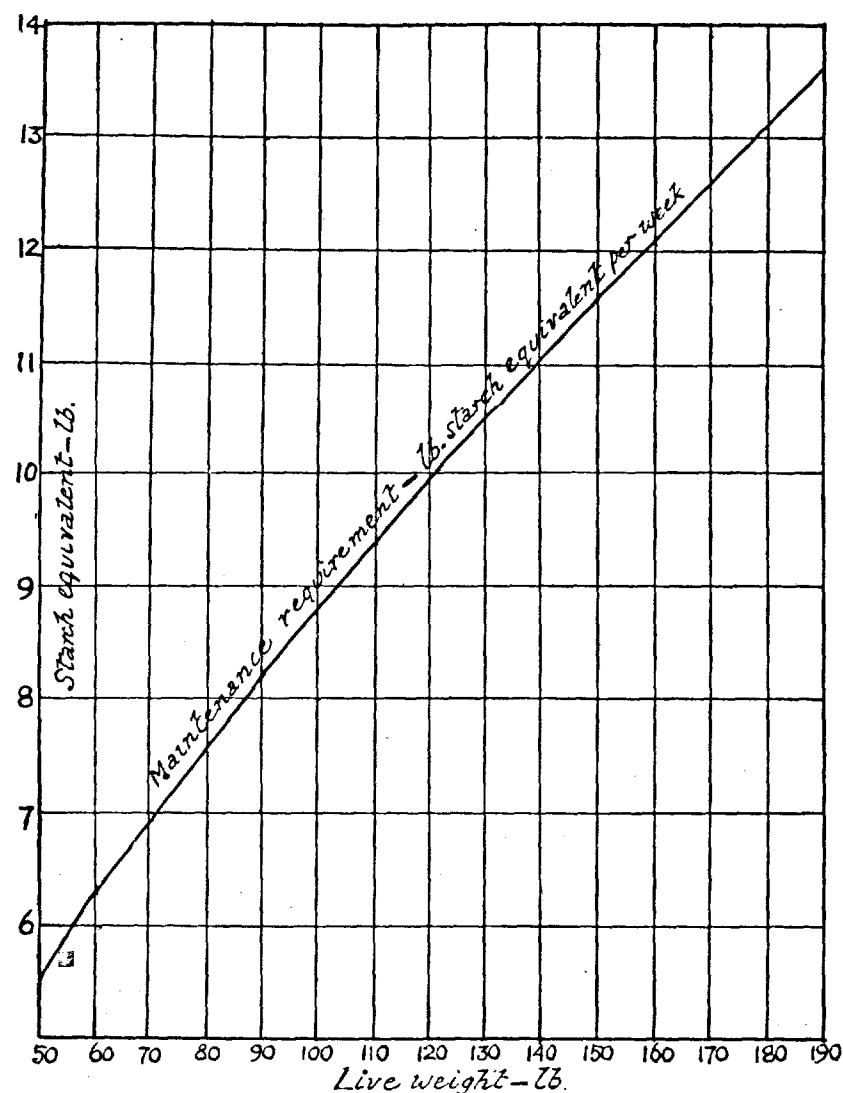


FIG. 1.

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Nutrition, Cambridge.)

Then if R is the ration in lb. of starch equivalent per week, M the maintenance requirement in lb. starch equivalent per week, and G the live-weight increase per week, it follows from the first assumption given above, that :—

$$R = M + Gx$$

where x is the production requirement, *i.e.*, the weight in lb. of starch equivalent required to make 1 lb. of live-weight increase. This equation only holds if the animals are contented and comfortable, so that they make no considerable movements beyond the necessary movements allowed for in the maintenance requirement. The above equation may be written :—

$$x = (R - M) \div G.$$

Mr. Graves was good enough to work out the value of x for 187 of the 200 trials recorded by Ingle. It was impossible to work out the remaining 13 trials because the rations included feeding stuffs whose starch equivalent could not be computed. The results obtained from this very laborious undertaking were most disappointing. The values of x varied from 4.7 lb. of starch equivalent per lb. of increase, an impossibly high figure, even if the increase was entirely composed of pure fat, to — 3.2 lb. of starch equivalent per lb. of increase, which is, of course, manifestly absurd, since it means that the animals are credited with having made an appreciable increase in live-weight on a ration which was below their maintenance requirement. Wide variations in the value of x were to be expected, because the equation used above contains no term for the amount of food used in muscular movement,⁸ which must vary from one trial to another. This, however, could not account for the large number of cases in which the value of x was negative.

Scrutiny of the rations of the various trials at once indicated that many of them were impossibly high or low, and this point was further investigated by calculating the weight of dry matter contained in each ration and comparing it with the weight of dry matter normally eaten by animals of the live-weights stated, this weight of dry matter being read off from the curve given in Fig. 2. This curve was originally plotted by E. T. Halnan and the writer from all data available to them, as for instance Kellner's Standards, Wolff's Standards, Armsby's Standards, and from figures collected by the late K. J. J. Mackenzie from successful practical sheep-feeders.

⁸ *Jour. Agric. Sci., loc cit.*

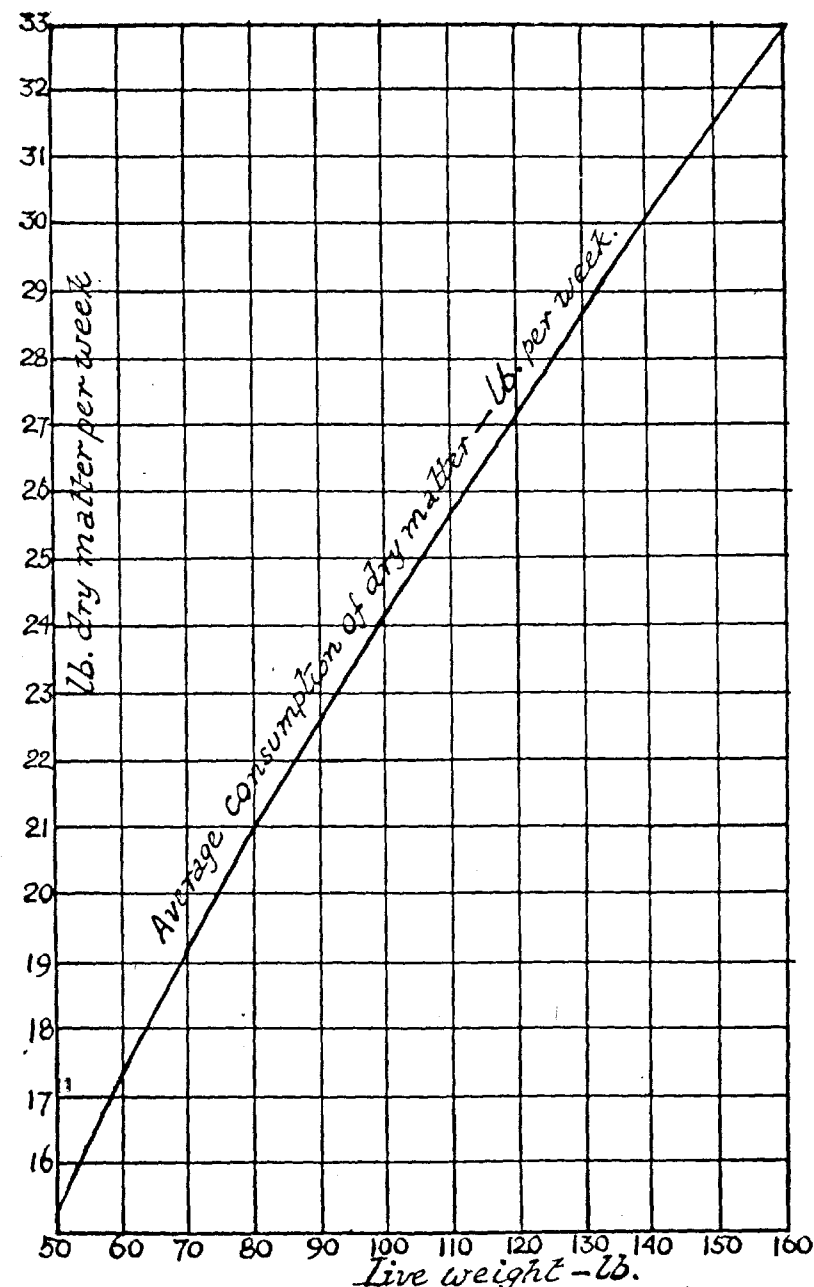


FIG. 2

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Nutrition, Cambridge.)

The comparison showed that in only 27 trials was the dry matter consumption within 4 lb. per head per week of the normal consumption indicated by Fig. 2. The consumption of dry matter was usually below the normal consumption, frequently 10, 15, or even 20 lb. per head per week below. The most likely explanation was that the roots on which the sheep were folded still retained a large proportion of tops and leaves, which were eaten by the sheep, but omitted in recording the ration. It is, also, possible that the estimated yield of roots per acre, from which the ration was calculated, was incorrect, or that no account was taken of the fact that the sheep ate more roots as they increased in weight.

Whatever the explanation, the fact remains that only 27 of the 200 trials are suitable for the calculation of x , which greatly decreases the value of the average figure. From these 27 trials the average value of x is 2.3 ($\pm .12$) lb. of starch equivalent per lb. of live-weight increase.

Method 2 : Specially Designed Feeding Trials.—A series of feeding trials, specially designed to provide data for the calculation of the production requirement of fattening sheep, has been carried out by the writer, in collaboration with the Norfolk Agricultural Station, on Sidney Farm, Saxlingham, Holt, Norfolk, of which the writer has control. The sheep used for the trials were in all cases half-bred Suffolk lambs about seven months old at the beginning of the trial. The sheep were folded during the winter on marrow-stem kale or swedes, supplemented by good seeds hay, crushed barley and linseed cake, decorticated cotton cake, or decorticated cotton cake meal. Many disappointments were encountered, owing to difficulties of estimating the consumption of kale, showers during weighing and such like, but a number of reliable results were nevertheless obtained. These are given in Table I, which explains itself, except, perhaps, the column headed "Period of Fattening." The animals were folded for about six months. The figures given in this column indicate to which of these months the result applies.

It will be noticed that dependable results were only obtained for 18 months of the 42 months during which, in the aggregate, the sheep were folded, thus more than half the possible results were vitiated by showers during weighing, difficulties in assessing weights of roots, kale and tops consumed and such like unforeseen happenings which are inseparable from outdoor experiments. The mean value of x —the production require-

TABLE I.

Year of trial	No. of animals	Period of fattening months	Average live wt. lb.	Average increase per head per week lb.	Ration lb. S.E.	M. lb. S.E.	x lb. S.E.	Ration lb. Dry matter
1924-5 ..	40	3, 4, 5	107	$1.8 \pm .05$	14.1	9.2	2.70	23
	40	3, 4, 5	102	$1.6 \pm .05$	14.0	8.9	3.20	23
1925-6 ..	50	2, 3, 4	103	2.45 ± 0.5	14.1	9.0	2.09	23
	50	2, 3, 4	102	$2.45 \pm .05$	14.4	8.9	2.25	23
	50	2, 3, 4	98	$2.31 \pm .04$	13.6	8.7	2.12	22
	150	5	127	$2.19 \pm .04$	16.2	10.3	2.70	26½
1926-7 ..	120	4, 5	131	$2.76 \pm .04$	17.2	10.6	2.4	28½

* These low figures are accounted for by the uneasiness of the sheep, which for some unknown reason broke out of their fold several times.

ment—from the above table is $2.5 \pm .14$ lb. starch equivalent per lb. live-weight increase, a figure agreeing satisfactorily with that obtained from the statistical examination of Ingle's tables. It is also noteworthy that the production requirement is on the whole lower for the early months of fattening, increasing as fattening proceeds.

Method 3 : Comparative Slaughter.—This method was first used, in agricultural investigations, by Lawes and Gilbert at Rothamsted, in their classic work on the composition of the entire carcasses of cattle, sheep and pigs.⁹ It has since been applied to sheep by Kern and Wattenberg and other German workers whose results have recently been recalculated and tabulated by Armsby and Moulton.¹⁰

The essence of the method is to select typical animals at definite stages of growth and fatness, to slaughter, dissect, sample and analyze, to combine the analyses of the samples so as to arrive at the composition of the entire carcass, and to compute the composition of the increase by subtracting from the weights of protein, fat, etc., in the older and fatter animal, the weight of the same constituents in the younger and less fat animal. It is usual to calculate the percentage of protein, fat, etc., in what is called the empty weight, which is the live-weight minus the contents of the alimentary canal and bladder.

Armsby and Moulton, in the re-calculations quoted above, give their final figures as calories per kilo of live-weight increase.

⁹ *Phil. Trans.*, Part II, 1859, p. 493.

¹⁰ "The Animal as a Converter of Matter and Energy": New York, 1925.

If it is assumed, as suggested above, that in the sheep, as in the bullock, 1 lb. of starch equivalent makes an amount of live-weight increase which contains 1,070 calories, then calories per kilo can be converted into starch equivalent by dividing by $2.2 \times 1,070$, and the quotient should give the corresponding production requirement in lb. of starch equivalent required to make 1 lb. of live-weight increase. This calculation has been made in Table II.

TABLE II

Authority, quoted from Armsby and Moulton	Age : months	Condition	Calories per kilo increase	Production requirement. lb. St. Equiv. per lb. increase
Kern & Wattenberg	7-13	low ration	4,888	2.04
" "	13-22	low ration	6,622	2.81
" "	22-28	low ration	7,155	3.04
" "	7-13	high ration	5,456	2.33
" "	13-18	high ration	7,799	3.20
" "	?	last stage	8,801	3.75
Lawes and Gilbert	15	store to fat	7,073	3.00
Henneberg	33	same age	6,777	2.88

The average of all these results—2.88 lb. starch equivalent per lb. of live-weight increase—is sufficiently in agreement with the results of statistical examination of Ingle's tables—2.3—and of the writer's own feeding trials—2.5—to justify the assumptions, made in the introduction, that the whole of the starch equivalent in the ration is used up in providing for maintenance and production, and that the sheep, like the bullock, makes from 1 lb. of starch equivalent an amount of increase which contains 1,070 calories. The agreement between the three methods also shows that the estimates of maintenance requirements, used in methods (1) and (2), are sufficiently accurate, for they are not used in method (3), and still the result is substantially the same.

Kern and Wattenberg's figures form two series, the first on a low ration which produced a low rate of increase of only $\frac{1}{4}$ lb. per head per week; the second on a higher ration giving a rate of increase of over 1 lb. per head per week. Both increases appear low as compared with British results, but their sheep were of the South Hanoverian breed, which are small and slow growing. In each series, the production requirement increases with age and condition.

As a final confirmation of all the figures obtained by the

three methods, the writer carried out a series of comparative slaughter experiments on five pairs of typical animals selected at intervals from the sheep used in the feeding trials at Saxlingham in 1924-25. The first pair were selected, as typical of the whole lot of animals, when they had been folded on roots for one month. Other pairs were selected at intervals of about three weeks, the last pair being picked out six weeks before the trial ended. Of the first and last pairs the duplicate animals gave almost identical results; the intermediate pairs were very unsatisfactory, the analyses of the duplicate animals varying so widely that the results were useless.

The following discussion, therefore, is based on the difference between the means of the first and last pairs of animals, the intermediate animals being ignored.

Method.—The method of selection was to pick out two animals having approximately the average live-weight of the whole lot. They were sent by rail to Cambridge, fasted overnight, and slaughtered. The blood was collected and preserved for further use. The skin and hoofs were removed and dried. The alimentary canal and bladder were removed and emptied, the contents being weighed and its weight subtracted from the live-weight to find the empty weight. The carcass was dissected into meat, and bone and tendons.

All the meat was then reduced to pulp in a rotating bowl provided with revolving knives; an aliquot part was then taken for analysis. The internal organs to which the blood had been added were treated in the same way. The wool was shorn from the dried skin, weighed, sampled and analyzed. The skin and hoofs were also weighed, sampled and analyzed. The bones and tendons were first cut up in a bone cutter, and then finely ground, sampled and analyzed. The results obtained for the first and last pairs of sheep are set out in Tables III and IV respectively.

TABLE III

SHEEP KILLED NOVEMBER 10, 1924. EMPTY WEIGHT 29.25 KILO = 64.35 LB.

□	Weight kilo	Percentages		Weights, kilo	
		Protein	Fat	Protein	Fat
Meat	12.600	13.33	20.06	1.68	2.53
Bones, etc. ..	3.954	19.87	13.99	.79	.55
Offals	7.360	13.50	9.16	.99	.67
Wool	2.078	70.00	10.00	1.45	.21
Skin, etc. ..	.769	71.66	9.88	.55	.05
				5.46	4.04

Percentages in Empty Weight : Protein, 18.7.
Fat, 13.8.

SHEEP KILLED NOVEMBER 10, 1924. EMPTY WEIGHT, 27.299 KILO=
60.06 LB.

	Weight kilo	Percentages		Weights, kilo	
		Protein	Fat	Protein	Fat
Meat	12.508	15.90	16.93	1.99	2.12
Bones, etc. ..	3.456	18.55	16.32	.64	.56
Offals	7.128	12.44	12.09	.89	.86
Wool	1.361	72.67	10.00	.99	.14
Skin, etc. ..	.742	63.69	19.18	.47	.14
				4.98	3.82

Percentages in Empty Weight : Protein, 18.2.
Fat, 14.0.

Means of the first pair of animals :—
Percentages in Empty Weight : Protein, 18.45.
Fat, 13.9.

Mean live-weight, 83 lb. ; mean empty weight, 62.2 lb.

Mean percentages in live-weight : Protein, 13.8.
Fat, 10.4.

TABLE IV

SHEEP KILLED MARCH 12, 1925. EMPTY WEIGHT, 48.39 KILO=
106.4 LB.

	Weight kilo	Percentages		Weights, kilo	
		Protein	Fat	Protein	Fat
Meat	23.20	14.64	34.63	3.90	8.10
Bones, etc. ..	5.40	17.97	14.45	.97	.78
Offals	10.75	10.21	23.00	1.10	3.00
Wool	2.96	70.00	10.00	2.07	.30
Skin, etc. ..	1.23	63.94	18.50	.78	.23
				8.82	12.41

Percentage in Empty Weight : Protein, 18.3.
Fat, 25.7.

SHEEP KILLED MARCH 12, 1925. EMPTY WEIGHT, 46.97 KILO=
103.3 LB.

	Weight kilo	Percentages		Weights, kilo	
		Protein	Fat	Protein	Fat
Meat	22.20	13.58	35.98	3.01	7.97
Bones, etc. ..	5.20	12.74	21.45	.66	1.12
Offals	10.87	9.56	30.56	1.04	3.32
Wool	3.32	74.14	7.36	2.46	.25
Skin, etc. ..	1.36	63.00	20.67	.86	.28
				8.03	12.94

Percentages in empty weight : Protein, 17.2.
Fat, 27.6.

Means of second pair of animals :—

Percentages in empty weight : Protein, 17.75.
Fat, 26.65.

Mean live-weight, 125 lb. ; mean empty weight, 104.8 lb.

Mean percentages in live-weight : Protein, 14.9.
Fat, 22.4.

The average live-weight of the whole lot of sheep on November 10 was 87 lb., and on March 12, 124 lb. Applying to these figures the mean percentages of protein and fat in the live-weight of the animals killed on these dates after selection as typical animals, the weight of protein and fat in typical animals on these dates were :—

On November 10 .. $87 \times 13.8 \div 100 = 12.00$ lb. protein.
 $87 \times 10.4 \div 100 = 9.05$ lb. fat.

On March 12 .. $124 \times 14.9 \div 100 = 18.50$ lb. protein.
 $124 \times 22.4 \div 100 = 27.80$ lb. fat.

Live-weight increase containing the differences between these weights, $124 - 87 = 37$ lb. The percentage composition of this live-weight increase was therefore :—

Percentage composition of live-weight increase :

Protein	17.6
Fat	50.7
Water (and ash)	31.7

100.0

The heat of combustion of sheep protein is very nearly 5.7 calories per gramme, or 2,600 calories per lb. ; of sheep fat, 9.5 calories per gramme, or 4,300 calories per lb. The calorie value of live-weight increase per lb. is therefore :—

Calories per lb. live-weight increase :

Protein ..	$17.6 \times 2,600 \div 100 =$	458 calories.
Fat ..	$50.7 \times 4,300 \div 100 =$	2,180 ..

2,638 ..

This figure is equivalent to $2,638 \div 1,070 = 2.47$ lb. starch equivalent, a figure which is in excellent agreement with those found for the production requirement by other methods. It applies to the second, third, fourth, and fifth months of fattening, the middle of which period is the end of the third month.

Summarizing all the figures given above, it appears that the best average round figure to take for the production requirement of fattening sheep is $2\frac{1}{2}$ lb. of starch equivalent per lb. of live-weight increase. There are clear indications that in the early stages of fattening, especially with young animals, 2 lb. of starch equivalent will make 1 lb. of increase, whilst in the later stages of fattening 1 lb. of increase may require over 3 lb. of starch equivalent. By rationing on the basis of the suggested average figure, the rate of increase obtained in the early stages may be expected to exceed, and, in the later stages, to fall short of, the rate aimed at.

Summary and Conclusion.—Although this paper appears under the writer's name alone, he wishes it to be distinctly understood that it represents a piece of team work by members of the staff of the School of Agriculture and others. He has already recorded his indebtedness to Mr. P. E. Graves for many of the statistical calculations. He takes this opportunity of thanking the following gentlemen for assistance in other directions: Mr. C. Heigham, late Director of the Norfolk Agricultural Station, now Farm Director of the Rothamsted Experimental Station; Mr. F. Rayns, Director, and Mr. S. T. Johnston, Assistant Director, Norfolk Agricultural Station, and Mr. W. J. Winn, Steward of the Saxlingham Farm, for supervision and weighing of the animals and the feeding stuffs used in the Saxlingham experiments; Colonel W. A. Wood, C.B.E., M.R.C.V.S., Mr. L. F. Newman and others for dissection of the carcasses and preparation of the samples; and Messrs. A. J. Codling, the late C. Bryant and others for analyses of the samples in the comparative slaughter experiment; and Mr. E. T. Halnan and others for assistance in looking up references and reading proofs.

The writer claims that the investigation taken as a whole has demonstrated the following points:—

(1) That in the case of a very large proportion of the feeding trials with sheep recorded in British agricultural literature, the rations credited to the animals are impossible, the dry matter consumption being in many cases far below standard requirements.

(2) That in the case of all recorded trials where the dry matter consumption was reasonably near normal, live-weight increase was produced at the average rate of 2.3 lb. of starch equivalent per lb. of increase.

(3) That in a series of specially designed trials, in which large numbers of sheep were used, live-weight increase was produced at the average rate of 2.5 lb. of starch equivalent per lb. of increase.

(4) That the average production requirement, calculated from a series of comparative slaughter experiments on the basis of 1,070 calories per lb. of starch equivalent, is 2.88 lb. of starch equivalent per lb. of live-weight increase, the average figure being rather high because the series included several cases of extreme fattening.

(5) That a comparative slaughter experiment, recently carried out at Cambridge, gives a production requirement of 2.47 lb. of starch equivalent per lb. of live-weight increase.

(6) That the practical identity of the figures obtained by calculation from feeding trials by the formula $x = (R - M) \div G$, and from comparative slaughter experiments, on the basis of 1,070 calories per lb. of starch equivalent, is a striking confirmation (a) of the correctness of the maintenance requirement as indicated by the curve given in Fig 1, (b) of the assumption that the whole of the starch equivalent in the ration is used up in maintenance and production, and (c) of the assumption that in the sheep, as in the bullock, 1 lb. of starch equivalent makes an amount of increase which contains 1,070 calories.

(7) That the best round figure for the production requirement of fattening sheep is $2\frac{1}{2}$ lb. of starch equivalent per lb. of live-weight increase.

(8) That the easiest, most interesting and most reliable way of computing rations for sheep is to read off the maintenance requirement from Fig. 1, which connects maintenance requirement with live-weight, and to add for production at the rate of $2\frac{1}{2}$ lb. of starch equivalent for each pound of live-weight increase which it is desired to produce.

(9) That a ration computed in this manner will, in the first stages of fattening, produce rather more than the desired increase, and in the last stages rather less.

Finally, it should be pointed out that the desired rate of increase will only be realized if the animals are contented and comfortable, so that they do not use up an abnormal amount of starch equivalent in unnecessary movements.

* * * * *

AGRICULTURE AND THE INTERNATIONAL ECONOMIC CONFERENCE

THE International Economic Conference held under the auspices of the League of Nations, which met at Geneva on May 4, concluded its session on Monday, May 23, when it adopted its final report.

As is well known, this Conference met to consider the general economic situation of the world. Representatives of fifty nations took part in its deliberations, and the report issued as a result of the Conference indicates the vast and complex problems with which it had to deal. A feature of great importance was that, for the first time in a Conference of this character, agriculture has been represented side by side with commerce and industry; this alone gave emphasis to

the fundamental importance of agriculture in the general economic prosperity of the world.

The work of the Conference was divided between three main Committees—Commerce, Industry, and Agriculture—and the Final Report includes those prepared by each of these Committees and adopted by the Conference as a whole. The section of the Report dealing with agriculture, and the documentation prepared for the Conference, bring out clearly the fact that a widespread agricultural depression exists, not universal and not of equal severity between one country and another, but affecting a large number of those countries from which the world's supply of food and raw materials is obtained. The causes of this depression are complex, and the documents of the Conference made it evident that they differ very considerably between one country and another. For example, in those countries where there was a severe post-war inflation, the working capital employed in agriculture almost completely disappeared and the cost of obtaining credit rose to nearly prohibitive figures. Again, the taxation borne by agriculturists had, in some cases, risen to as much as three times its pre-war value. Another factor of great importance was the change in the political and economic frontiers in Central Europe. The old Austro-Hungarian Empire, for example, has been split up into a number of separate states, each of which attempted to pursue a policy of self-sufficiency, protecting its own industries by high tariffs, but increasing thereby the difficulties of exchanging agricultural and industrial products between these countries. A fourth factor was the great diminution in the stream of agricultural produce which, before the war, flowed westward from Russia and the Danubian countries, and consequently in the counter stream of industrial products from west to east. Where, formerly, Europe had drawn its supplies of foodstuffs so largely from these countries, it now looked to the United States, Canada and elsewhere.

All these facts and many others are shown, by the documents of the Conference, to have profoundly affected the world's agriculture, but not its agriculture alone, for the causes of agricultural depression were largely the same as those which operated against a revival of European industry and commerce. Perhaps the most significant feature of the section of the Report dealing with agriculture is the realisation of the essential inter-dependence of agriculture, industry and commerce; in the words of the Report, "it would be vain to

hope that one could enjoy lasting prosperity without the others."

The broad fact upon which the Report lays emphasis as a symptom of economic depression in agriculture, is the relatively lower level of agricultural prices, as compared with industrial prices, which is shown by the index numbers of several countries. The result has been the diminution of the purchasing power of the agricultural population. Although not true of all countries, "the documentation of the Conference," to use the words of the introduction to the Final Report, "indicates that if agricultural prices are low and the agricultural communities in many countries in a state of depression, it is not because there has been any abnormal increase in the production of foodstuffs, but because the demand from certain manufacturing communities in Europe is inadequate."

The Agricultural Report, the text of which is given below, necessarily represents an attempt to embody a great number of divergent points of view. Practically all of the 50 countries taking part in the Conference were interested in agriculture, but, not unnaturally, the outlook of the delegates from the various nations depended first of all on the national problem which confronted them, which differed very widely between one country and another. Nevertheless, bearing in mind what has been mentioned above, it will be seen that the Report, in effect, indicates two main directions in which an agricultural revival must be sought. One lies in the improved demand which would be created by an expansion of industry and commerce, and although the main recommendations of the Conference on the subject of trade barriers are contained in the section of the Report dealing with Commerce and not in that relating to Agriculture, nevertheless the recommendations of the latter concerning the removal of all hindrances to the free circulation of and trade in agricultural products, to the reduction of customs prohibitions both for industry and agriculture, and to the abolition of systems of export prohibitions and duties and of frequent changes in customs tariffs, are some indication of the importance which the Agricultural Committee attached to these matters.

The other direction in which improvement is to be sought is in raising the standard of agricultural technique, and the majority of recommendations contained in the Report are concerned with this subject. They relate to the extension of co-operation—particularly between producers' and consumers' organizations—to the improvement of credit facilities, to

international co-operation in providing statistical information and in the development of systems of farm accounting, and also to the development of forestry and colonial agriculture. Not the least important is the recommendation relating to an international campaign to combat plant and animal diseases, in connection with which the International Institute of Agriculture in Rome are proposing to call a further conference. In addition to the above, the Report makes certain recommendations in regard to the application of legislation to agricultural workers, and calls attention to the importance of improvement in stock breeding, marketing and the standardization of agricultural products. The full text of the Report of the Agricultural Committee is as follows:—

* * * * *

INTERNATIONAL ECONOMIC CONFERENCE

6. AGRICULTURE

1. Introduction.—Agriculture is the occupation of the majority of workers throughout the world; its various products represent in value the greater part of human labour, and the exchange of its products against industrial products forms, indeed, the basis of world trade.

The agricultural population remains for humanity a reservoir of energy capable of preserving the nations from the rapid human wastage which may result from any excessive growth of industry.

The quantity of foodstuffs and raw materials produced by agriculture is one of the factors which determine the maximum limit of industrial development.

The interdependence existing between nations is no less close between the main classes of occupations—agriculture, industry, and commerce—and it would be vain to hope that one class could enjoy lasting prosperity independently of the others.

Agriculture is at present hampered in the complete fulfilment of the economic role assigned to it by a general depression varying in degree but affecting a large number of countries on which the world depends for its supply of foodstuffs and raw materials.

The economic depression in agriculture is characterized by the disequilibrium which has arisen between the prices of agricultural products and those of manufactured products; as a result, agriculturists in a great number of countries no longer receive a sufficient return for their labour and on their capital. This depression is aggravated in many countries by the difficulty of obtaining credit on normal terms and by the great increase in fiscal charges; while it has led to a decrease in the purchasing power of agriculturists, consumers have not, in all cases, benefited by a fall in the price of foodstuffs.

The diminution in the purchasing power of the agricultural population has reacted upon industrial production, and is consequently one of the causes of unemployment, which in its turn reduces the outlets for agricultural products.

Unless practical measures are taken to restore the price equilibrium, it is to be feared that sooner or later there will be a diminution in agricultural production detrimental to the welfare of mankind.

Technical means exist, however, for a considerable development of agricultural production. They must therefore be put into operation. Their general adoption would have the most beneficial consequences for the prosperity and economic peace of the world.

II. General Resolutions.—(1) The Conference regards as a vital economic question the increase of agricultural production, and, with this in view, the placing of agriculture on an equal footing with industry by enabling all those engaged in agriculture to obtain a satisfactory standard of living and a normal return for their labour and on their capital.

It is important that this necessity should be brought home to public opinion, which does not always realize the true situation of agriculture and too often regards it as an industry of secondary importance.

(2) The improvement of agriculture must in the first place be the work of the agriculturists themselves. The general adoption of technical improvements, the scientific organization of production and stock-breeding, of the campaign against the diseases and the enemies of plants and animals, of marketing, of the standardization of agricultural products in the interests both of the producers and consumers, of the search for outlets, and of credits and insurance, will permit agriculturists to reduce their costs of production in their own interests and to the benefit of consumers.

Owing to the considerable number of small and medium-sized agricultural undertakings—the tendency towards concentration displayed in industry being absent—the organization of agriculturists should be continued along the lines of association and co-operation which have already been tested in many countries; it may with advantage be supplemented by agreements between agricultural and consumers' co-operative societies.

It is to the interest of Governments to encourage agriculture and the agricultural associations which have as their object the improvement of the situation of the agricultural population. In particular, the creation and development of mutual credit would be greatly facilitated by Government assistance.

The Conference draws the attention of the Governments to the fact that high rates of interest and heavy taxation hamper production.

(3) Other measures to be contemplated depend chiefly on legislative action. In particular, the Conference is of opinion that social laws ensuring the welfare and security of workers should benefit agriculturists no less than industrial workers and employees, it being understood that such laws must be adapted to the special requirements of agriculture and to the special living and working conditions of rural populations. It is also of the opinion that agricultural instruction at all stages and the technical training of agriculturists should receive the attention of the different Governments as well as of agricultural associations.

(4) It is desirable that all hindrances to the free circulation of and trade in agricultural products should be removed, in so far as their removal does not endanger the vital interests of the different countries and their workers.

In those States in which Customs protection is maintained, it should be reduced, both for industry and agriculture, to the lowest possible point indispensable to production; care should be taken to assist in the maintenance of an equitable balance between industry and agriculture and not to stifle one to the advantage of the other.

The system of export prohibitions and export duties (with the exception of taxes levied for the benefit of the industry concerned)

and frequent changes in Customs tariffs, which long experience has shown to be ineffectual and dangerous, should be definitely abandoned.

(5) The agriculturist should find his just remuneration not through speculation but in the regularity of prices, permitting him to reckon on a legitimate return equivalent to that accorded to other producers.

(6) Since, finally, the policy pursued in industrial or commercial questions reacts on the economic situation of agriculture, and *vice versa*, the Conference requests the League of Nations to ensure that in all its organizations already existing or to be formed which are or may be entrusted with economic questions a place be always reserved for agriculture proportionate to its importance as a social and economic factor.

III. Special Resolutions.—In addition to the general resolutions formulated above, the Conference draws the attention of the League of Nations to the following points:—

1. *Agricultural Co-operation: Relations between Agricultural Co-operative Societies and Consumers' Co-operative Societies.*—(i) The agriculturists of the different countries contribute to the improvement of their standard of living and to the general prosperity by utilizing to an increasing extent all forms of co-operation: co-operative supply societies, either for the technical or domestic requirements of members; co-operative selling organizations for the regular marketing of products; producers' co-operative societies for the intermediate processes between the production of the raw material and the sale of the finished product; co-operative credit societies to meet the need for capital (bringing equipment up to date, improving the cultivation of the soil, storage of products).

Co-operative institutions thus increase the purchasing power of agriculturists both as producers and as consumers. At the same time they further economic progress both by increasing productivity and improving quality and also by making it possible to utilize fully the products of the soil and their by-products. Lastly, they assist the organization of markets by methods which reduce to a minimum the costs of distribution.

(ii) Agricultural co-operative societies will contribute to a still greater rationalization of economic life in proportion as they develop their relations with the consumers' co-operative societies. Direct commercial relations between producers and consumers, and between associations of producers and of consumers, eliminate superfluous intermediaries, and, when they are sufficiently widespread, result in the establishment of prices which are advantageous to both parties. In addition to material profit, there is a moral advantage; by direct commercial relations producers and consumers learn to know each other and to take account of the special characteristics and requirements of the other party. The producers' and consumers' co-operative societies learn to appreciate the value of direct relations in accordance with their common principles. The clear realization of the possibility of mutual collaboration and mutual confidence in business transactions are essential to a practical solution of the question of direct commercial relations between producers' agricultural co-operative societies and consumers' co-operative societies—a question which has for a long time past been settled in theory.

The efforts made to achieve practical results should be furthered on the part of agriculture by the production of articles of specific quality and uniform type; on the part of the consumers' co-operative societies by the determination to buy agricultural produce as far as possible from the agricultural producers' co-operative societies; on

the part of States and of public authorities by supporting the co-operative movement through the creation of chairs at universities or of other scientific institutions, the institution of public courses dealing with the co-operative movement, and by a fiscal policy of abstention from discriminatory measures against co-operative societies.

Effective collaboration, if need be in the form of common undertakings, will be the easier of realization if the producers' and consumers' co-operative societies of the different countries are already nationally organized in common economic committees.

To ensure the normal development of co-operation in all the branches in which it exercises its activities, it is extremely important that the laws which govern co-operation should be unified where such is not yet the case, and should impose the fewest possible obstacles.

(iii) International agreements between co-operative agricultural organizations with regard to a number of products might be of value in placing markets on a sound basis, in regularizing production and in stabilizing prices at levels satisfactory from the point of view of the balance between production and consumption. Such international agreements, to attain their aims, require loyal collaboration with the national and international co-operative consumers' organizations by the establishment of regular business channels and long-term contracts.

(iv) These efforts of agricultural and consumers' co-operative organizations should be encouraged and furthered by the creation of a committee representing national and international co-operative organizations of agriculturists and of consumers—a committee which should be entrusted with the establishment of a programme of research and documentation, as well as with the task of elucidating the lessons taught by past experience, with a view to bringing about new achievements.

2. *Agricultural Credit.*—The increase of agricultural production is intimately bound up with the organization of agricultural credit, which will place at the disposal of agriculturists the necessary capital on favourable terms.

Certain countries have at their disposal sufficient capital for agriculture, but in many countries adequate provision for agricultural credit has not as yet been made, either because saving has been diminished by the general economic conditions or because the appropriate organizations have not yet been constituted.

Such a position is seriously harmful to agriculture in the countries in question, since it prevents agriculturists from increasing their harvests, from exploiting their land to the full extent, from securing lower costs of production and from providing for contingencies arising from the very nature of agricultural production by the use of suitable equipment or of a reserve working capital.

The first condition for surmounting these difficulties is the organization of suitable credit institutions in those countries where they do not yet exist and their development where they are already in existence. The best form of institution appears to be the co-operative credit society operating by means of resources which the very fact of association enables it to procure and to increase with or without the assistance of the public authorities.

It is, moreover, by the co-operation of national organizations that the necessary effective guarantees for appeals for credit, whether national or international, can be most easily procured.

Having had laid before it by several of its members schemes with regard to the setting up of an international organization capable of increasing the resources available for agricultural credits where they are as yet insufficient;

But having heard observations on that question based chiefly on the elementary consideration that credit must be secured by effective guarantees ;

And being aware of the fact that the International Institute of Agriculture is collecting special information on the question of agricultural credits :

The Conference requests the League of Nations to give full consideration to the documentation of the International Institute of Agriculture with a view to examining the possibility of international collaboration in respect of agricultural credits in whatever form may be found from experience to be most suitable with a view to promoting the recovery of agriculture where agriculture is short of capital.

3. *Campaign against the Diseases Affecting Plants and Animals.*—Diseases which affect plants and animals diminish agricultural production, and should be scientifically combated, on the basis of an international plan and international agreements.

This international campaign has already been admitted in principle by 43 nations, which have set up an "International Epizootic Office," and the International Institute of Agriculture is proposing to convene a special conference to bring about united international action in connexion with phytopathology.

International agreements which establish sanitary supervision, if they provide the contracting countries with adequate guarantees, should, without infringing sovereign rights, remove from the regulations any suspicion of disguised protection, and should add to the stability of trade relations, which is one of the conditions of successful production.

4. *Agriculture in Colonies.*—The Conference recommends that an investigation be made into the best means of encouraging agriculture among the indigenous inhabitants in colonies, and especially in tropical and sub-tropical colonies, in order to augment the prosperity of the indigenous inhabitants of those countries and to increase the general wealth.

5. *Forestry.*—The Conference recommends that a special study should be made of the resources and the exploitation of forests in order to assure the regular satisfaction of the needs of industry.

6. *Documentation on Agricultural Questions.—Statistics.—Inquiry.*—(i) Great as is the value of the documentation which has served as the basis for the discussions on agriculture, it must be acknowledged that there is not yet a sufficient foundation to permit of a complete analysis of all the problems or to suggest a solution of them.

The fundamental importance of agriculture demands an exact knowledge of its economic situation. Such knowledge can only be gained satisfactorily through a methodical analysis of farm accounts. Such researches would bring about a general improvement in agriculture. They would facilitate the mutual understanding between the nations, and the common interests of the agriculturists of all countries would thereby be interpreted with precision. Finally, a better understanding would be created between the producer and the consumer.

To achieve this purpose, it is desirable that in the different countries an exact system of farm accounting should be formulated. These accounts should be drawn up in every country as simply as possible, but by the method ensuring the greatest guarantee of accuracy, so as to obtain comparable results for the different kinds of agricultural enterprises in any country, classified by climate, nature of soil, size of holding, systems of cultivation, principal crops grown, etc., and so as to make it possible to study the influence exerted on the net return of agriculture by the factors of greatest importance in production and returns (wages,

quantities of chemical fertilizers consumed, taxation and social charges, prices, indebtedness of agriculturists, etc.).

It is therefore recommended that a committee of experts be established charged with the study and preparation of the requisite measures.

(ii) The Conference considers it necessary that a better service of periodical agricultural statistics should be instituted, especially as regards live stock and animal products. The data collected by the International Institute of Agriculture show that, during the last 25 years, only 37 countries, representing less than half the total area and about 30 per cent. of the population of the world, have as yet proceeded to the compilation of an agricultural census.

A world agricultural census on the lines proposed by the International Institute of Agriculture would make it possible to give to the statistical data of the different countries a character of uniformity which up to the present they have lacked.

It is no less necessary to organize, nationally and internationally, the speedy transmission to agriculturists of information on harvests, stocks, consumption, and the movements of different commodities, these being important factors in the formation of prices. The monthly publication of indices of comparative prices of agricultural products and industrial products would prove of great value, as would indices of the principal elements of the costs of production of agricultural products.

(iii) The Conference requests that all Governments should be invited to initiate a general inquiry into the present situation and the possibilities of developing agriculture, the distribution of holdings and the systems of exploitation, into the relations between agricultural and industrial production, into the comparison between agricultural and industrial prices, into the costs of production and selling prices, into the condition of the workers and into the facilities required for their access to the land, etc.—in fact, into the economic, social, financial and technical conditions of agriculture, the study of which will permit further progress to be made.

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MARKETING DEMONSTRATIONS AT AGRICULTURAL SHOWS

IN this JOURNAL for April last (p. 8) were given particulars of the shows at which the Ministry proposed to demonstrate improved methods of marketing during the present summer. During May, demonstrations were given at the Oxfordshire Show (May 18-19) and at the Bath and West and Southern Counties Show (May 24-29). At the former show, the demonstration was limited to eggs and poultry ; at the latter, the demonstration covered the marketing of eggs, poultry, fruit, pigs and pig products. During June, demonstrations were given at the Suffolk Show at Ipswich (June 2-3), Three Counties Show at Worcester (June 7-9), Royal Cornwall Show at Truro (June 8-9), and the Lincolnshire Show at Spalding (June 22-24). With the exception of the Three Counties Show, the demonstrations during June related to egg and poultry marketing. The demonstration at the Three Counties Show related to fruit.

The demonstrations proved very attractive and seem to have been much appreciated; the large numbers of visitors who passed through showed considerable interest. Leaflets explaining the object and scope of the demonstrations and the special marketing leaflets issued by the Ministry were in great demand; over a thousand copies of the marketing reports in the Ministry's Economic Series were sold. H.R.H. The Prince of Wales honoured the demonstration at Truro with a personal visit. The Imperial Economic Committee, the Royal Commission on Agriculture in India (of which Lord Linlithgow is Chairman) and representatives of the Standing Committee appointed under the Merchandise Marks Act, 1926, made special journeys from London to see the demonstrations at Bath, which were also visited by the Minister.

The following is an outline of the demonstrations, the main features of which were fully explained to visitors by a series of posters.

Marketing of Eggs.—*The Care of Eggs.*—The perishable nature of eggs is not sufficiently realised. Attention was, therefore, drawn in various ways to the importance of the care of eggs from the moment they are laid. Absolute cleanliness is essential. Dirt on the shell not only detracts from the appearance but may contaminate the contents, particularly if moisture is present when mould growths may develop inside the shell and give a musty flavour. The shell of an egg is porous and the contents evaporate at a variable rate according to the thickness of the shell and the conditions under which the eggs are kept. Further, it follows from the porous nature of the shell, that eggs are likely to become tainted and their flavour impaired when placed near strong-smelling goods.

Sale of Eggs by Weight.—The sale of eggs by weight is now compulsory in Northern Ireland. The procedure is simple, but it is an innovation so far as England and Wales are concerned and an endeavour was made, in various ways, to illustrate its advantages. Wholesale transactions on the basis of weight are fairer to all concerned than sale by count.

Candling.—The object of the "candling" exhibit was to afford ocular demonstration of the blemishes and wide variations in quality frequently met with in eggs, and, further, to illustrate methods of testing which are indispensable to the distributive trades. It is not suggested that producers who pay due attention to the collection and storage of eggs should necessarily candle all their supplies. Candling should, however, be undertaken by distributors as a routine safeguard to their business.

Grading.—Grading is essential if eggs from the surplus-producing areas of England and Wales are to take their rightful place in the large consuming centres. The chief advantage which the foreigner possesses in our markets is the fact that foreign eggs are uniformly graded according to a definite system and can safely be bought on description. Home-produced eggs must therefore be put in a position to carry a similar guarantee of reliability. It is not, however, sufficient that they should be graded according to the theories of this sender or that. What is required commercially is not a multitude of grading systems, but one system of grading for both size and quality that is so widely recognized and practised that the grades become, in effect, *national standards*. A display of home-produced eggs graded in accordance with the standards proposed by the Ministry was on view; in addition, commercial samples of imported eggs were shown to illustrate the nature of the competition which confronts the home producer. Of special significance was the display of well-graded eggs from Northern Ireland and the Irish Free State, which showed what legislation can do for the producer in the direction of better marketing. Until recently, no mechanical means of egg grading suitable for general adoption had been evolved, but a mechanical egg grader was exhibited of a type which is now largely used in Ireland, and attracted much attention.

Packing.—Packages should weigh as little as possible consistent with adequate strength, should be easily packed and unpacked, and should be designed not only to show their contents to the best advantage but to withstand severe handling in transit. Care should be taken to use only clean packages and clean, dry, non-odorous packing material; this is of special importance for eggs that are destined for the cold-store (*see later*), when a well-ventilated package is also essential. Finally the branding of cases with the name of the consignor and an accurate description of the contents is an effective advertisement. These considerations were brought out in the exhibit. Of particular interest were two designs for brands, one for use by local organisations of packers and the other for use as a national mark. Some of the packages in use for imported supplies were to be seen in the exhibit of packed eggs from Dominion and foreign sources. Specimen standard non-returnable boxes, as recommended for home-produced eggs by the Committee* recently set up by the Ministry for

* See this JOURNAL, June, 1927.

that purpose, were on view, also examples of packing materials.

Organization.—Large producers are, themselves, in a position to grade their eggs before sale and many of them do so, but, as a rule, the supplies of any given area can be most efficiently and economically tested, graded and packed, when concentrated locally at specialist packing stations for the purpose. This also ensures regular and economical consignment. Packing stations need not be co-operative, but if, in any area of surplus production, existing facilities are insufficient, or inefficient, or both, it may be desirable for producers to combine to establish packing stations for themselves. By means of a diorama, an attempt was made to illustrate the "packing station" idea; packing stations lead, through standard grades and packages, to a national brand or trade mark (see above), and so to national advertising.

Marketing of Poultry.—*The Right Stages at which to Market Fowls.*—The manner in which surplus poultry is placed on the market in this country is frequently very wasteful; large numbers of fowls are sold at wholly unsuitable and unprofitable stages of development. This is sometimes due to neglect, but more often to lack of knowledge. Attention was, therefore, directed to this point by means of simple and well-chosen illustrations.

Sale by Live Weight.—A poster explained that this is a common practice for turkeys and geese, and it is customary, in some parts, for fowls and ducks. Its general adoption is desirable as bringing into prominence differences in price due to variations in quality and as being a fairer basis of sale than sale by the head.

Conditioning.—The conditioning of poultry before slaughter is of great importance and may be regarded as a ripening process. An economical method was demonstrated. Conditioning must be more generally practised than is the case to-day if the poultry trade is to develop. Specialized fattening, as carried out in Sussex, is an extension of the conditioning process.

Dressing Poultry for Market.—The methods of killing and dressing demonstrated represented the best commercial practices. Variations in the methods of dressing occur in different parts of the country, but greater uniformity is desirable and closer attention to detail.

Grading.—At present, the practice of grading is hindered by the lack of any uniform method of classifying home-produced poultry, and the time has come when some attempt should be made to introduce a standard system of classification and grading which is suited to British conditions and capable of general adoption. The commercial advantages of such a course are obvious. So far as the supplies available would allow, displays were given of the standard classes and grades which it is suggested should be applied to home-produced poultry; these sufficed to show that if producers and distributors would give their close attention to the problem, the general adoption of a standard system need not be far distant. The exhibits of poultry from the Dominions illustrated the value of efficient grading and of marketing a *standard* article. Commercial samples of graded supplies from foreign sources were also shown.

Packing.—Packing is closely linked with grading. In order to simplify grading, it is desirable to pack in comparatively small units. Distinctive types of packages for home-produced poultry are desirable, and it is necessary for greater convenience in trade that these should be non-returnable; inexpensive, standard, non-returnable packages, as recommended by the Committee referred to above, were shown. The packages in use for imported supplies were on view in the display of graded dressed poultry from Dominion and foreign countries.

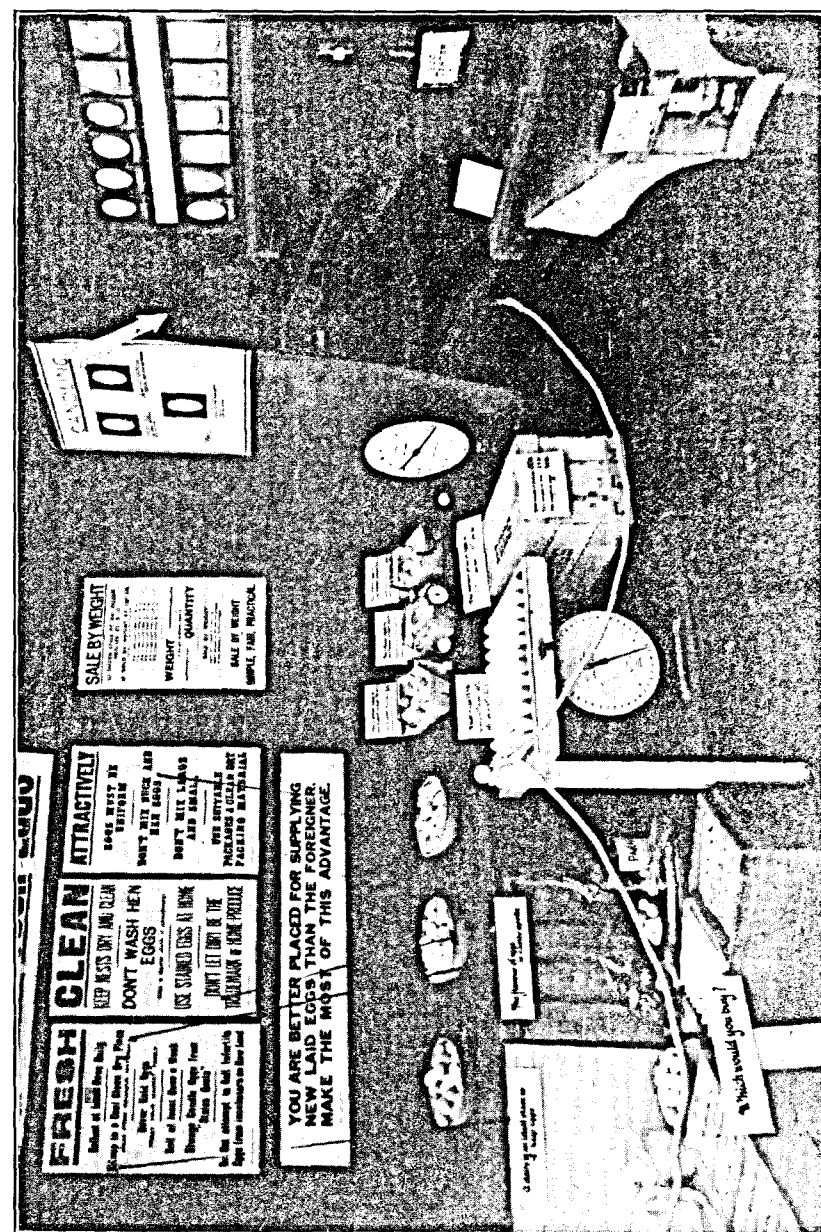
Cold-Storage.—Cold-storage is of growing importance to the poultry industry. The carrying over of seasonal surpluses to meet trade demands when supplies are short is a necessary public service. The special methods of preparation and packing desirable for produce intended for cold-store are, however, neither widely known nor understood. An exhibit dealing with the cold-storage of both eggs and poultry was, therefore, arranged in conjunction with the Low Temperature Research Station at Cambridge. This conveyed much practical information of value. The chilling of dressed poultry before dispatch to distant markets is another point of importance. The small chilling plant shown was of particular interest to wholesale buyers in country districts. Serious losses are sustained in hot weather if dressed poultry arrives on the large central markets in a condition unfit for sale, through failure to chill the carcasses rapidly and adequately before packing. Preliminary chilling, immediately after killing, is also essential for supplies that are intended for transfer to distant cold-

Organization.—The attention required in the final conditioning of poultry for the table is often not justified with small numbers. There would, therefore, seem to be room for many more specialist conditioning plants where birds can be assembled from local farms and markets for systematic preparation in large numbers. At such plants, birds can also, as a general rule, be more economically and efficiently dressed, graded, packed, stored, transported and sold by a specialist staff handling large quantities, than by individual producers operating independently on their own farms. In fact, standardization can hardly be achieved in any other way. As in the case of egg-packing stations, these conditioning and packing stations for poultry need not be co-operative, but if, in any area of surplus production, other agencies are insufficient or are working on too small a scale or are otherwise not up-to-date, producers may find it necessary to combine and undertake these specialist services for themselves. A diorama illustrated the "conditioning and packing station" idea. The combined conditioning and packing plant is common in America, Holland and elsewhere. Conditioning and packing stations must inevitably play an important part in marketing developments in the surplus-producing areas of this country.

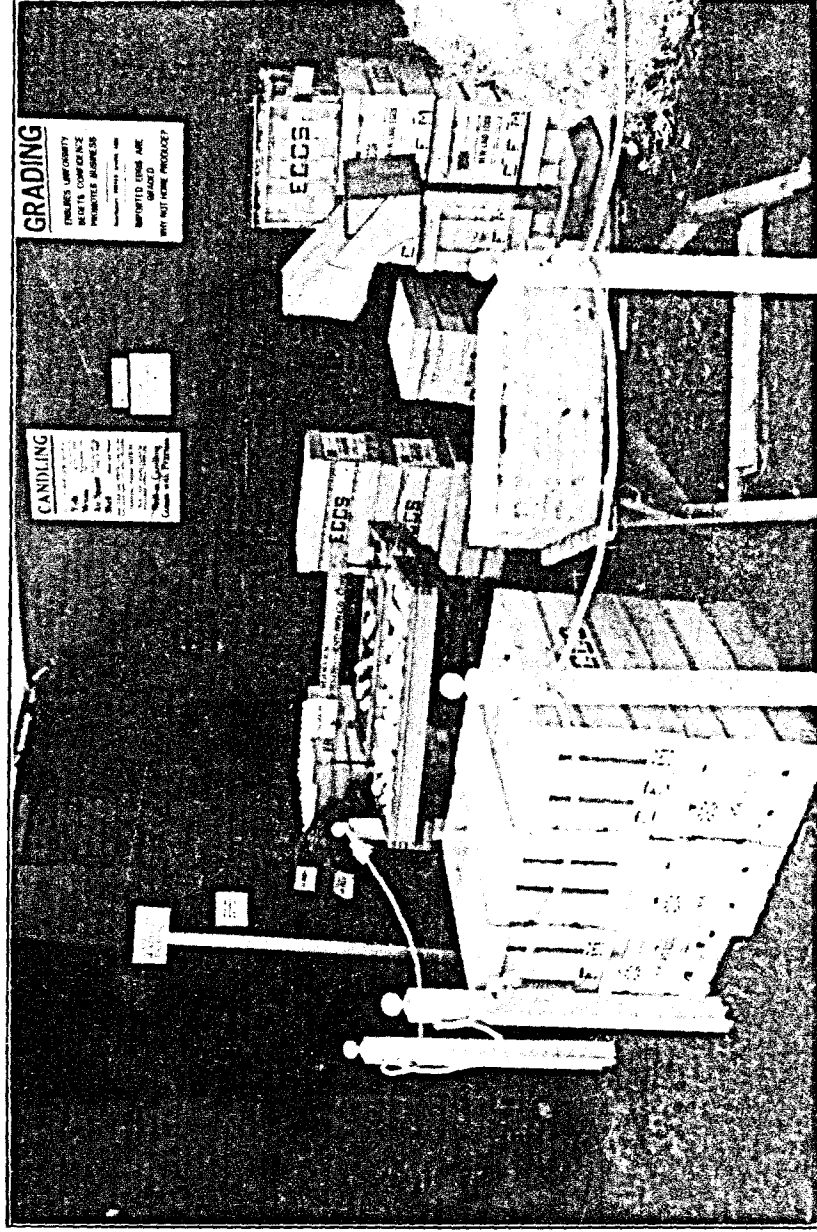
Marketing of Fruit.—Varieties.—The factors which determine the comparative value of particular fruits are: soil and situation where best grown, cropping capacity, age at which fruiting commences, period of profitable bearing, susceptibility to attacks of pests and diseases, edible, keeping, packing and transit qualities, and popularity with consumers. A list was shown of varieties which are now established as commercially valuable and well known on the markets.

Thinning.—A well-worded poster brought out the significance of this essential market preliminary. As with vegetables and roots, fruits, such as apples and pears, must be allowed sufficient room to develop and mature. It should be borne in mind that, although thinning may reduce the total number of fruits, it increases the number of higher grades of fruit and gives fruit of more uniform size and colour; culls are reduced to the minimum. Finally, thinning prevents exhaustion of the tree in glut years and assists more regular production. The early thinnings of early varieties of cooking apples may often be profitably marketed.

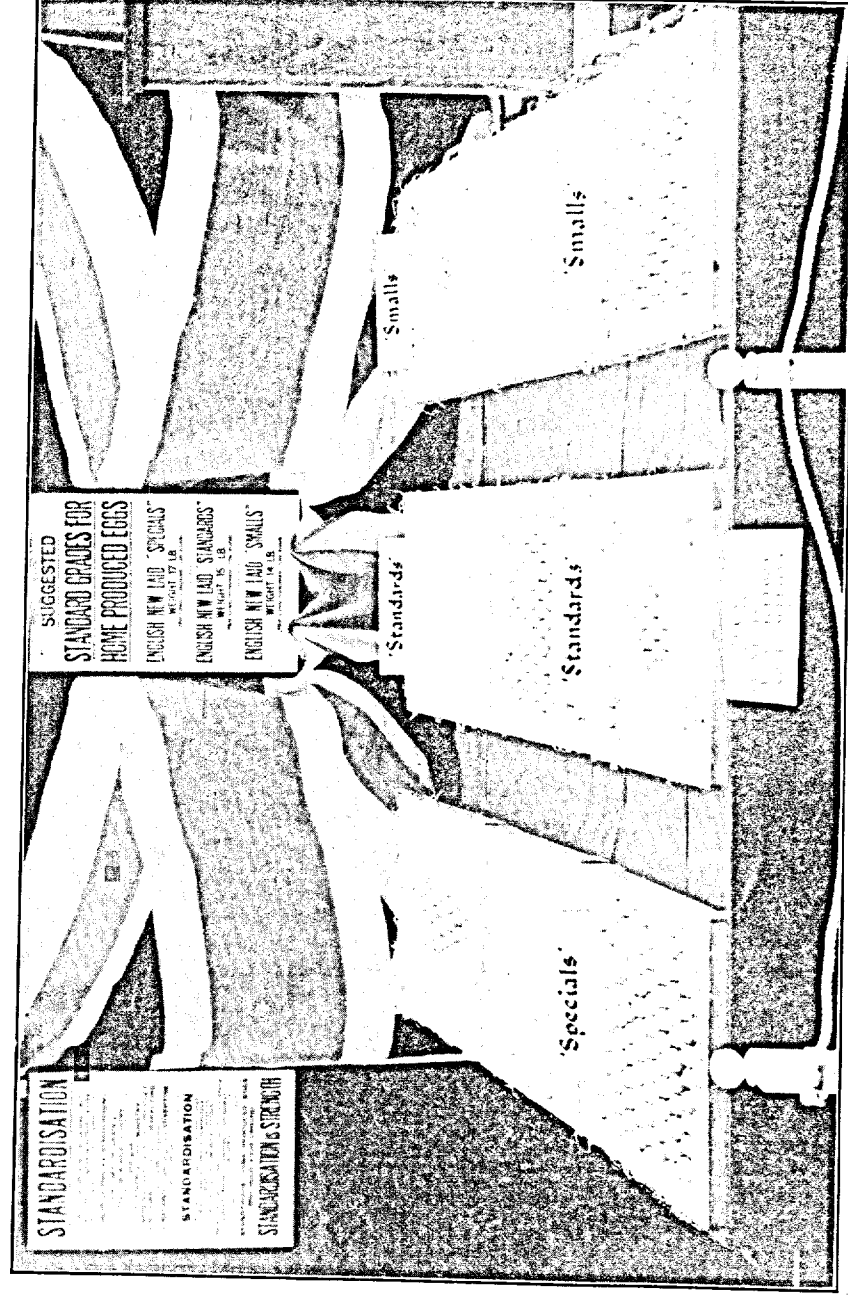
Picking.—The harvesting of the crop is a marketing operation of great importance, which often receives too little attention. In many instances, the poor and damaged appearance of



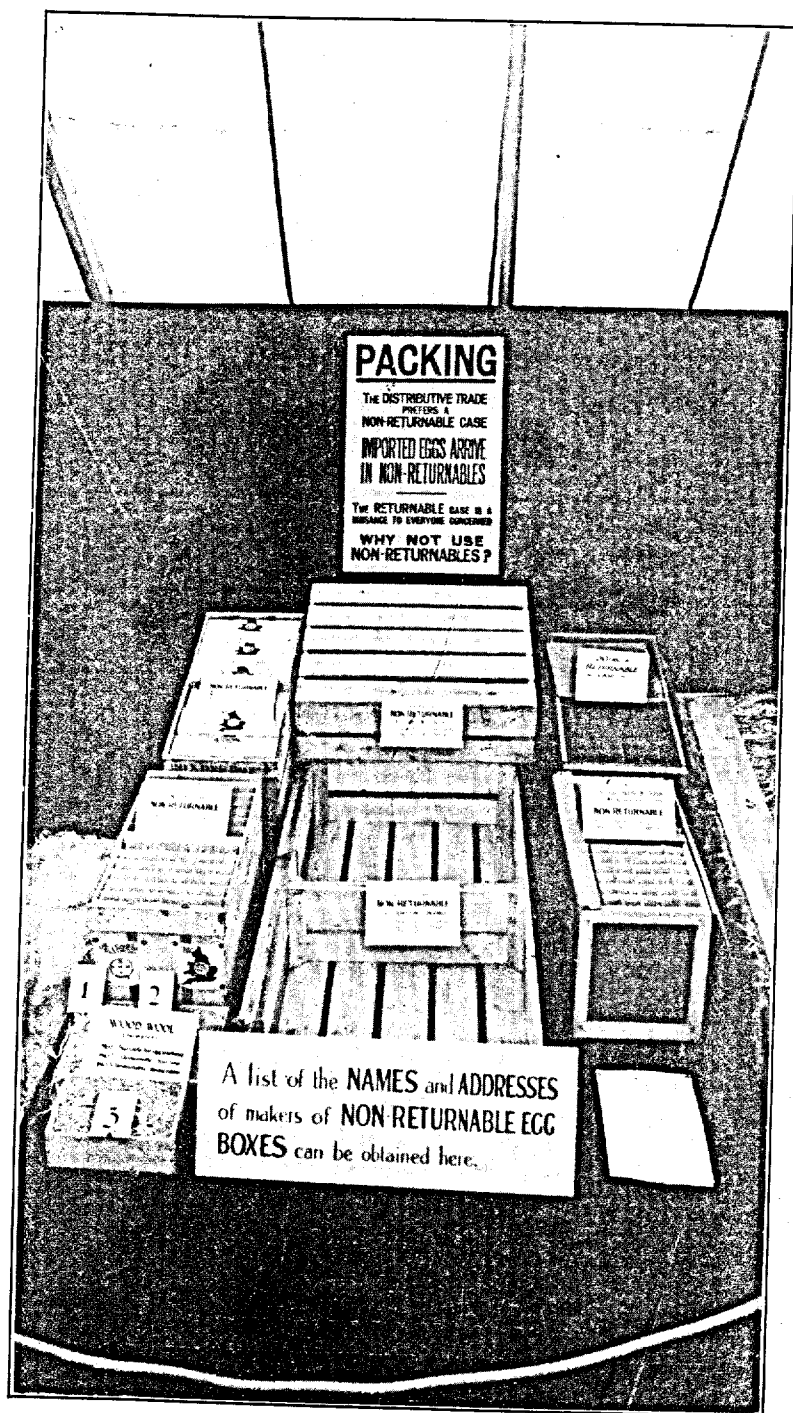
A section of the exhibit dealing with preliminary care of eggs by producer, and sale by weight.



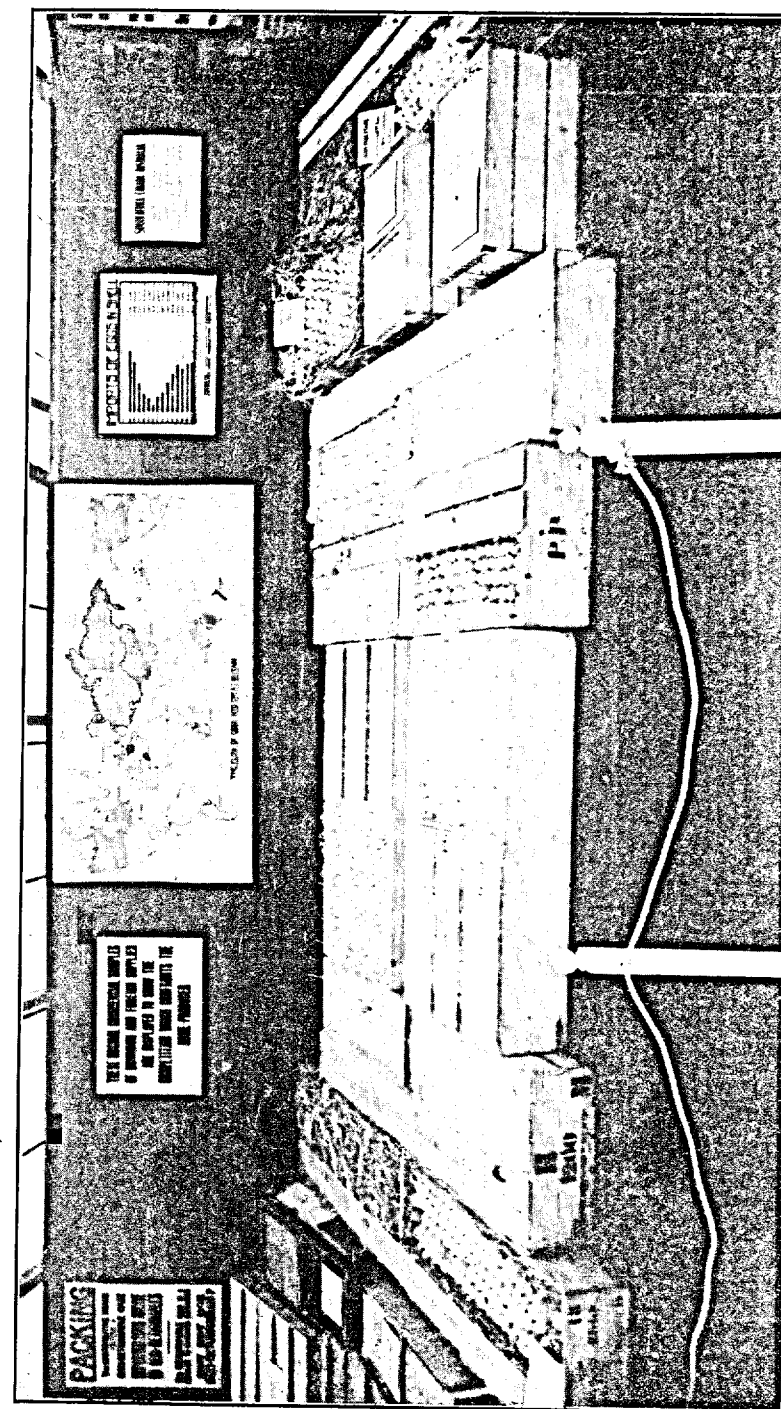
The candling, grading and packing section, showing mechanical grader and daylight tester.



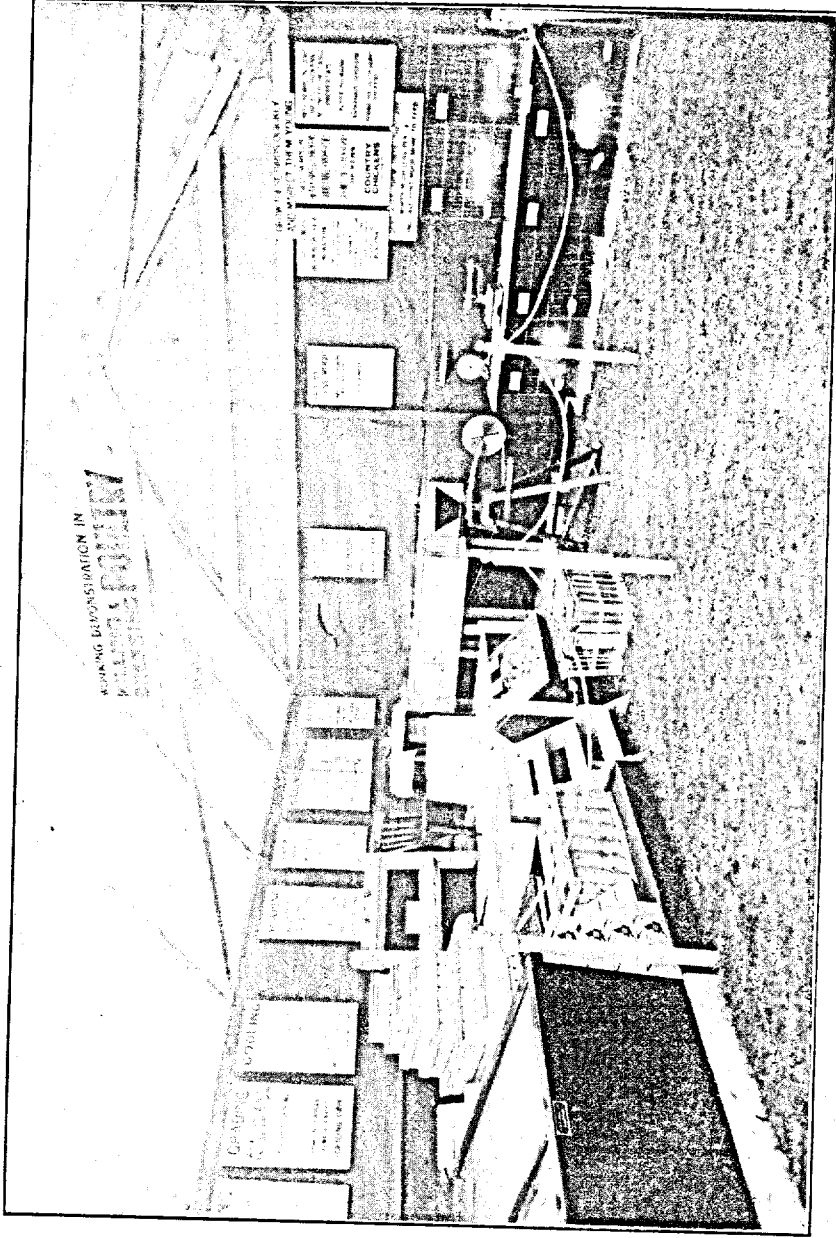
Eggs graded according to the Ministry's suggestions.



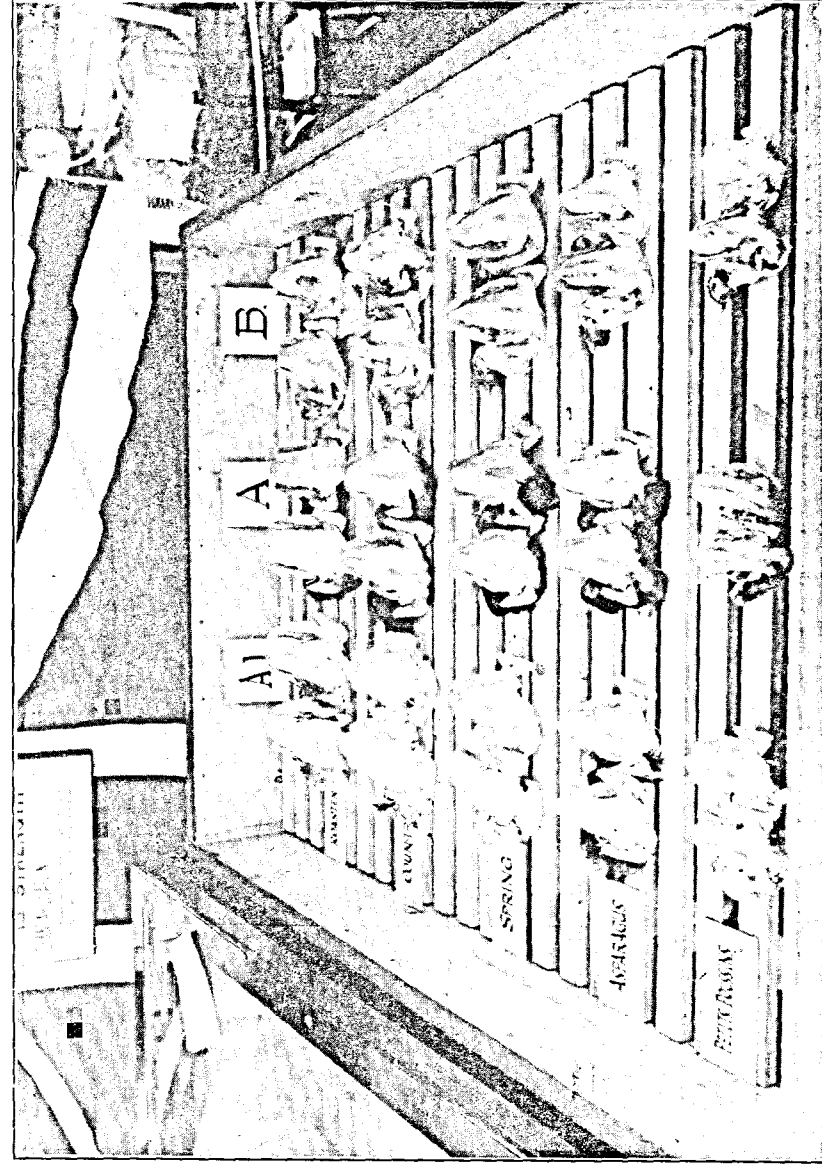
Types of egg-packages in use or recommended.



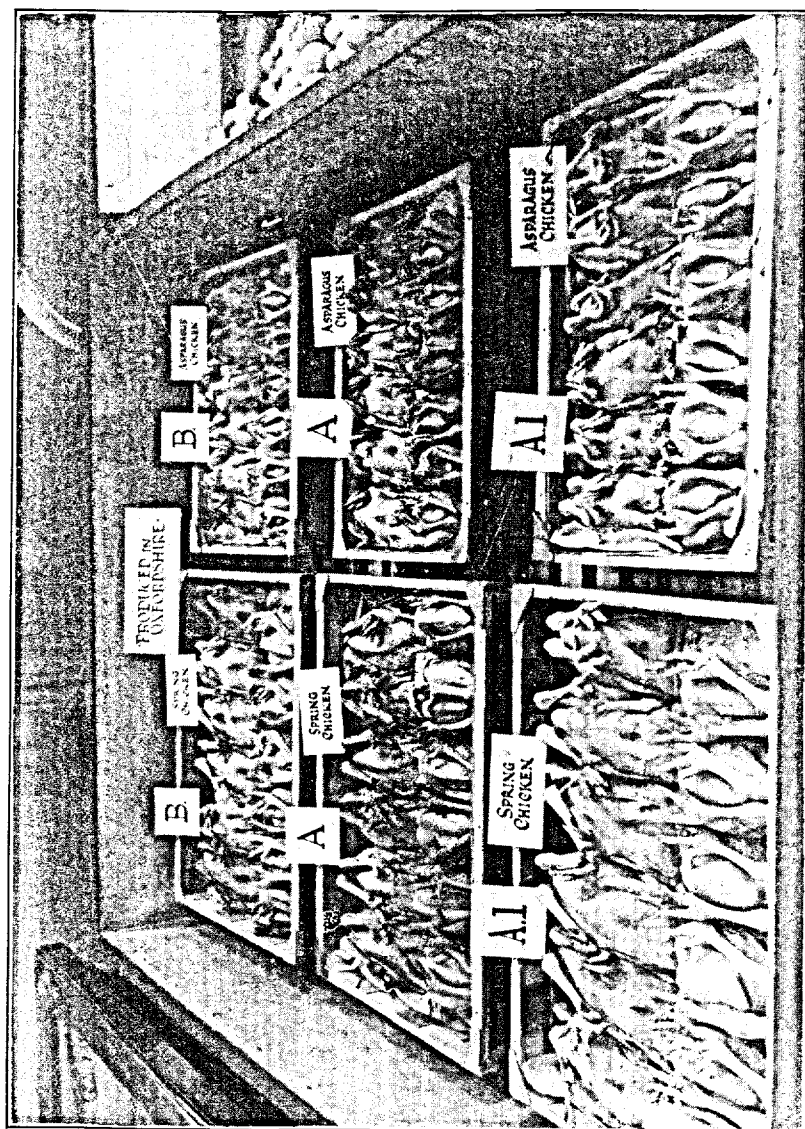
Samples of Dominion and foreign eggs.



A corner of the poultry marketing demonstration.



Fowls graded according to the Ministry's suggestions.



Specimen standard packs for home produce, as recommended by the Ministry.

graded and packed fruit as seen on the markets can be traced to rough handling in the course of picking, although the damage may not have been noticeable at the time. Injury may result from the employment of careless pickers, from lack of supervision, or from the use of unsuitable receptacles. Hard fruits more often bear evidence of careless and unskilled handling than soft fruits. Strawberries, currants, raspberries and fully-ripe soft fruits of other kinds are so obviously damageable that they are instinctively handled with greater care.

In order to avoid re-handling, soft fruits for dessert purposes are usually, and rightly, picked direct into the market package.* Apples and pears, on the other hand, are usually picked into baskets or pails and then transferred to storage or "orchard" boxes before removal to the packing shed. If unlined wicker baskets or rough-sided boxes are used, the fruit may be damaged. A sharp blow, or even a skin puncture due to one fruit knocking against the stalk of another, may result in the setting up of rot which will seriously depreciate the value of the fruit and make it useless for storage. Suitable types of picking receptacles were shown. The crate pattern of orchard box is well adapted for hard fruit; it is of convenient size for handling and economical of storage space.

Ladders for picking orchard fruit should be strong, but light; heavy and cumbersome ladders, that are likely to cause injury to branches and spurs, should not be used; the three-leg step ladder is to be preferred for medium-size trees. The ladders illustrated in the exhibit were suggested as the most practical for fruit-picking.

Grading.—It is not generally realized that the market for ungraded fruit in this country is rapidly contracting. The high standards of grading adopted by overseas growers who market their fruit here, and the steady increase in the quantity of graded home-grown fruit coming on to the markets, must eventually force low-grade fruits out of the main channels of trade. Indeed, the best buyers do not purchase ungraded fruit.

Many home growers make some attempt at grading their fruit before sending it to market, but the methods adopted not only vary from one grower to another, but are frequently crude and are rarely precise. A multitude of grades, and of grading methods of varying degrees of efficiency, is a serious business weakness which hampers distribution and handicaps home-grown fruit in its competition with imported supplies. What is

* It is hoped to reproduce illustrations of this demonstration in the next issue of this JOURNAL.

needed is the adoption of *standard* grades for home-grown fruit. A complete set of standard grades has been put forward by the Ministry; these have been carefully drafted and are believed to be suited to British conditions. Where possible, samples of fruit graded to these standards were shown. Comparison of these samples with those of ungraded fruit demonstrated the obvious selling advantages and more attractive appearance of the graded product. It is by such methods of uniform grading that large shipments of imported fruit change hands by sample, and, in many instances, by mere reference to the label or brand on the package.

Several types of hand-grading machines are in use in this country—mainly on the smaller fruit holdings—and a number were shown or illustrated in the exhibit. As a rule, hand-grading machines grade for size only and do not have adequate provision for grading for colour and blemish. The power-driven mechanical grading machines of large capacity, such as that demonstrated, are intended for use when considerable and continuous supplies of fruit are available.

Large low-grade apples and pears find an outlet in canning factories, which also take well-grown samples of other fruits. To ensure the best results, all soft fruits for canning must be graded carefully for colour, size and ripeness. There is an increasing demand for cull apples for cider purposes. The importance of commercial and domestic canning and of other subsidiary outlets was demonstrated.

Packing.—Firmness and tightness of pack are essential. Fruit will support considerable pressure if this is evenly applied and distributed, but packs that become loose lead to serious damage through bruising. Fruit should, therefore, be so packed that contact is maintained throughout transit. The methods of packing apples and other fruits demonstrated or exhibited were simple and have been arrived at after considerable commercial trial. They are suggested as standard methods of packing home-grown fruit.

Packages.—Some 25 years ago, growers began to realize that a package, cheap enough to be used once only and sold with the contents, removed many of the difficulties associated with the use of returnable containers. The first breakaway from the old system was made by strawberry growers, whose need for speed and elasticity in distribution is very great. The adoption of non-returnables for other fruits followed somewhat slowly at first, but there are signs that the returnable-

basket system for all fruits is threatened with ultimate extinction for other than local trade. In an average season, the number of non-returnable packages used for home-grown fruit already approximates to 24 million. These are almost wholly used for strawberries, raspberries, currants, tomatoes and cucumbers. On the other hand, non-returnables are, as yet, only used to a comparatively small extent for apples, pears, plums and gooseberries. Imported fruits of these kinds arrive almost entirely in non-returnables and pass readily and freely through the markets, while home-grown supplies, in returnables, sometimes move with difficulty. Although the non-returnable system has made fair progress, growth has been haphazard and has resulted in an infinite variety of dimensions and capacities in all packages other than the apple box. The packages exhibited were those which the Ministry suggests should be standardized throughout the trade. Standardization of packages is as important as the standardization of grades, and both are essential for successful business, under present conditions, on the wholesale markets of this country.

Organization.—Modern developments in fruit distribution call, not only for standardization of grades, packs and packages, but also for large and regular supplies of the standardized goods. Individual growers can seldom, by themselves, supply the necessary volume, nor can they, as individuals, secure the most efficient distribution of their produce. To secure the best results and most economical working, the ungraded supplies from individual orchards and plantations should be concentrated at selected centres (packing stations) in the producing areas and there graded and packed by specialists and marketed, under their direction, in the form of a steady supply of graded produce. An organization of this kind need not be co-operative. It is difficult to demonstrate it in an exhibit and all that could be done was to suggest, by poster and diorama, the gap that the packing station should fill in the fruit growers' organization. It should be understood that no packing station can succeed unless assured of a steady stream of supplies, including all the growers' best fruit and not merely all his worst. Practically all imported fruit passes through packing stations.

Advertising.—All fruit is grist to the mill of the distributors whatever its source. It is their job to supply what is in demand. A demand for a particular product can be created and sustained by judicious advertising, and this has been accomplished by many of our overseas competitors who have succeeded in

popularizing a particular brand of fruit on the markets of this country. The home grower, on the other hand, is, at present, in a position only to advertise fruit in general, and any resulting increase in demand would, of course, be shared by his competitors. If the home grower wishes to advertise to advantage, he must establish brands of home-grown fruit and proceed to make them a household word. If packing stations in a particular fruit-growing area would agree to work to the same standards of grades, packs and packages, then an area brand or trade-mark becomes feasible. If, to carry the idea a stage further, packers in the various fruit-growing areas agreed to work to national standards, such as those suggested, then a *national* brand or trade mark becomes a possibility, and the home grower will then be in a position, by advertisement, to divert demand to the home-grown product. Suggested area and national marks were on view.

Refrigeration.—The cold storage of home-grown fruit is not undertaken to any great extent, although the practice is increasing. Numerous cold stores exist in consuming centres, but these are not generally used for fruit. In any event there is little cold storage accommodation where it is really wanted, that is, at the production point. Refrigeration of fruit can serve two purposes :—

(1) To hold fruit off the market at a time when supplies are heavier than the market demand and to prolong the marketing season. This is storage proper and, in the exhibit, attention is duly drawn to its importance.

(2) To reduce the temperature of fruit before its journey to market in order to delay the ripening processes so that it arrives on the market in a fresh condition. This is sometimes called "conditioning." If this is done as a preliminary to placing fruit in cold storage, it is called "precooling." A chilling plant suitable for this purpose was shown.

The technique of these two processes is different, but it is possible to combine both methods in one installation. It is of the greatest importance that fruit should be cooled within the shortest possible time after picking.

The Commercial Pig.*—A large proportion of the pigs marketed in this country fail in one or more respects to comply with the standard required by either the pork butcher or the bacon curer, the chief fault being excessive fatness. Further, owing to a lack of precise knowledge of the requirements of the different markets, many pigs are sold unclassified as to either weight or quality.

* It is hoped to reproduce illustrations of this demonstration in the next issue of this JOURNAL.

The object of the demonstration, therefore, was to show the *standard* of pig and carcass best suited to the various demand categories of the trade, and to illustrate the principal defects which make pigs unsuitable for any trade and consequently unremunerative to the producer. In this task, the Ministry was assisted by the National Federation of Meat Traders' Associations and the Western Curers' Association, and a committee representing these organizations selected the animals, carcasses and joints shown.

Live Pigs.—The live pigs exhibited were chosen, irrespective of breed, to illustrate the type, weight and conformation best suited to each of the following markets :—

Pen No.	Market	Grade	Representing a DEAD Weight of
1	Fresh Pork ..	Porkers	60-80 lb.
2		Porkets	80-100 lb.
3		Cutters	100-130 lb.
4	Wiltshire-Side Bacon Trade.	Sizeable Baconers	130-170 lb.
5	Midland and Northern Ham and Bacon Trades	Baconers	150-200 lb.

A pen of pigs (Pen No. 6) conforming to the weight requirements of the Wiltshire-side bacon trade, but unsuitable in other respects, was also shown.

The pigs in the first five pens, whether in the pork or bacon categories, had certain characteristics in common. Thus, there were no black pigs, neither did pigs of any one pure breed predominate. Heads were of medium size, indicating absence of excessive bone formation and of excessive weight in front; necks and shoulders were light, these being the least valuable parts of the carcass; backs were firm and level; ribs were well sprung and bellies had a straight underline; hams were broad, deep and full to the hocks; flanks were thick and well let down. Attention was duly drawn in the exhibit to the effect of unsatisfactory conformation on value.

It is the general opinion of the pork and bacon trades that certain first crosses are the most suitable for their respective requirements; these opinions were put forward in the form of statements signed by the trade organizations concerned and were displayed for information. It is significant that both butchers and curers are unanimous in the choice of the boar, the Large

White being insisted on, and both have almost identical preferences as regards sows. The Large White boar has played an important part in the principal countries which send Wiltshire-cut sides to Great Britain, namely, Denmark, the Irish Free State, the Netherlands and Canada, and also in those countries interested in the English pork market.

Carcasses, Sides, etc.—These were divided into three groups, representing the pork trade and the Wiltshire-side and Midland curing industries respectively, and were as follows:—

Pork Trade:—

- (1) Typical carcass of a "porker" (60–80 lb. dead weight).
- (2) Typical carcass of a "porket" (80–100 lb. dead weight).
- (3) Typical carcass of a "cutter" (100–130 lb. dead weight).
- (4) Unsuitable carcass showing results of indifferent feeding.
- (5) Unsuitable carcass showing seedy cut.
- (6) Carcass illustrating the method of packing for Smithfield Market, London.
- (7) Sections of carcasses cut transversely behind the shoulder to show the advantage of the arched as compared with the flat back.
- (8) Carcass showing depreciated value owing to excessive fatness.

Wiltshire-side Trade:—

- (9) Typical sides of bacon of the following grades:—
 - (a) Lean Sizeable English.
 - (b) Sizeable Danish.
 - (c) Sizeable English.
 - (d) Medium English.
- (10) Unsuitable sides showing bad conformation and disproportionate fat and lean.
- (11) Unsuitable sides, showing results of improper feeding.
- (12) Unsuitable sides, showing seedy cut.

Midland Trade:—

- (13) Typical best-grade English hams.
- (14) Unsuitable hams due to improper feeding.
- (15) Overfat and badly-shaped hams.
- (16) Typical shoulder-bellies for the Midland trade.
- (17) Unsuitable shoulder-bellies showing disadvantage of excessive fatness.
- (18) Shoulder-bellies, showing effect of feeding stuffs of too high oil content.

Typical Carcasses, Sides, etc.—Specimens of these were shown for each group. In the pork group, the carcasses of porkers, porkets and cutters corresponded to the live pigs in pens 1, 2 and 3. The carcasses were within the weight requirements specified; the meat was firm and of a good bright colour with a suitable proportion of lean to fat; the skin was thin, smooth and mellow. In the Wiltshire-side bacon group, three selections of English bacon and, for comparison, sides of sizeable Danish bacon were exhibited. It cannot be too strongly emphasized that only pigs of the type shown in pen 4

are suitable for the production of the best grades of Wiltshire-side bacon demanded by the consumer in this country. Similarly, in the Midland curing industry, the best grade hams, which are required for both home and export trade, and shoulder-bellies are produced from pigs of the type seen in pen 5. These conform in carcass specification to the pigs required for the Wiltshire-side trade; the range of dead weight is, however, slightly wider, namely, 7 score 10 lb. to 10 score.

Unsuitable Carcasses, Sides, etc.—The principal defects in carcasses for pork or bacon arise from unsuitable breeding or feeding, or both.

Unsuitable Breeding.—Breeds vary in their ability to meet the requirements of butchers and curers. Certain breeds, it is held, have naturally thin streaks and bellies; others have consistently thick streaks—unfortunately, thick streaks are often associated with excessive back fat; others, again, have a thick rind, others a thin rind, and so on. Black pigs are considered to suffer from certain disadvantages, namely, the visibility of *seedy cut*, which reveals itself as a black, spotty discoloration of the milk ducts of some *female* pigs, the unattractive appearance, when dressed, of black heads and feet and the racial tendency of the flesh to be of coarse texture.

Unsuitable Feeding.—Correct feeding, which is reflected in the substance, colour and texture of the flesh and, to some extent, the quality of the bone, is not less important than judicious breeding. It has often been said that the only pig to pay its way is the good pig well fed, and that the best pig, badly fed, will turn out a bad pig. Improper feeding may lead to excessive fatness, irrespective of weight; this is a common defect of home-produced pigs. The demand is for small, well-finished, fine-boned carcasses, with a good proportion of lean and a low proportion of offal, early maturity being an important consideration. Then, again, the use of inferior feeding stuffs, or the misuse of suitable foods, causes otherwise excellent carcasses to turn out practically worthless or to be reduced seriously in value. Swill-fed pigs are obnoxious to the bacon curer; carcasses of pigs indifferently fed on wash are common on the fresh pork market. Maize, rice meal and certain oleaginous foods, when fed indiscriminately, produce dark, coarse flesh and soft, spongy fat. The use of fish meal of the wrong kind, or in excessive quantity, or too close to killing time, taints the flesh and makes it unsuitable for either pork or bacon.

Specimens of unsuitable carcasses, sides, etc., illustrating the various points referred to above were shown for each group.

History charts, supplied by Harper Adams Agricultural College, giving details of feeding, weight and cost, and charts, photographs and diagrams, supplied by the Animal Nutrition Institute at Cambridge, relating to Scandinavian methods of pig recording, were also shown.

Packing of Pork Carcasses.—The correct method of packing for Smithfield Market, London, was demonstrated. Carcasses forwarded to this market, by either road or rail, should be suspended during transit, wrapped in clean stockinette or muslin cloth, further enclosed in stout hessian and completely sewn up.

By-Products.—All efficient industries pay as much attention to the by-products as they do to the main output. A display of small goods or delicatessen, a selection of various by-products, and a variety of pharmaceutical preparations were shown in order to demonstrate the commercial uses to which all portions of the pig are put.

* * * * *

HERBAGE SEED PRODUCTION IN NEW ZEALAND:

II—RED CLOVER AND LUCERNE

Professor R. G. STAPLEDON, M.A.,

Welsh Plant Breeding Station, Aberystwyth.

IN recent years, New Zealand has harvested considerable quantities of red clover. In 1924–25 the total crop amounted to 899 tons, which was in excess of all other herbage species, except rye-grass, while, since 1916, the crop has usually exceeded 450 tons. In 1925, the export amounted to 207 tons, rather less than one-third of this quantity going to Australia and the bulk of the remainder to the United Kingdom, though, doubtless, much of this latter was re-exported. Twenty years ago, New Zealand was importing more red clover than she exported—the exports now frequently exceed the imports.

About thirteen years ago, New Zealand was importing practically all her lucerne seed; this is rapidly altering, and, to-day, the majority of the seed used in the Dominion is home-grown, and there is a ready and increasing demand for locally-produced seed of high quality. At present, New Zealand lucerne is, to all intents and purposes, not used in this country, while New Zealand is not regarded as a regular source of supply

for red clover in large amount, although the seed in certain years may be imported in appreciable quantity to make good deficiencies from other sources.

The chief interest to the British farmer regarding the production of red clover and lucerne in New Zealand, is the cash-earning aspect of these crops. It is true that, speaking generally, the climatic conditions in the Canterbury and Marlborough districts of New Zealand are far more favourable to the harvesting of herbage seeds than are the conditions ruling over the greater area of England and Wales.

A seed crop from a herbage species is, however, a very important addition to the earning capacity of a ley, and the taking of such a crop is a practice that fits in admirably with the production of fat lambs, and with animal husbandry in general, conducted on grassland consisting predominantly of long duration leys.

RED CLOVER

Crop Production.—In both the Marlborough and Canterbury districts, autumn and spring sowing can be adopted with almost equal success, and, in both districts, the harvesting of a seed crop in the first harvest year is not a foregone conclusion, but will depend to a considerable extent on the weather conditions, and on the amount of keep available for the lambs. The whole procedure is, therefore, one of considerable flexibility, the more so since, in New Zealand, the red clover almost invariably persists in good quantity into the second harvest year; so that seed is frequently taken in the second harvest year instead of in the first year, while, sometimes, it is taken in both harvest years and occasionally even in a third harvest year. Amongst many growers, the view is held that the second year's crop gives seed of the highest quality. This may be due to the well-known fact that a too crowded stand of clover is not as satisfactory as a relatively thinner stand for seed production. The methods adopted, and which lead up to seed production, are very varied. The following cases of practices adopted in the Marlborough district afford interesting examples.

Example I.—Eight pounds of red clover with 40 lb. of Italian rye-grass, and 1 bushel of Algerian oats, sown in March (autumn). This mixture will become rapidly established and, by August, may be depended upon to give an abundance of green grazing for lambs. The Italian rye-grass and the oats will be grazed very hard during the late winter and early spring of the sowing year, and the red clover will not be seriously harmed. The field would be shut up in time to give a seed

crop (of red clover) in the following March. This productiveness, within a twelvemonth of sowing, affords a striking commentary on the immense benefits, to the farmer, of a climate which allows of autumn sowing of herbage seeds followed by a winter and early spring which permits of continued and abundant growth from autumn sown oats and Italian rye-grass.

Example II.—Sow a full seeding of oats in March and 10 lb. of red clover on the braided oats. By the following December, the oats will be cut for oat-hay (including some red clover) and will be chaffed for sale off the farm.* The field will then be “put up” for a seed crop of red clover which will be taken in April.

In many cases, the leys will remain standing for three to four years, when they will be ploughed and re-sown with oats and red clover. This, in some instances, constitutes the rotation practised over the whole farm, with, perhaps, a crop of white clover taken off a ley, sometimes, in the fourth year, before it is ploughed. Usually the paddocks will be given a periodic change in lucerne instead of red clover. It is somewhat remarkable that, despite this very continuous growing of red clover in the district around Blenheim, clover sickness in any form does not appear to be a factor that has to be seriously reckoned with.

In the Canterbury, as in the Marlborough, district the rotations are very flexible, but in the former a cereal as such (for grain) more usually enters into the rotation. The type of rotation is generally more or less as follows: rape; wheat; oats (seeds sown either with the oats or on the stubble in the autumn); temporary grass for three (and sometimes up to six) years. Some of the leys, as occasion permits, will be devoted to red clover seed production, and it is not infrequent for a particular ley to give a crop of clover hay and a seed crop in each of the three harvest years. The writer was informed of cases where a seed crop had been taken in a sixth harvest year.

Harvesting Practices.—The best growers look for yields of from 300 lb. to as much as, or exceeding, 500 lb. per acre; the general average yield, however, frequently falls below 200 lb. per acre.

The seed crop is always stacked and never thrashed from the stook. The hulling is almost invariably undertaken by

* The city horse is still in decided evidence in New Zealand, while horses are largely used in connexion with timber milling, so that favoured districts still do a considerable trade in connexion with horse feed.

travelling mills, as is the case with lucerne and white clover, the charge being, usually, 25s. to 27s. 6d. per hour. It is interesting to remark, in passing, that whereas the hullers are invariably of American make, the steam engines are as constantly British. In so far as agricultural implements in general are concerned, it is indeed only in respect of the stationary oil engines, and the steam engines, that the British manufacturers may be said to have completely held their own.

The bumble-bee was introduced into New Zealand in 1885, and these fertilizing agents now appear to be general in the clover-growing districts. Complete or almost complete failure of the seed crop is not usual. It may be observed, however, that exceptionally poor yields have been recorded in the Blenheim district following seasons of severe winter-flooding, which would, doubtless, be responsible for the large-scale destruction of the bees' nests.

Characteristics and Agricultural Usefulness.—New Zealand red clover, or “cowgrass” as it is usually called in the Dominion, appears always to be of the broad red type, and this is confirmed by Capt. Williams's investigations at the Welsh Plant Breeding Station. It is interesting to find, therefore, that, in New Zealand, this strain invariably holds the ground well for two-years and, frequently, for much longer periods. Trials at Aberystwyth have also shown that New Zealand red clover tends to last into a second harvest year rather better than the generality of strains of broad (or early) red clover, though not as well as the late-flowering reds. This clover is more uniform in character than most of the European strains. It is more closely allied in botanical characters and manner of growth to the North American (*e.g.*, American Medium and Canadian) strains than to the European, having a more spreading habit of growth than the latter and being more hairy—it is not, however, as hairy as the American clovers. In common with American Medium and Canadian, New Zealand clover makes very little growth in the winter in this country, but it is nevertheless one of the earliest strains to flower, being but four to five days later than American Medium, which is the earliest to flower. At Aberdeen, it has given excellent results in the first harvest year; at Garforth, it gave excellent stubble grazing, and was decidedly productive, in the first harvest year. At Aberystwyth, it gave decidedly less stubble grazing than English broad red, or than Chilian red. In the first harvest year at Aberystwyth, it has given somewhat variable results. In 1924, it outyielded most of the other broad reds,

while, in 1921, and again in 1923, it was inferior to British and to several other strains of broad red, but, on the average of all the trials, has proved distinctly superior to French and Brittany red.

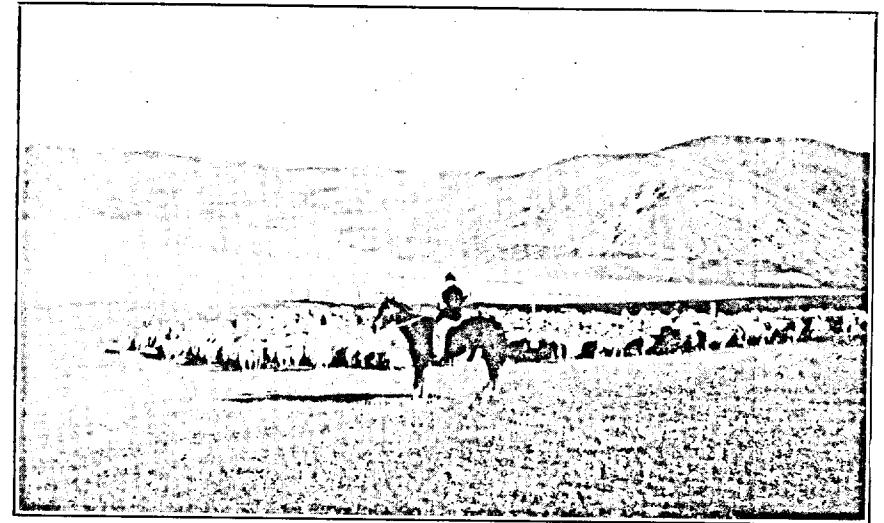
In view, particularly, of the fact that New Zealand red clover has an undoubted ability to run into a second harvest year, and that, in the main, it has given good results in the first harvest year, it would seem desirable that more extended trials should be undertaken with this strain. This would seem the more advisable since the seed coming to this country is usually plump, heavy and of good colour: the seed is invariably larger than that of the closely-allied American Medium and Canadian nationalities, while the New Zealand samples also contain considerably less yellow seed.

Marketing Practices.—Blending is largely adopted, especially for the export trade to Europe, the chief aim being to ship bulks which conform to the purple coloration which, probably, does denote a sample harvested and matured under highly satisfactory conditions. Blending on these lines, however, entirely overlooks the question of strain and the possible, nay, probable, effect on longevity of harvesting from leys subsequent to this first harvest year. A long-duration, broad red clover would be of extreme value to British no less than to New Zealand graziers; it is, therefore, much to be desired that tests with so-called New Zealand cowgrass should be conducted in relation to the year of harvest of the seed, and not on blended lots, since blending entirely masks the all-important, albeit subtle, differences as between strain and strain.

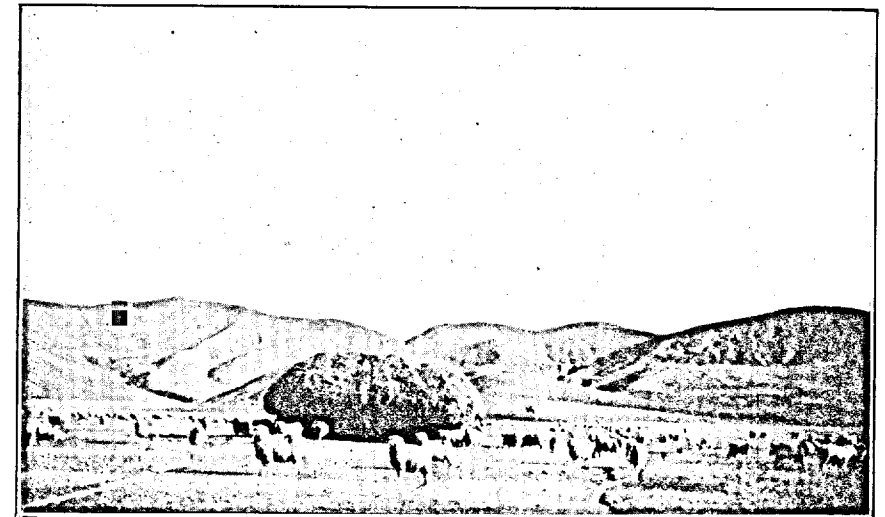
LUCERNE

Crop Production.—Lucerne is very extensively grown in the Marlborough district, and it was estimated, in 1916, that there were over 4,000 acres under the crop in that district alone. The leys in this district are grown on an almost ideal lucerne soil—a very deep, rich, calcareous alluvial loam. Many of these leys have been down for 10 to 20 years, and it is a common occurrence for seed to be taken from leys 10 to 15 years old.

Frequently, however, seed is taken from a ley in its second year, and then yearly for a number of years: but speaking generally, a very large proportion of the Marlborough district seed is taken from old leys. Seed production from old leys, however, presents certain difficulties. The old leys tend to become very grassy. *Poa annua*, *Poa pratensis* and barley



Flock of 800 ewes on lucerne, Marlborough, N.Z.



Lucerne stock, Marlborough, N.Z.

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grass in particular are very bad weeds. The older leys have in recent years, however, been enormously improved by generous applications of superphosphate, and by resort to heavy harrowing in the autumn with strongly tined implements. Many of the leys have been completely regenerated by these means and are yielding heavy crops of seed where seed has never previously been harvested.

It is the usual practice to graze the leys all through the winter with sheep, and such is the suitability of the soil, and the climate, for lucerne that the plant withstands this rigorous treatment in a remarkable manner. The lucerne hay is, however, stacked in the paddocks and fed to the sheep during the winter, so that this supplementary feed serves to some extent to reduce ultra-close grazing of the lucerne crowns. A number of the Marlborough sheep farms consist partly of lucerne land and partly of improved or semi-improved native tussock grasslands. The high stock-carrying capacity of such farms and, incidentally, the immense value of lucerne, when it grows to perfection, is indicated by the following example :—

Acreage	..	..	550 acres.
In lucerne	..	..	220 acres (leys 5 to 15 years old).

On this farm, an average of 1,500 ewes are regularly wintered.

Harvesting Practices.—The crop is always cut when fully ripe, *i.e.*, when some of the pods are turning black, and it is customary to risk a certain amount of shedding. The crop is cut with a side-delivery reaper and handled as little as possible; it is sometimes carried within eight days of reaping and is usually stacked for about three months before hulling. The dry haulms are frequently fed out on the paddocks to store cattle. The yield of seed may reach 750 to 1,000 lb. per acre. Various practices are adopted prior to the seed harvest, but a hay crop always precedes the seed crop. The necessity of taking a hay crop as preparation for a seed crop entails the production of rather more hay than can normally be consumed, but this at least safeguards an abundance of supplementary winter feed. The following procedure is one commonly adopted by those who are fattening lambs :—

August—November. Ewes grazing with their lambs until fat lambs sold off their mothers; close the field until the *middle of December*, when a crop of hay is taken.

Again close the field and take a crop of ripe seed in *April*.

The seed is usually sold on sample rubbed out from the stack, and on the basis of guarantee of freedom from dodder

and other noxious weeds. In recent years, the grower has received up to 12½d. per lb. for the seed, and it is no uncommon thing for one man to harvest as much as 100 acres of seed, as much as 200 acres having been put up to seed on a single farm; consequently very large cash payments have been credited to lucerne on Marlborough farms since the war.

Leys are, to some extent, now being sown primarily for seed production, and drilling at a somewhat reduced seed rate is advocated for this purpose.

Characteristics and Agricultural Usefulness.—With lucerne, as with red and white clovers, blending is rather the rule than the exception. It follows that no exhaustive tests have been conducted, so far as the present writer is aware, with seed harvested from young as compared with old leys. Marlborough lucerne has, furthermore, not been extensively tested in this country; it is desirable therefore that proper tests should be instituted, but, as with the clovers, it is idle to conduct these with blended samples. The full potentiality of this lucerne should rather be tried out by using specially collected lots harvested from leys of known age. New Zealand lucerne, since, in the main, it is largely grown in districts where red clover is also abundantly employed, is prone to contain, as an impurity, greater or less amounts of this clover.

Thanks are due to Captain Williams, M.Sc., for providing data as to the behaviour of New Zealand red clover at Aberystwyth.

* * * * *

MILKING COMPETITIONS HELD IN CONJUNCTION WITH CLEAN MILK COMPETITIONS

J. H. MATTINSON, B.Sc. (Agric.),

Agricultural Organizer for Surrey.

FEW operations on the farm require more skill and concentration than milking, which is one of the chief factors of success in dairy farming.

Really first-class milkers are not very numerous. This, no doubt, is because a man is seldom taught to milk; he is allowed to acquire the knowledge himself. Beginning with cows which are easy to milk, he gradually improves his speed on the methods and style which come to him naturally. It is not surprising therefore that many milkers cultivate habits which are undesirable and which are not conducive to efficiency.

In recent years, clean milk competitions have emphasized the importance of the human element in the production of milk of a high standard of cleanliness, and have shown how great a responsibility lies with the milkers for the delivery to the milk room of milk of low bacterial count.

In the Surrey Clean Milk Competitions, it has been the practice to take sediment tests from the unstrained milk, and these tests are taken as each man finishes milking a cow. A pint of milk is poured from the pail into the tester and is forced through a small cotton-wool disc or pad; any dirt or dust gaining access to the milk during milking is thus exposed on the pad. It was found that this test indicated the efficiency or otherwise of the cleaning of the cows; it was, further, found that the cleanliness of the disc reflected to a large extent the skill of the milker. Where the washing of the cows in a herd had been the same throughout, some men would return clean discs, others dirty ones. Those who milked quickly, quietly, with full hand, employing a squeezing action on the teats with no arm movement, obtained cleaner milk than those who milked with a pulling action.

This test, carried out in the cowshed, has been proved to have great educational value by bringing home to the milkers the need for efficiency in cleaning the cows and the importance of good milking. The accompanying illustration shows the discs taken on a farm where six milkers were employed, and where all cows had been cleaned alike. They indicate the difference in milkers and the extent to which a man could improve at a second attempt.

When, in 1925, the Ministry of Agriculture drew attention to the value of competitions for the encouragement of skill in farm operations, it was felt that the clean milk competition offered excellent facilities for conducting, simultaneously, a milking competition for the workers.

At the time inspecting judges visit the farms for the purpose of awarding points for methods and equipment, and for taking surprise samples, ample opportunity is afforded them of seeing the milkers at work under ideal conditions for forming an opinion on their skill. It was hoped such a competition for milkers would give added interest to the workers and have distinct educational value by stimulating keenness in good methods.

The Surrey Agricultural Committee therefore decided to conduct a Milkmen's Competition concurrently with their 1926 Clean Milk Competition. Miss M. M. Macleod, N.D.D., C.D.D.,

the then Instructress in Dairying and Poultry Keeping to the county, and the writer were the inspecting judges in the Clean Milk Competition; with the valuable assistance of Mr. J. Mackintosh, of Reading, they devised the score card appended below and, by it, judged the milkers.

SCORE CARD		Points
(a) Preparation of cow for milking		10
(b) Personal cleanliness of milker, suitability of dress and equipment		15
(c) Style of approaching cow and management during milking		10
(d) Management of fore milk		7
(e) Skill in milking, including grip, motion and style		20
(f) Thorough stripping and method of carrying out same		16
(g) Time taken in relation to quantity of milk produced		12
(h) Cleanliness of milk		10
TOTAL		100

MILKING TEST

Name of cow	Name of cow	Name of cow
Time beginning	Time beginning	Time beginning
Time ending	Time ending	Time ending
Quantity of milk	Quantity of milk	Quantity of milk

REMARKS.

This score card does not differ to any great extent from that suggested by the Ministry of Agriculture. Two classes were provided, one for milkers under 18 years of age, the other for those of 18 and over. It was decided that money prizes should be awarded to the first three in each class, and that certificates of merit should be presented to those attaining a sufficiently high standard of merit. A copy of the rules of the competition, giving particulars of the scale of points on which the judging would be based, was circularized to the farms along with the particulars of the Clean Milk Competition.

The following discussion of each item of the score card will indicate how the judging was carried out.

Preparation of the Cow for Milking.—Before milking is commenced, the cows should be thoroughly cleaned. As time is valuable, it is very essential that the milker be able to clean the cow effectively and rapidly. Only a good system which has become a matter of habit, will enable this to be done. If the system is not good, either the man takes too much time or he does not clean the cow. Observations at the farm quickly show whether the men are doing as they are accustomed to do. If the cows are used to the treatment they take no notice of it. If extra trouble is being taken for the benefit of the judges, the cows show impatience.

A man who has established a routine which is good does the work speedily, changing the water as it becomes dirty, and taking care to finish off the udders with clean water. It is a simple matter to time the milkers over this operation, the effectiveness of which is further checked by the sediment test.

Personal Cleanliness of the Milker, Suitability of Dress and Equipment.—It is much easier to judge this on the farm than it would be at a show, where the milker would arrive specially "spruced up" for the occasion.

In the cleaning of the cows, the milking and the handling of the milk in the shed, there are so many opportunities for a milker to show whether he is scrupulously clean or not. The milker, whose aim it is not only to milk speedily but in a cleanly manner, is particular in details. He is clean in himself, he takes care to keep his overalls as clean as possible, he keeps his nails short, and washes his hands before milking each cow. His stool is clean and, after each cow is milked, is set down carefully and not in such a way that it may possibly fall over. He uses the covered pails as they are intended to be used, and when not in use lets them stand so that the open part is not exposed to possible contamination.

The help given, to encourage cleanliness, by the provision of suitable equipment and adequate facilities for washing, must, of course, be assessed for each particular farm.

Style of Approaching the Cow and Management during Milking.—Cows, and more especially the heavier milkers, are very sensitive animals; any disturbance will be reflected in the yield. It is therefore essential that the cows be treated gently at all times and particularly at the time of milking. If the cow is not disturbed, the milk secretion will start more readily and milking will be more expeditious. Good milkers realize this; they are quiet in manner and voice, approach the cow with a word so that she is not startled at their sudden appearance, coax her into a favourable position, and then sit down on the stool with the pail in position without undue disturbance or noise. There is no necessity to stroke or pat the cows before sitting down and after the hands have been carefully washed. During milking, the good milker concentrates on the work of the moment and does not shout at the cows nor engage in loud conversation with other milkers.

The behaviour of the cows in the shed shows whether the treatment is generally good. Watch the cows come into

the shed, whether they walk in quietly or in a hasty, nervous manner. The presence of kickers is generally an indication of rough treatment at some time or other in their lives.

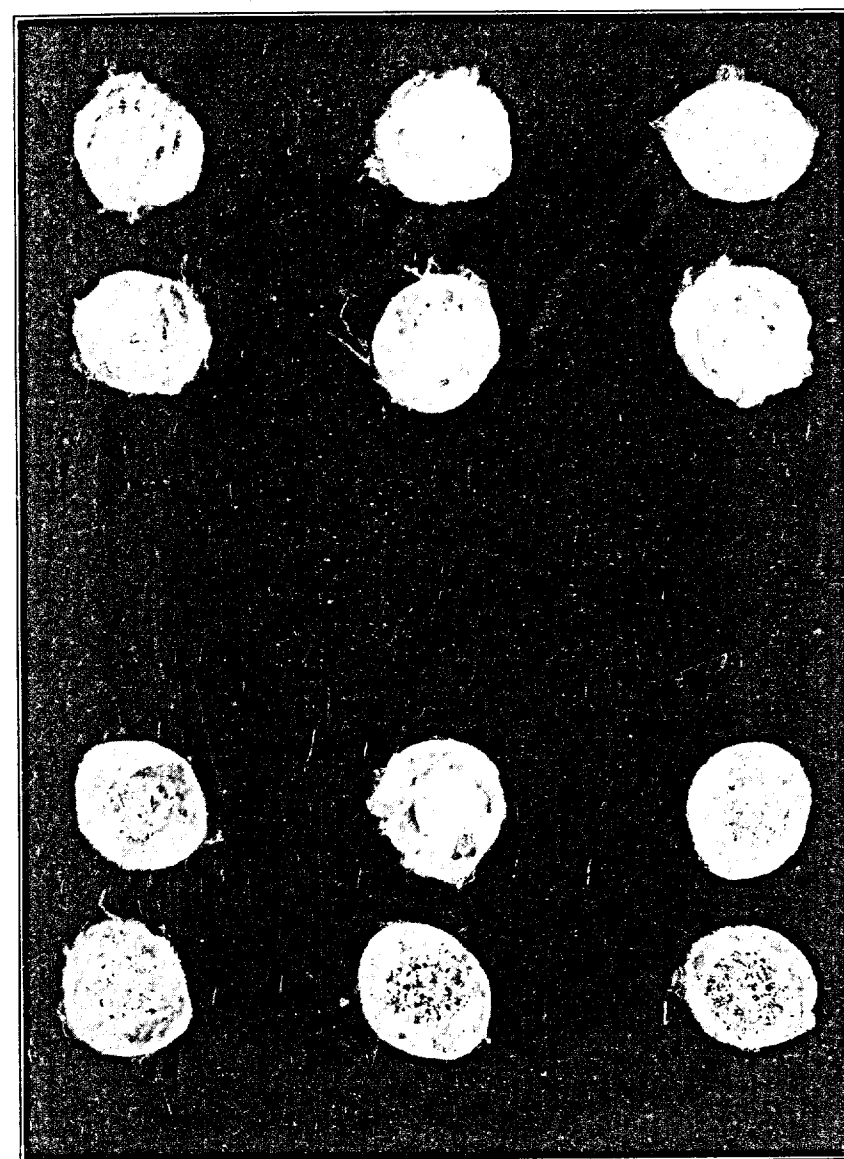
Management of the Fore Milk.—The importance of discarding the first strippings of milk from each teat is fully realized by all who have been competitors in clean milk competitions. Full marks were awarded when the fore milk was collected in a separate pail, one not likely to be confused with the other milk pails. This is the best method, because it becomes a definite operation and therefore less likely to be forgotten; moreover, when milk is squirted on to the floor it presents an excellent breeding ground for bacteria. Some milkers, by turning the teats, squirted the fore milk into the gutter, but most milked it straight on the floor, while a few did not discard it at all. Where it has not become a definite practice to discard the fore milk, the milkers frequently forget to do it unless a separate pail is provided for this purpose.

Skill in Milking, including Grip, Motion and Style.—Milking should be done whenever possible by a full-hand grip, the teat lying in the palm of the hand and the ends of the fingers reaching about three-quarters of the way round the teats. Finger-and-thumb milking is not to be encouraged. The milk should be expelled by a squeezing motion by horizontal pressure and not by a downward pulling motion. The arms of a good milker will remain motionless; all the work will be done by the hands and wrists. Where there is much arm movement there will be more sediment in the milk.

The milking should be done speedily (speed affects both quantity and quality) without change of action. Some milkers will milk a short time full handed, then with finger and thumb, and will occasionally devote both hands to one teat.

A good milker is particular about his milking stool and will be careful that the legs of the stool are of the right length. He will not milk with any stool. In some cases the legs of the stool were too long to allow of the milker sitting in a comfortable position.

Wet-handed milking should be discouraged. It was intimated in the rules that wet-handed milking would not receive encouragement from the judges, and this no doubt had considerable effect in preventing wet-handed milkers from entering. Very few really wet-handed milkers were therefore encountered in the competition, but some were rather careless



Discs from sediment tests on unstrained milk, taken on a farm where six milkers were employed, and all cows had been cleaned alike. Showing the greater cleanliness in the second set of discs, due to improved method.

Second Attempt.

First Attempt.

in the way in which they allowed milk to get on to their hands by indifferent methods of milking. It is advisable to ask a milker of this type to show the palms of his hands when he is actually milking a cow.

Thorough Stripping and Method of Carrying it Out.—

The last strippings from the cow are richest in fat ; thus, if a cow is not milked out, the quality of the milk will suffer ; moreover, if the cow is not properly stripped she will give less and less milk and speedily dry off. In a competition this operation must be closely observed, and, when the milker has finished, the judge should try drawing the teats and ascertain if the work has been well done.

While the full-handed grip is to be encouraged for the milking, the stripping must be done by drawing the finger and thumb down the teats until all the milk has been obtained. In some cases the milkers used one hand on the udder, lightly squeezing the quarter which was being stripped, while the finger and thumb of the other hand were being drawn down the teat. This is a very effective method and indicates the milker's appreciation of the importance of obtaining all the milk from the udder at each milking.

Time Taken in Relation to the Quantity of Milk Produced.—

Each man was timed over the milking of at least three cows. The yield of milk in each case was weighed, and at practically every farm visited this yield could be compared with previous yields as given on the record sheets.

It was found that the quantity of milk obtained by naturally quick milkers compared favourably with previous weighings, while the quantity obtained by one who attempted to milk more quickly than usual was low for that particular cow.

Quick milking if done well and accompanied by efficient stripping is a very important factor in controlling the yield of milk and the percentage of butter-fat, and is to be encouraged.

Cleanliness of the Milk.—The points under this head were awarded on the result of the sediment test. One pint of milk is forced through a cotton-wool pad, leaving the sediment behind. After the milk has been forced through, some clean water is passed through the tester to carry on to the pad any hairs or sediment which may adhere to the sides of the tester.

Conclusion.—The competition proved very attractive to workers, and justified itself in the great keenness on the part

of the milkers to know their faults and to eradicate them where possible. 45 entries were received from workers on the 37 farms entered in the clean milk competition. Of these seven were in the class for juniors.

In addition to the three prizes awarded in each class, 12 certificates of merit were awarded and presented at the annual luncheon of the Surrey Milk Recording Society with the prizes and diplomas of the clean milk competition.

The winner of the county competition competed later in the milkers' contest at the Dairy Show in London and was successful in obtaining fourth place.

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PIG KEEPING AND FRUIT CULTURE AT WESTWICK FRUIT FARMS

H. GOUDE, N.D.H.,

Horticultural Organiser, Norfolk County Council.

ACCORDING to agricultural history, there has always been a shortage of farmyard manure. Good lands grow the greatest amount of straw, but very few farms can produce sufficient for the actual demand of the cultivated land. Inorganic manures can only supplement the yard manures and, so far, no system of green manuring, plus inorganic fertilizers, has maintained any land in the highest condition of fertility for intensive cropping over a lengthy period. With the increase of fruit culture, the shortage of manure is accentuated, as the fruit lands do not produce straw or material for making litter. In these districts, the supply is automatically decreased while the need is considerably increased. The supply of manure from towns also shows a progressive reduction in quantity. This was the problem that confronted Mr. G. Davison, the manager of Col. B. J. Petre's fruit farms. It is a problem that is present to practically every fruit farmer and market gardener. It has been found that pig manure will enable the soil to gather fertility with greater rapidity and lasting effect than that from any other kind of stock. In several instances, pigs have made it possible to bring sandy, derelict land into a profitably fertile condition. Col. Petre and Mr. Davison, therefore, decided to keep pigs with the sole object of making manure for the 180 acres of fruit grown on the estate; the large acreage of black currants demands an abundant supply.

The Westwick System.—Although the production of pigs was not the primary object in view, Mr. Davison evolved a sound scheme to produce the best bacon pigs. His scheme is so arranged that the pigs are improving the fruit plantations all through their lives until they are entrained for the bacon factory. The fact that all the animals return the highest price at the factory, at a low cost of production, indicates the value of the methods employed. The success with black currant culture and other hardy fruits on these farms is largely due to the manure made available on poor, light, sandy soil. The breeds of pigs kept for producing the necessary vigorous youngsters are large black sows and large white boars. The parents lead natural lives on the pastures and are farrowed in movable wooden houses, specially devised by Mr. Davison, the sides and roof being held rigidly together by a few pegs. These sheds accommodate from 20 to 30 stores, and can be taken down and loaded on a cart in ten minutes for transferring to a new site whenever necessary.

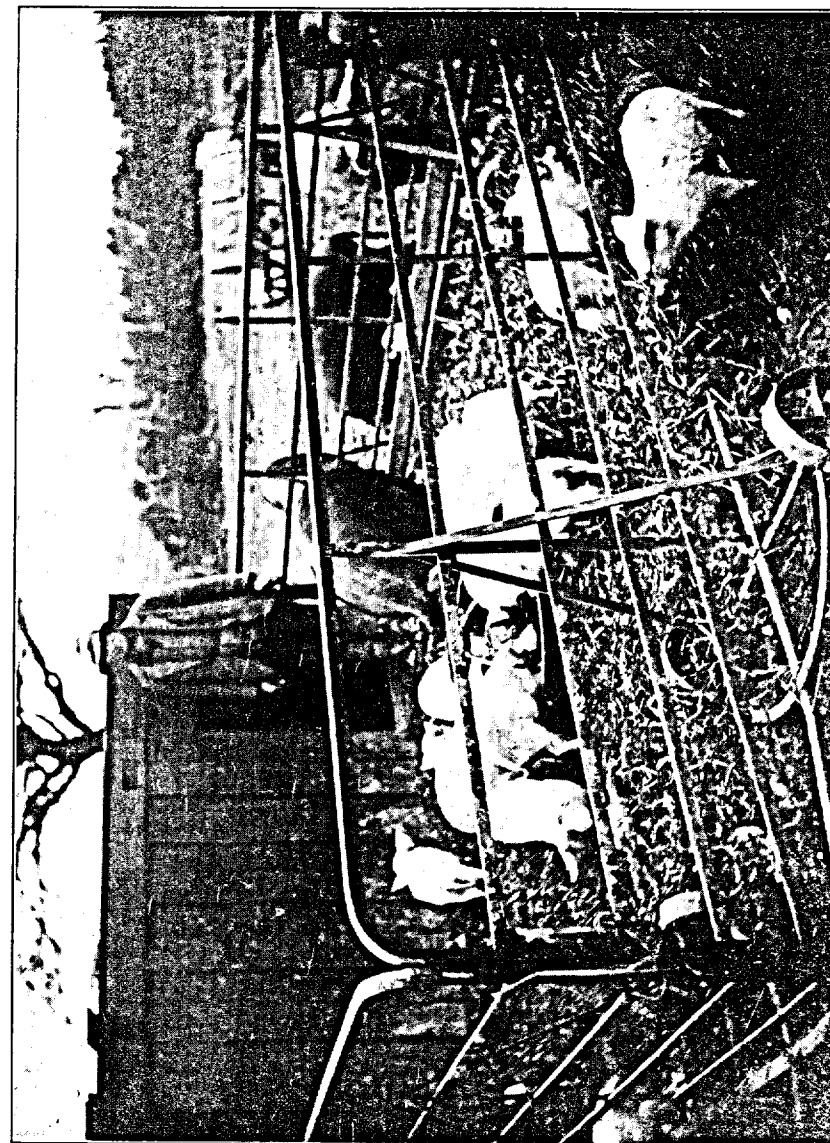
The fruit plantations have lapsed into natural herbage since the war period, owing to increased cost of labour and to evolution in the methods in fruit production. Formerly the soil of the plantations was kept scrupulously free from weeds at a high cost for labour. The pigs now do the necessary soil work and have increased the weight and quality of the crops through their fertilizing activities. Part of the plantations is wired to three-quarter acre pens, in each of which about 25 young pigs, eight weeks old from the sows, are drafted, being dry fed and given an ample supply of clean water. They also receive a daily ration of either marrow-stemmed kale, swedes or mangolds throughout the year. The animals are induced to work the soil over the whole pen by the moving of the dry-feed boxes, even distribution of the root feed, and by moving the shed. They sometimes work the soil too deeply in places, presumably rooting for some mineral, although they are supplied with a mineral ration. Such spots are fenced with wooden hurdles if the rooting is likely to cause injury to the trees. Open sows in season will sometimes gnaw the bark of the trees, and have to be taken out of the pen for a time. The pigs also rub themselves against the trunks of the trees, but no injury has been noticed from this cause.

When the soil is all turned in the pens and the growth of grass checked for the time, the pigs are re-graded and transferred to another pen. The ground is then harrowed

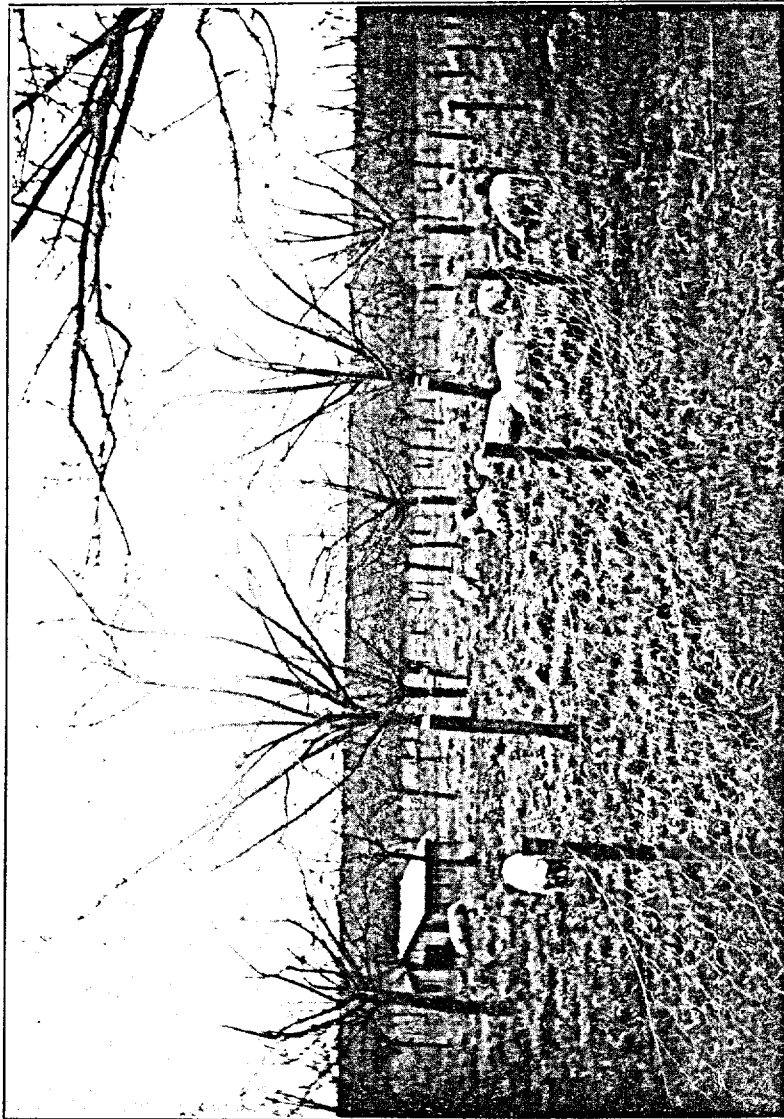
level and left till the herbage grows for another occupation. The re-graded pigs are moved in smaller groups, usually of six, to pens which have been rested. When six or eight months old, they are ready for the next step in the order of production. The breeding, feeding and the life natural to pigs, have produced long, vigorous, short-legged animals, and their frames are correct for taking on meat rapidly just where the prime cuts lie.

Intermediate Pens.—The procedure at first was to transfer the pigs from the plantations direct to the fattening house, but the change was found to be too sudden and it also entailed alteration in the percentages of food mixing for pigs of varying age. Mr. Davison solved this difficulty by building covered yards in sheltered places, and, incidentally, the output of manure was considerably increased thereby. These yards are 48 feet square, accommodating 50 pigs each, and sunk 15 inches below the soil level and concreted with a rough face. Cross rails are nailed to posts that support the corrugated iron roof, and a fence of boards four feet high is nailed to the rails. Feeding troughs, faced with granite chips, are built into the sides of these shallow pits. The first yard constructed had a drainage system, but this was found to be unnecessary as the litter soaked up all the moisture. For litter almost anything available is utilized—straw, the brushings from the banks round the farm, leaves, and marsh litter. Although trouble from weed seeds was anticipated with this miscellaneous litter, no difficulty has been experienced. The yield from one yard was 100 loads of manure in three months. In these intermediate yards, the pigs are gradually brought on to a richer diet of barley, middlings, and maize with a constant supply of green food or roots; and after six weeks of this feeding they are ready to be graded into the fattening house. In the plantations they are actively searching for food all day, and grunting with satisfaction. In the yards a change of habit is noticeable: the richer food induces laziness and more time is spent lying down; and, after being settled in the fattening house, their activity is almost negligible, for they feed and sleep practically all their time.

The Fattening House.—The final stage of feeding is carried out in a specially constructed house of more than usual dimensions. It is known locally as the "pigs' palace," and is designed to accommodate 300 pigs. The length is 200 ft., width 34 ft., height 20 ft. The roof is a span with a glass lantern



Sow, with eleven young pigs. Reared in the open.



Stores working the fruit plantations. Showing the Davison movable house.

top, and windows are provided on each side, giving ample light. Ventilation is provided on each side of the roof and walls, and can be regulated from one position by turning a handled crank. The ventilating system adopted is the one common to span-roof glass-houses, and the "palace" is aired with as much care as choice greenhouse crops. On entering the house, one is struck with the scrupulously clean and neat appearance of everything. It is quiet, and the objectionable smell commonly associated with pig-keeping on any scale is absent. Pigs will keep themselves clean and wholesome if they have a chance. The floor is cemented all over. The pens are 20 ft. by 14 ft. and placed on each side of the house, the flooring of each pen having a fall of 6 in. to a gutter 3 ft. wide. This gutter has a 6 in. fall to a wide concreted surface that falls 24 in. and conducts all the liquid from every part of the "palace" to a large reinforced concrete tank constructed at the lowest end. The pigs do not soil any part of the fattening pens but the inside gutters. The manure is thrown from the gutters through a swivel door to the outer concrete surface at each side of the house, and eventually carted by motor lorry to the black currant plantations. The construction of the pens enables the pigs to co-operate in keeping the house clean, as all the manure is in the gutters and is easily thrown through the swivel doors each day. The outer concrete surface is covered and the manure is not leached by rain. The liquid from the tank is pumped by engine power to the fruit plantations and distributed by horse-drawn barrels on wheels up and down the rows of bushes that require stimulating. At every turn, Mr. Davison's ingenuity is shown in inventing articles and appliances to save labour and in utilizing the whole of the manurial output to the greatest advantage for the production of fruit.

Feeding and Finishing for Bacon.—When the pigs are drafted from the yards into the fattening pens, they are ready for richer diet. The main food is now 70 per cent. barley meal and 30 per cent. made up of middlings, bran and maize meal. All the grain is ground in the mixing house and soaked in water twelve hours, previous to being fed. A small proportion of boiled potatoes, and fish meal is included in the 30 per cent. portion of the food if these feeding stuffs are low in price. In the order of feeding, as with the whole organization, the system works the man. The first feed each day is given at 6 a.m. At 12.30 p.m. a green ration of roots or marrow-

stemmed kale is given. At 4 p.m. the final feed of meal is provided. Every trough is licked out clean and not a particle of the meal or green food is left over. The food is ladled from the mixing tanks into metal skeps on a small trolley. The trolley runs on rails the length of the house. Another trolley brings in the green food and straw from the opposite end of the house.

When the pigs are ready for the factory, the side of the pen is lifted across the middle path, the pigs walk to the weighbridge and from there into the rail trucks. The fat pigs are starved 24 hours before weighing and average 78 per cent. dead weight to live weight. The purchaser is responsible for the animals when they are delivered to the railway. Customers for these pigs have always praised the quality of the meat and frequently state it is the best that they receive. There is no wasted time in producing the finished animal, although it takes, on the average, twelve months to produce the finished article at an average weight of 22 stone per pig. At this weight, the system gives tender, lean, fine-flavoured meat without an undue proportion of fat. If a younger pig were brought to this weight, by intensive feeding, an undue proportion of fat to lean meat is naturally produced on a low-grade carcass. No trouble has arisen through seedy cut in the pigs of this cross, and although the average weight is heavy for bacon the pigs realize grade A 1 price. Mr. Davison's method allows a man and a boy, comfortably, to feed and keep clean 400 fattening pigs. The whole of the sheds and the buildings were built to his plans by labour on the estate. Col. Petre stated that the venture is a profitable undertaking and most of the capital expenditure has, also, been recovered. Westwick produces about 1,200 fat pigs per annum, a fair contribution for one farm to the national demand for home-fed and cured bacon.

Effect of Pig Keeping on Fruit Production.—The above is an outline of the main features of a system of pig-keeping, in conjunction with fruit culture, which I have not seen approached at any other centre. There is no doubt as to the beneficial effects of the pigs on the health of the trees and bushes throughout the plantations. The store pigs are utilized for improving the older plantations of apples and pears. In a few cases, parts of plantations are not included in the pens owing to the difficulty in wiring off these portions. To a certain extent these parts of the plantations act as a control to the trees inside the pens. The trees outside the pens in

every case produce smaller leaves, paler in colour, very indifferent crops of fruit and have an obviously starved appearance. Economy in running pigs in plantations is also shown to a marked degree. The whole cost of producing fruit amounts to pruning, spraying, gathering and marketing the crops. Soil cultivation and manuring are practically all effected through the pigs. The manure from the yards is utilized for the plantations of bushes and enables the farm to produce extraordinarily heavy crops of black currants, the quality of which is apparent to the numerous visitors who visit the farms each year. No part of the scheme is carried out in a hard-and-fast manner. Slight variations are continually being made, either for the benefit of the pigs or the fruit plantations. In this way continual improvements are being made, and new, ingenious, labour-saving devices are observable almost every time a visit is made to these farms.

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THE COUNCIL OF AGRICULTURE FOR ENGLAND

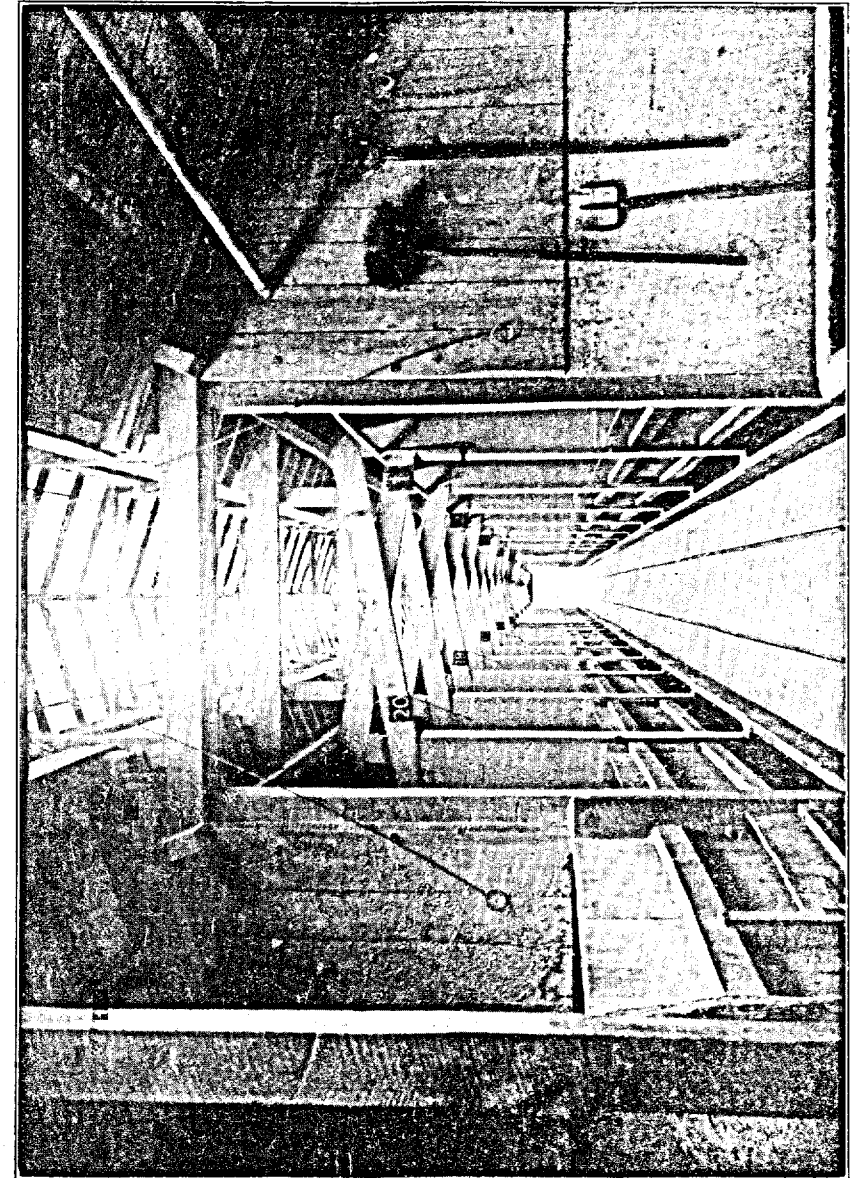
THE twenty-fourth meeting of the Council was held on May 27, 1927, at the Middlesex Guildhall, Westminster. The chair was taken by Lord Clinton in the absence of Mr. W. R. Smith, who was, at the meeting, elected chairman for the year 1927.

Sir Francis Floud, K.C.B.—The CHAIRMAN said that everyone on the Council would feel great regret at the pending retirement of Sir Francis Floud from the Permanent Secretaryship of the Ministry of Agriculture to take up his new position as Chairman of the Board of Customs and Excise. Sir Francis had always shown the greatest interest in and sympathy with the agricultural industry, and the industry had always found him to be a firm friend, very willing to assist with information and advice. He proposed that the Council should congratulate him on the promotion which had come to him. Lord STRACHIE seconded the motion, which was carried with acclamation.

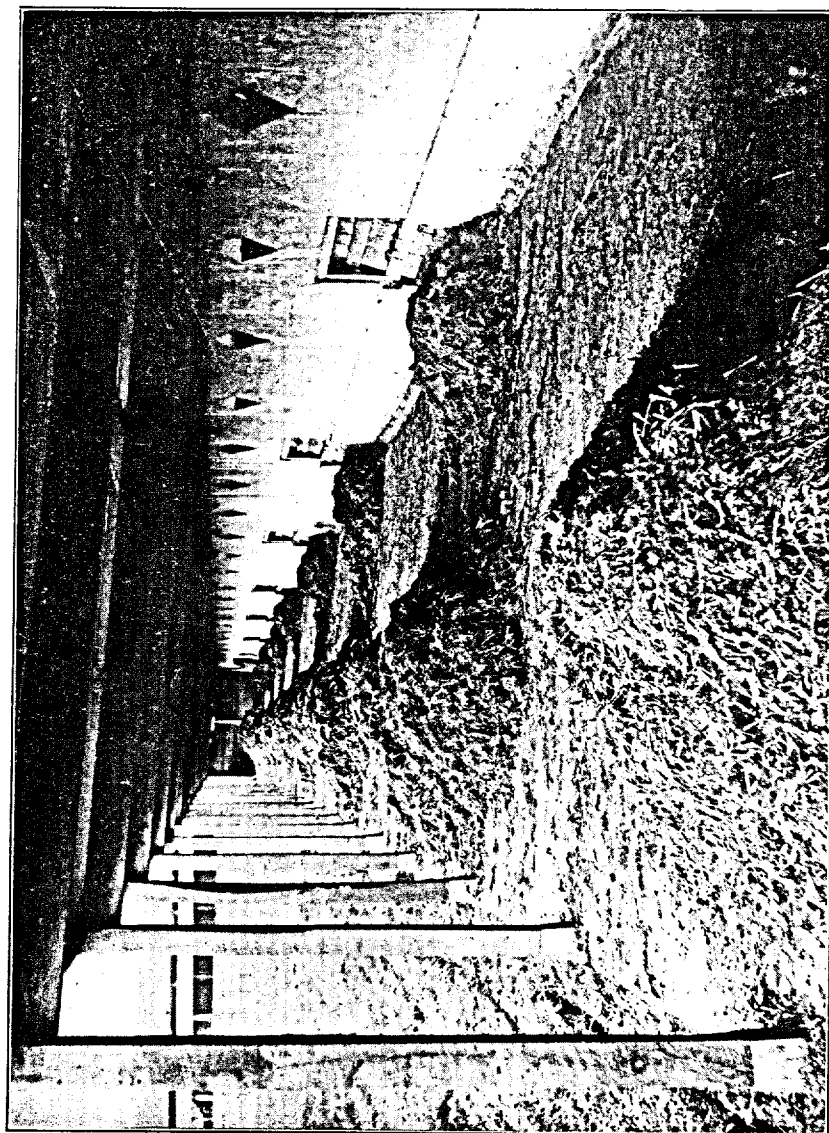
Statement by the Minister.—The Rt. Hon. WALTER GUINNESS addressed the Council. He said that the trend of agricultural prices had remained very unfavourable to the producer. Since the last meeting of the Council, the Report on *The Agricultural Output of England and Wales* had been issued. The figures in it merited careful attention, and he was sorry to see that he had caused indignation in certain quarters for having mentioned this census and for having drawn attention to the results

there recorded. Much as he sympathised with farmers in their present difficulties, he would be most unhelpful if he never dealt with any other subject, and did not mention other important aspects of the agricultural situation. The farmer nowadays needed defence from proposals which would put him in an even worse position, and there were plenty of traducers who were ready to argue that the British farmer was inefficient, basing their case on unfavourable comparisons with the Continent and an alleged falling off in the production of food in this country. There was no more effective answer to that line of attack than the figures summarised in the Report, which stated that the aggregate value of agricultural produce, £225,000,000 in 1925, was 77 per cent. above £127,000,000 estimated in 1908; the average increase in price over the same period was also 77 per cent. In the aggregate, the increases and decreases in output from the various branches of the industry had just about balanced one another. An even more recent publication, *The Agricultural Statistics, Part I, for 1926*, showed that the tendencies recorded in the Report still continued. There was a notable increase last year in the wheat acreage. The acreage under sugar beet had increased by no less than 130 per cent. As regards live stock, the number of cattle was the largest ever recorded. Sheep also showed an increase, and the number last year was only about 400,000 below 1914. So that transformations in our form of agricultural output were still going on. These very changes showed the very difficult time through which the farmer was passing. They were clear evidence of the dislocation which had taken place owing to the fluctuation in prices, and the farmer could not have reacted to the economic pressure which had developed without a great deal of distress and a great many excellent cultivators suffering heavy loss. The position would, in his opinion, be worse if the State were to step in and control cultivation, and it did seem that these figures of production were the most complete and effective answer to those who would impose control.

He then referred to the improved position in regard to Foot-and-Mouth Disease, to the Order prescribing conditions for the transit of animals from Ireland and Overseas, to the progress made with the Rabbits and Rooks Bill, the Diseases of Animals (Amendment) Bill, the Destructive Insects and Pests Bill, and to the Royal Commission on Land Drainage which had been set up to examine as to the necessity of amendments in the drainage law of the country, stating that the



The "Pig Palace," with accommodation for 300 fat pigs.



One side of the "Pig Palace," showing concrete surface, and swivel doors to each pen, through which the manure is thrown daily.

Ouse Drainage Bill would have to be pressed on without awaiting the result of the Royal Commission's inquiries. The efforts which were being made to improve the methods of marketing agricultural products, especially by demonstrations at the Agricultural Shows, were specially mentioned.

Government Meat Contracts.—Mr. H. W. THOMAS (Hants) asked as to the resolution of the last meeting of the Council on the question of the provision of British Meat for the Army, Navy, and Air Force. The MINISTER stated that the Services gave preference in all cases of contracts to home production, though that preference had to be limited to a reasonable percentage. It was not possible to give the exact figures to which the Services were prepared to go to carry out that preference, but at the present time there was such a difference between home-bred and imported frozen meat that they could not see their way to face the heavy additional expense which would be involved in changing their source of supply.

Ouse Drainage Bill.—Sir DOUGLAS NEWTON, M.P. (Cambs), inquired whether it would not be possible for the Minister to defer the decision as to the proper basis of the rate to be levied under the Ouse Drainage Bill until the Royal Commission had reported. The MINISTER said he was sorry he could not comply with the request. It was no new principle that was proposed to be adopted. It had been recommended by various Commissions in the past, and it had been adopted in certain Local Acts. The County of Middlesex, for instance, rated by means of the ordinary county rate the whole of the county area for the purposes of land drainage within their area. At the same time, the House of Commons would no doubt very carefully examine the basis before they decided whether or not it was applicable to the Ouse area, which was a very special one. In it, without the extensive embankments to keep back flood waters, nearly 400,000 acres would return to the state of a morass. The problem of the drainage of that area was largely caused by the waters which came from a district far above the level of the floods. If it was a matter of getting rid of only the waters which fall on the Fens it would be comparatively easy to pump them out into the tidal water, and for them to be carried away without any danger. Complicated and expensive work was largely caused by the fact that in the flat areas there was an enclosed space between the embankments which had to provide for flood waters coming down from the uplands. It was quite true that the ratepayers in those uplands did not get direct individual benefit, but very direct and definite expense

was caused to someone in getting rid of that water, and it seemed a perfectly reasonable and just principle, and a principle which has been accepted over and over again in our recent legislation, that a communal contribution should be made for this public service.

Agricultural Credit.—The Rt. Hon. Sir FRANCIS ACLAND, Bart., asked whether the Minister would deal with the question of Agricultural Credit in his Statement, or await the Resolution on the Agenda. The MINISTER said that on this subject he had at present nothing to add to the answers which had been given in the House of Commons. Negotiations between the banks, the Treasury, and others and efforts to solve the difficulties which had arisen were still going on. There was no possible chance of legislation this Session, but as soon as any decision was arrived at, it would be communicated to Parliament. Mr. ASHBY inquired whether the position in regard to negotiations had improved in the last six months, and whether the idea of the chattel mortgage had been entirely dropped. The MINISTER replied that certain modifications were being put forward as regards the chattel mortgage. He did not think it would be useful to give exact details as to the stage the negotiations had reached.

Urea as a Fertilizer.—Sir DOUGLAS NEWTON, M.P., moved the adoption of the Standing Committee's Report on the use of urea as a fertilizer. The Report recommended that the Government should take steps to make the fertilizer immediately available for farmers in this country. Lord BLEDISLOE, Parliamentary Secretary to the Ministry said that in view of the difficulty of producing electricity in this country at a relatively low cost as compared with Sweden or Switzerland it was quite possible that Urea could not be produced here at so low a cost as in those and other countries with similar advantages. It came under Part I of the Safeguarding of Industries Acts as a synthetic organic chemical and paid a duty of $33\frac{1}{3}$ per cent. It could be exempted from that duty for such period as the Treasury might specify in an Order made after proper inquiry into certain points as directed by the Finance Act. The President of the Board of Trade would be consulted to see what could be done along the lines suggested in the Report. The Report was adopted.

Ministry's Report on Fruit Marketing.—Sir FRANCIS ACLAND moved the adoption of the Standing Committee's Report, which was carried. The Standing Committee stated that the Report was well ordered, well produced, and well illustrated, and was a

straightforward record of inquiry into the sources of production of our fruit supply, its preparation for the market, and the methods by which it is sold. The questions of transportation, and, where they are employed, the methods of preservation, including canning and bottling and storage, were dealt with in the Report, and the Standing Committee concluded that the consideration of a survey of that kind could not fail to stimulate those engaged in the industry to greater efforts to reduce their costs and so make their industry more profitable or more able to compete successfully with outside competition.

"The Agricultural Output of England and Wales."—Sir FRANCIS ACLAND moved the adoption of the Standing Committee's Report, which was agreed. The Report stated that the volume published by the Ministry was one of great interest, giving a detailed comparison of the position in 1925, not only with that of the last complete census in 1908, but with those in preceding and intervening years. The main figures of the report referred to the agricultural area, the number and size of agricultural holdings, the production and distribution of crops, the number and distribution of live stock, the output of live stock products, and the value of the agricultural output. Careful estimates were made of the number of persons engaged in agriculture. And for the first time figures were recorded as to the rent and value of agricultural land, the capital employed in agriculture, and the motive power used on farms. A final chapter dealt with agricultural prices. In dealing with such a work, it was impossible to summarize the figures, but a few extracts and analyses of figures were given which illustrated its scope and summarized certain outstanding tendencies in our agricultural development. They indicated, in the opinion of the Standing Committee, the desirability of a study of the publication in detail by all interested in agriculture. The Committee recorded the opinion, however, that the value of the publication would have been even greater if Scotland could have been included in its scope.

Hertfordshire Rural Education Syllabus.—Mr. DENTON WOODHEAD moved the adoption of the Standing Committee's Report which recommended the sending of the Syllabus to other County Education Authorities in England and Wales. The Report pointed out that the Syllabus was specially designed to bring into the curriculum of public elementary schools in rural districts teaching on rural subjects, including visits to farms and rural industrial centres, and the careful

observation of a large variety of farming and other rural operations. Mr. DENTON WOODHEAD said that the scheme proposed the giving of special attention to agricultural and country operations in the school curriculum at an age when children were very susceptible to such impressions. That kind of education would be useful to them all through their lives. He paid a special tribute to Capt. Morris, the Chairman of the Hertfordshire Agricultural Education Committee, in connexion with the preparation of the Syllabus. Mr. R. G. PATTERSON (Staffs) objected to bringing in too strong a rural bias into country children's education. Mr. W. HAWK (Cornwall) did not think the objection applied to this particular scheme. Mr. W. McCracken (Cheshire) considered that the careful selection of teachers for rural schools was very important. At present rural schools were suffering because they did not get such good teachers as the town schools on account of the smaller salaries offered. The Cheshire Education Committee were obliged to offer larger salaries for rural teachers. Sir MERRIK BURRELL (West Sussex) expressed the view that the word "bias" in this connexion was wrong. It was necessary to train children to understand their own environment and to teach them in terms of the conditions under which they lived. Mr. CHRISTOPHER TURNOR raised the question of the means of circulation of the Report, and it was suggested and agreed that the Council of Agriculture should do it.

Importation of Canadian Cattle.—Sir MERRIK BURRELL moved :—

That the Council of Agriculture for England considers that the statement of the Free Importation of Canadian Cattle Association of Great Britain that 50 per cent. of British dairy cattle are tubercular is unjustifiable, inaccurate, unsupported by any evidence or authentic figures, and is merely a biased estimate calculated to mislead uninformed opinion: furthermore, that there is no reason to suppose that Canadian cattle possess any greater resistance to bovine tuberculosis than British cattle if exposed to infection. The Council is of the opinion that any further relaxation of the present Orders governing the importation of cattle into Great Britain would cause grave injury to the cattle breeding industry and in no way benefit the supply of meat or milk to the population of this country either as regards price, quantity or quality.

After dealing generally with the position under the Tuberculosis Order of 1925, by which animals in an advanced state of tuberculosis are required to be slaughtered, and rebutting the statement in question, Sir MERRIK added that if Canadian cows were found to be free before importation he saw no reason why they should be more immune to tuberculosis in this

country than our own cattle. Lord BLEDISLOE, on behalf of the Ministry, said that it agreed with the substance of the first part of the resolution, and, as regards the second part, the Ministry had no intention of altering its present policy. There were no authentic or official figures giving 50 per cent. of British dairy cattle as being affected with tuberculosis. Indeed, the statement was seriously inaccurate and in its implication grossly misleading. Existing figures showed that about 1 per cent. of the dairy cattle, actually tested, showed signs of being definitely dangerous to human life in respect of the milk supplied. This was a very small proportion of the total dairy cattle. The motion was put to the meeting and carried.

Agriculture and Safeguarding of Industries.—Sir GEORGE COURTHOPE, M.P., moved :—

That this Council, while recognising the value of recent Agricultural legislation, is convinced that its effect upon the present economic position of Agriculture is insufficient to maintain food production and rural employment, and further legislation of a far-reaching nature is urgently required for this purpose. In view of the increased production and employment which has been promoted in other industries by the Safeguarding of Industries Act, and other protective measures, without increase of cost to the consumer of the articles produced, this Council urges His Majesty's Government to extend the operation of this Act to Agriculture, in order to maintain and increase the production of those classes of farm and garden produce which are most seriously threatened by foreign competition.

In the course of his speech, Sir GEORGE COURTHOPE drew attention to the fact that the McKenna duties and the Safeguarding of Industries Act had been successful as applied to other industries and had shown that it was possible for Protection if wisely applied to increase production and employment, and to produce revenue without necessarily increasing the cost to the purchaser of the goods produced. It was inevitable that this safeguarding should be extended to other industries; and why not to Agriculture? He would be the last to ask the Government to depart from the solemn pledge to the Country at the General Election that it would not increase the general volume of taxation by taxes on food. It should be remembered, however, that over 24 millions a year addition to the revenue resulted from taxes on tea and sugar alone. He asked the Government to consider whether it could not, consistently with its mandate from the people and with the pledge which had been given, substitute food taxes which would have a protective effect for food taxes which had none. The resolution was seconded by Capt.

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MORRIS, who appealed to all parties to come together with an earnest endeavour to place Agriculture on a sound basis of prosperity.

LORD STRACHIE (Somerset) moved an amendment that as the Government had declared against Protection for Agriculture the Council should rather urge it to lighten the heavy burdens of Imperial and local taxation on agricultural land. He drew attention to the large increase in price which had resulted from the application of the Safeguarding Act to gas mantles and to the fact that unemployment in the motor and silk trades had increased after safeguarding. Dealing with Protection he said it could be summed up in the words of Lord Balfour:—

“What is a Protective policy? A Protective policy, as I understand it, is a policy which aims at supporting or creating home industries by raising home price. The object of Protection is to encourage home industries. The means by which it attains that object is by so arranging import duties that the prices obtained in those industries are increased. If home prices are not raised, industry is not encouraged. If industry is encouraged, it is by raising price. That is, in a nutshell, Protection properly understood.”
—(Lord Balfour at Edinburgh, October 3, 1904.)

A remedy for the agricultural situation might be to bring the grants under the Agricultural Rates Act, 1896, up to the full amount of the rates. Agricultural land should be treated in the same way as the raw material of a manufacturer.

The amendment was seconded by Sir FRANCIS ACLAND. He thought that protection was bound to increase prices. Mr. Ritchie's registration duty on corn was repealed because it had influenced prices in the upward direction. The suggestion of transferring the duty from the articles already taxed to agricultural commodities needed no discussion. A duty on tea went all to the Exchequer, a duty on corn went partly to the Exchequer and partly to the English farmer, and there must be a far larger burden to obtain the same result. The only way in which Parliament could help the industry was to help it to help itself. Mr. C. B. FISHER (Northants) drew attention to the risks of dumping, an example of which occurred in 1923 with potatoes, when the consumer did not reap the benefit of the lower prices. Mr. R. P. ALLSEBROOK (Leicester) held that imported skimmed milk should be taxed. Mr. CHRISTOPHER TURNOR said that if agriculture was to be left to work out its own salvation it must not be handicapped. There was the present fixation of minimum wages and he did not

think it possible to make arable farming pay at the present time if wages were more than £2 an acre. All were in favour of raising the standard of living of the working people, but if that were done the industry must be helped to maintain that standard. In other countries employees were working longer hours and getting one-third of the British wage. Mr. R. G. PATTERSON said that Protection was of no use to the farmer unless it did increase his prices. He thought the country had to consider whether it was fair to see agriculture go down, with the result that the control of prices passed entirely into the hands of the exporting countries. If agriculture were ruined, these exporters would have no mercy on the British public. The MINISTER said, with regard to the amendment, that the State was now contributing under the agricultural rates relief grants alone about 4½ millions a year, with the result that the rates on agricultural land come now about the same as in 1896, whereas the rates on other property had increased fourfold. As to the original resolution, he agreed with Sir George Courthope that the particular details of the method of applying Protection to Agriculture were relatively unimportant, and at this stage Sir George only wished the Council to accept the position that our tariff arrangements should give special assistance to the industry. As mover, Sir George had based his case very largely on the opinion that the safeguarding duties had not in fact increased the cost to the consumer. In the Minister's view the consumer paid differently in different cases. In the motor industry, where the powers of production in this country were so great that it was independent, the foreigner had to pay the duty if he wished to enjoy the market. That result would not necessarily follow in the case of some other commodities in which the country was not self-supporting, as, for instance, wheat, where the foreigner might not consent to send it unless the country was prepared itself to pay the extra cost of the tax. The kind of Protection which would not raise prices would not help the farmer. The Minister further discussed the question from the political aspect and pointed out that the proposal was not, in fact, practical politics. He added that, in view of the importance of Sir George Courthope's resolution, he had taken the occasion to consult the Cabinet specially on the subject and he had its authority to say “*That the Prime Minister's pledges at the General Election stand, that the White Paper on Agricultural Policy of February, 1926, stands as the Government's considered policy, and that the Government is unable to depart from the conclusion, at which it arrived after careful and anxious considera-*

tion, that it cannot give assistance to agriculture by means of protective duties."

Lord Strachie's amendment was put to the meeting and lost by 33 votes to 13, and the original motion was put to the meeting and carried by 30 votes to 14.

Improving Transport in Country Districts.—Mrs. HUGH MIDDLETON moved :—

That this Council respectfully requests the Minister of Agriculture to do all in his power to enforce the recommendation contained in Paragraph 37 of the Report on Agricultural Policy agreed by this Council on August 6, 1925, and presented at that time to the then Minister of Agriculture.

She said that in the purely agricultural part of the country where she lived the inhabitants had been deprived of a 'bus service which was really helping them in many ways. The Minister of Transport had said that if it were proved to him that the deprivation was a mistake he would not stand to it. She thought the Minister of Agriculture could prove to the Minister of Transport that he had made a mistake and she, therefore, brought the matter forward under this general resolution. Sir FRANCIS ACLAND seconded the motion, which was put to the meeting and carried.

* * * * *

POULTRY KEEPING ON A SMALL FARM IN OXFORDSHIRE

G. AND F. HENDERSON:

Introduction.—This is a holding of 85 acres, of which 60 are arable land. It is situated, 500 ft. above sea level, in the parish of Enstone, midway between Oxford and Banbury, and eight miles east of Chipping Norton. The land is well watered by springs which never run dry, and, in this respect, the holding is singular for the district, most of the surrounding, and much larger, farms depending on water that has to be pumped by wind or ram over considerable distances.

When the farm was taken over, some three years ago, there were from four to six different crops in each arable field; but it is hoped by next year that it will be possible to work on a five-course rotation: roots, barley, oats, seeds, wheat. Being limited in area, the grassland carries, usually, only a few calves and a cow or two in addition to two horses and some sheep, the last item being represented this year by 36 Kent lambs.

A varying number of pigs are kept, but no sows, the grass not being suitable for running before farrowing. From 10 to 50 store pigs are purchased in the spring, number depending on prices of feeding stuffs and fat pigs, and these are run in the yard during the summer. By the above means, straw is being trodden into manure all the year. In addition to the two horses, a tractor is kept. With the exception of threshing time, when some casual assistance has to be obtained, all labour is furnished by the two owner-occupiers.

POULTRY.

Accommodation.—In one grass field of 13 acres, sloping towards the west, there are three fowl-houses, spaced 60 yards apart, each of which holds 120 birds comfortably. The construction of these houses, which are home-built, is described later, and illustrations are given in Figs. 2, 3, 6, and 7. It is hoped in the near future to erect another five of these laying-houses, which will bring the total accommodation up to about 1,000 birds, allowing 3 sq. ft. of scratching space to each bird. There are also some ordinary small poultry-houses for rearing chickens.

Breeding Stock.—The original stock was purchased from a large pedigree breeder. The number of pullets being increased annually and, therefore, needing more cockerels, the latter are hatched from eggs purchased each year from well-known breeders. In this way it has been possible to keep the flock up to a high standard although mass mating is practised. Replacing the cockerels each year has been found necessary, it being practically impossible to put cockerels with year-old cocks, the latter fighting the cockerels until they will not go near the hens. About 100 to 150 eggs are purchased in January, and out of the chicks, which are reared separately, there are usually 50 to 60 cockerels, from which the required birds are selected.

The present stock consists of 250 Light Sussex pullets and 100 Light Sussex hens. These are mated with Light Sussex cocks, of which 20 are required. The egg average last year was 170 eggs per bird.

Foodstuffs and Feeding.—It will be noted that the prices for foodstuffs, given later, are rather cheaper than is usually quoted. They are, however, mostly home-grown, and the prices given are those that at the time were obtainable on the farm. As far as possible, home-grown corn is used. The ground oats for the mash are home-grown, and are ground

at a neighbouring mill. Bran, toppings and fish meal are purchased each month, and, whenever possible, are bought along with artificial fertilizers or cattle cake, so that a two or four-ton truck can be made up and carriage saved.

The adult birds are fed twice a day, the morning meal being a mash. This is similar to that given to the chickens (described later) except that it is mixed with water instead of milk and that the fish meal is increased to 15 per cent. during the winter. Two ounces is allowed to each bird, weight before adding water. The second feed consists of wheat during the summer; and as the season advances cracked maize is introduced, the latter being increased until all maize is fed in the winter.

Incubators and Hatching.—The incubators comprise three hot-air and two hot-water machines, having a total capacity of 1,500 eggs. They are housed in the barn which, of course, is no longer used for stacking corn; but, to provide floor space for storing feeding stuffs, etc., an upper floor, 6 ft. from the ground, has been erected in it. Notwithstanding the fact that the temperature in this building is usually between 40 and 50 deg. F. during the hatching season, the hatching average last season was 72.37 per cent. for hens' eggs and 76 per cent. for ducks' eggs.

The incubators are started in November, and take all the first grade eggs from the stock at the beginning of the hatching season. The chicks hatched from November until February are not for stock, but for marketing as "spring" chickens. The stock birds are hatched from February until April, and about 5,000 day-old chicks are sold, there being a ready sale in the locality for these at 12s. per dozen for the early hatches, the prices being reduced as the season advances. It is usual, in fact, to be booked up for them several months ahead.

Rearing "Spring" Chickens.—The early hatchings for the "spring" chicken trade are reared, in lots of 100 to 150, in ordinary small poultry houses, with the aid of small hovers. The birds are taken from the incubators as soon as dry and placed under the hovers, only water and fine limestone grit being given for the first 48 hours. Any small or weakly chicks are killed on the second or third day, as they do not pay for rearing. The first feed mixture is composed as follows:—

- 3 parts cracked wheat.
- 1 part cracked maize.
- 1 part coarse oatmeal.
- 2½ per cent. each of linseed and hempseed.

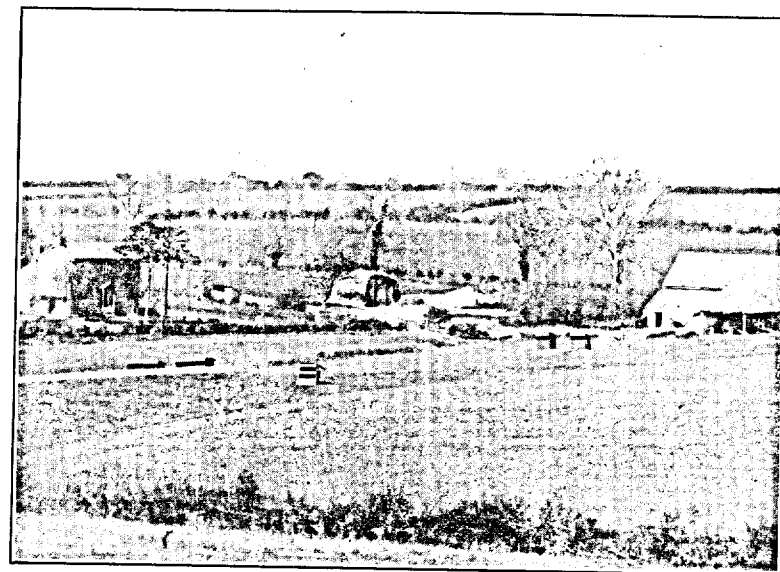


FIG. 1.—General view of the Farm.

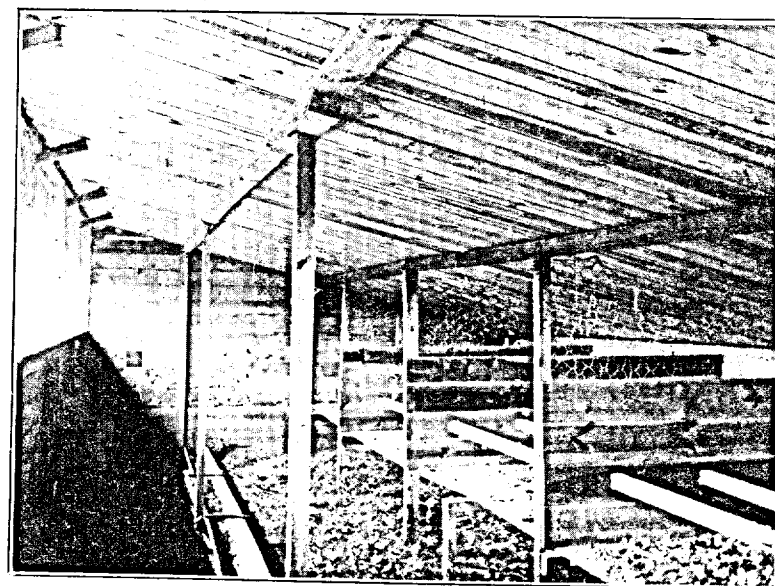


FIG. 2.—Interior of a laying house.

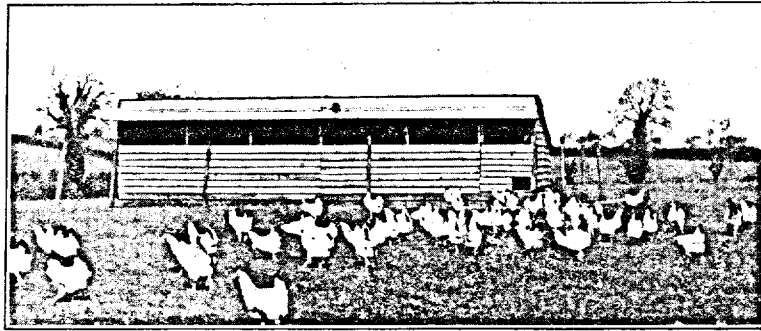


FIG. 3.—Exterior of a laying house.

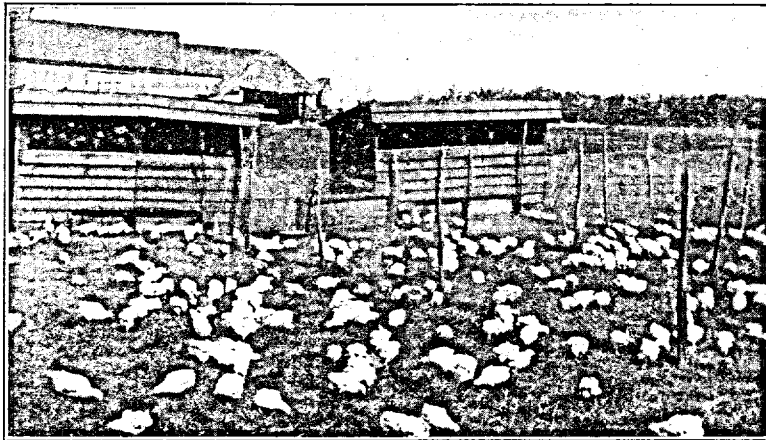


FIG. 4.—Two of the brooder houses and pens, containing over 600 eight-week old chicks.

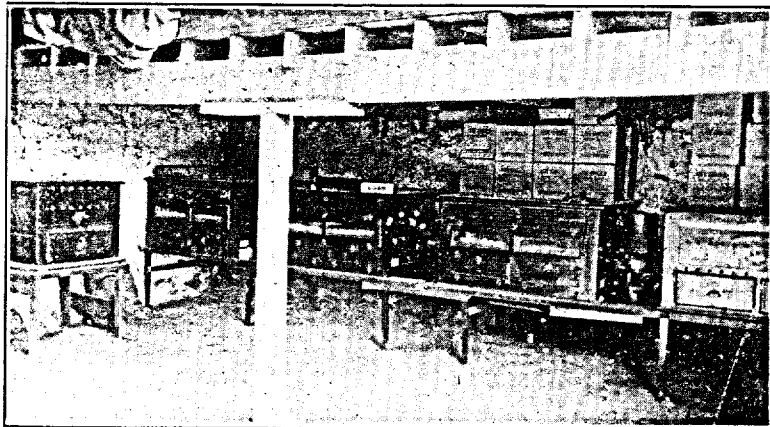


FIG. 5.—The incubators, in which over 5,000 chicks are hatched each season.

This mixture, alone, is fed during the first ten days, every two hours from 6 a.m. to 6 p.m., the first and last feeds being in artificial light, using a hurricane lantern. On the eleventh day, two feeds of mash are introduced, made up as follows:—

- 1 part Sussex ground oats.
- 1 part bran.
- 1 part toppings.
- 10 per cent. fish meal (the best obtainable).

The mash is mixed to a crumbly state with milk, and the number of feeds are increased until such time as the chicks are having half mash and half grain mixture. By feeding in this manner it has been found possible to get the cockerels up to 3½ lb. in four months, without cramming or special feeding. Chicks for stock are reared in the same manner.

Cost of Rearing "Spring" Chickens.—To get a fair idea of the profits that can be made from the rearing of this class of table poultry, a special account was kept last year of the cost of one batch of chickens. This worked out as follows:—

	£	s.	d.
120 eggs at 3s. per dozen	1	10	0
Oil and wick for incubator	0	6	0
Oil for brooder	0	4	6
8 cwt. of mash at 12s.	4	16	0
8 cwt. of grain at 13s.	5	4	0
Total	12	0	6

Ninety-one chickens were sold, of a total weight of 260½ lb., at 2s. per lb., totalling £26 1s. 0d. The expenses of selling, transport, etc., were £2, so that it will be seen that there was exactly 100 per cent. profit on the outlay. This result was checked by the figures of the final account for all the chickens reared last season, which showed almost 100 per cent. profit on the outlay, out of which to meet the costs of labour, depreciation, risk, return on capital, etc. This seems to show that there is a promising future for table poultry.

Marketing.—The fat chickens are taken to London (a distance of about 70 miles) by the farm lorry once a week, together with eggs. Some of the chickens are sold dead (rough plucked), but on account of the difficulty of getting them plucked locally, a larger number are sold alive, and this does not make a big difference to the price realized. It would make a considerable difference, however, if the live birds were sent by rail, the rail charges for live birds, also for returned empty crates, being heavy. By using lorry transport, it is as cheap to take live birds as dead ones, and this method has the advantage of bringing the owners into personal touch

with the buyers, whose requirements are thus ascertained. The London price for chickens is usually considerably higher than that obtainable locally. In the case of eggs, which are sold, under a yearly contract, to a large London dairy firm, there is often a difference of 6d. per dozen, after deducting carriage. The chickens are sold to retail shops and hotels.

Ducks.—There is also on the farm a flock of White Runner ducks. These have drakes running with them to ensure that the eggs are fertile, this being essential, as the incubators are filled with duck eggs as soon as it is too late for hatching chickens. Most of the ducklings are sold as day-olds, the price being 12s. per dozen. The demand for these is not so great as for chicks, but no difficulty has been experienced in disposing of them.

The flock average for the ducks last year was 180 eggs per bird, the greatest number in one month being 1,022 in March.

To ensure that all eggs are laid in the duck house, which is 10 ft. square, with a board roof, the ducks are kept indoors until 9.30 a.m. They then roam over the grass and arable land (it is surprising what distances they will travel after worms, insects, etc.), but when the corn is in ear they have to be kept off the arable by sheep netting, for they will spoil acres of corn. Just before sunset they are called in and given a mash (3 oz. per bird) of the same ingredients as that for the fowls, except that the fish meal is increased to 20 per cent. during certain times of the year.

Laying House for Fowls.—The home-built laying house, shown in Figs. 2 and 3, is 28 ft. long by 14 ft. deep (over-all dimensions), and costs about £16 to build, exclusive of labour. It can be erected by anyone who is sufficiently handy with saw and hammer to repair fences. The timber required is as follows :—

- 1,200 ft. run 2 in. $\times$ 3 in. framing.
- 1,400 ft. run 7 in. $\times$ $\frac{3}{4}$ in. grooved and tongued boarding.
- 2,000 ft. run 7 in. $\times$ $\frac{3}{4}$ in. weatherboarding.
- 250 ft. run 1 $\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ in. battening.

These are the scantlings of the timber used for the houses on the farm, and, if thought insufficient, it may be said that the houses stand in an open field, 500 ft. above sea level, and have stood against all winds for many months. The method of erection is described below, the first operation being to construct four frames of the 2 in. $\times$ 3 in. timber, shown as A, B, C and D in Fig. 6. The general arrangement of the parts of the house are shown in Fig. 7.

Frames.—Frame A, the front of the house, has six uprights, each 7 ft. 6 in. high. Lay these on the ground, spaced 6 ft.

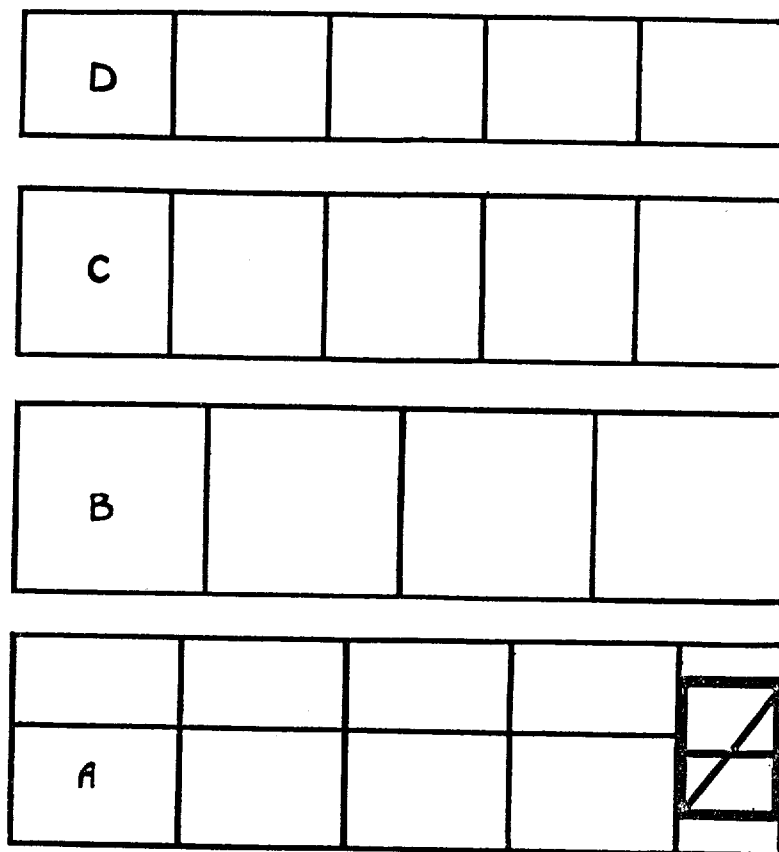


FIG. 6.—Showing arrangement of members in the four frames.

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apart, except the two at the right-hand side, which should be spaced 3 ft. apart to form doorway. Top and bottom pieces or plates should then be nailed respectively to the tops and bottoms of these uprights. Make a centre rail by fixing pieces between the uprights at a height of 4 ft. from the bottom. From base to centre rail cover with weatherboarding, and from centre rail to top with wire netting.

Frame D, forming back of house, has six uprights, each 4 ft. long. Construct as A and weatherboard from base right up. When completed these two frames should be set upright in position (it will need two men to do this), care being taken to see they are exactly 13 ft. 6 in. apart in the clear. The frames can be stayed in position by temporarily half-nailing a few planks to their tops and sides.

Frames C and B, intermediate between A and D, give support and stiffening to roof and sides, and are similarly

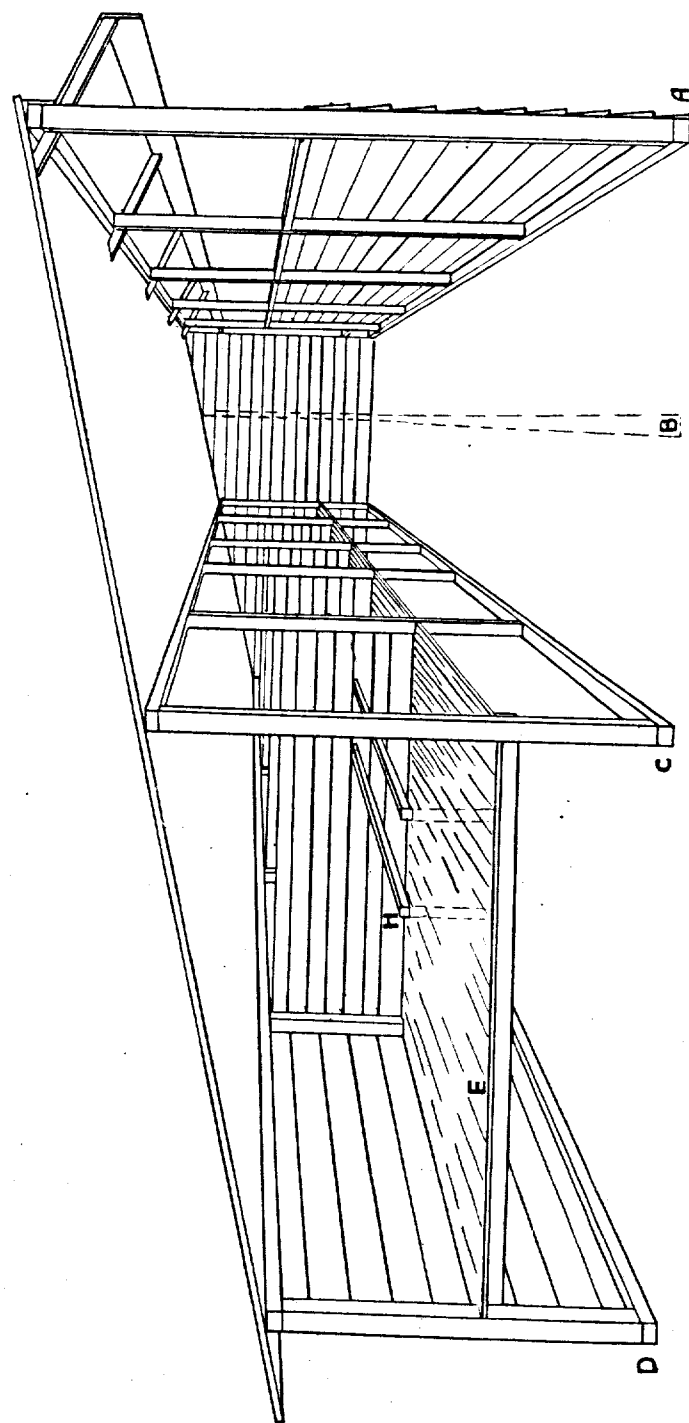


FIG. 7.—Interior of laying house, showing method of construction.

[Copyright Reserved.]

constructed, C having uprights 6 ft. high and B uprights 7 ft. high. The distance between C and D, when in position, should be 5 ft. 4 in., and between C and B and between B and A, 3 ft. 10 in., all dimensions in the clear.

Ends and Roof.—When the four frames are in position, weatherboard the sides up. Cover the roof with the grooved and tongued boarding, giving an overhang at the back to throw drip clear of back wall. Over boarding, lay felt lengthways, beginning at back and giving a good lap, say 4 in., of each width over the preceding one. Further secure felt with strips of the battening, nailed on, parallel to the slope, 2 ft. apart. The hood, fixed over wired opening of front to prevent ingress of rain, is supported on bracket pieces, 2 ft. long, nailed to uprights of Frame A, as shown in Fig. 7. Nail one row of weatherboarding to ends of brackets along front, and two rows on top of them.

Floor.—Of rammed earth, stones or concrete. Last is best, but rammed earth will do, provided site is fairly dry and plenty of litter (straw or chaff) is used, and renewed frequently.

Interior Fitting.—Dropping boards (E) are of grooved and tongued boarding, ends being fixed to bearers which are nailed to uprights of frames C and D, about 2 ft. 6 in. above ground. Division partitions (H), to prevent wind blowing over the birds at night, are also of grooved and tongued boarding, nailed to uprights of C and D above dropping boards. If the house is very exposed, four of these divisions may be required; in very sheltered positions one should suffice. Perches, which should have top edges rounded, are fixed between the divisions.

Nest Boxes.—Can be made, against the front, with odd pieces of wood. They should not be less than 1 ft. square, and fourteen nests will be sufficient.

* * * * *

WOOL FROM RABBITS

W. KING-WILSON,

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Harper-Adams Agricultural College.*

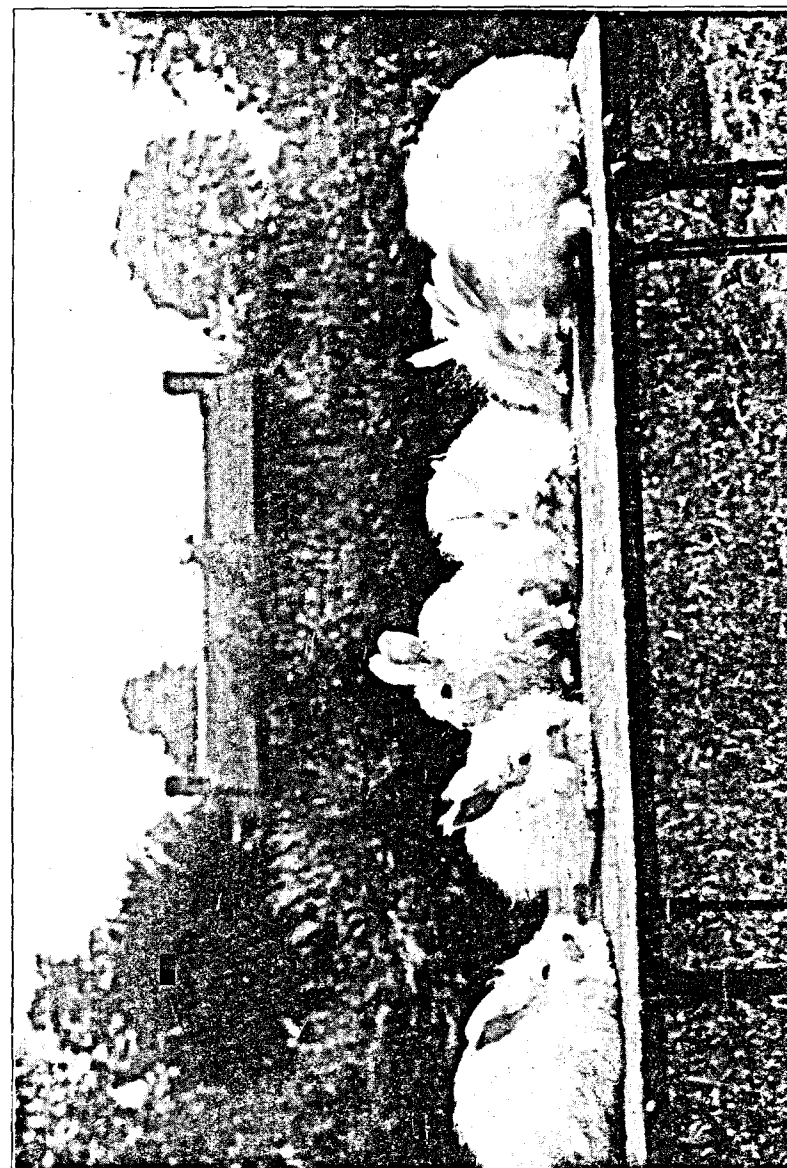
THE years since the war have seen rabbit breeding in this country develop from a hobby, and a small addition to the food supply, into the status of an industry. Expansion has been along two distinct lines, the one being the production of pelts and flesh, the other the production of rabbit "wool." For the former purpose the rabbits have, necessarily, to be killed to obtain the marketable products, but in the case of

wool production the life of the animal is preserved for the growing of successive coats of the wool.

The Angora Rabbit.—The Angora breed of rabbit alone grows a coat of sufficiently fine texture to merit the appellation of "wool." The name is popularly supposed to indicate the place of origin of this particular breed, but the fact that goats associated with the town of Angora have fine, silky coats may give it another significance. If Asiatic Turkey, however, can claim to be its original home, the Angora rabbit must, in the distant past, have spread to the adjoining continent, for it is now to be found in most European countries. It has been bred in the United Kingdom for many years, but France appears to have been the first to breed it on commercial lines, using the wool for the making of wearing apparel. Her example has now been followed in this country, and the British wool, being held, in the trade, superior in quality and capable of extended use, commands a higher price than the French article.

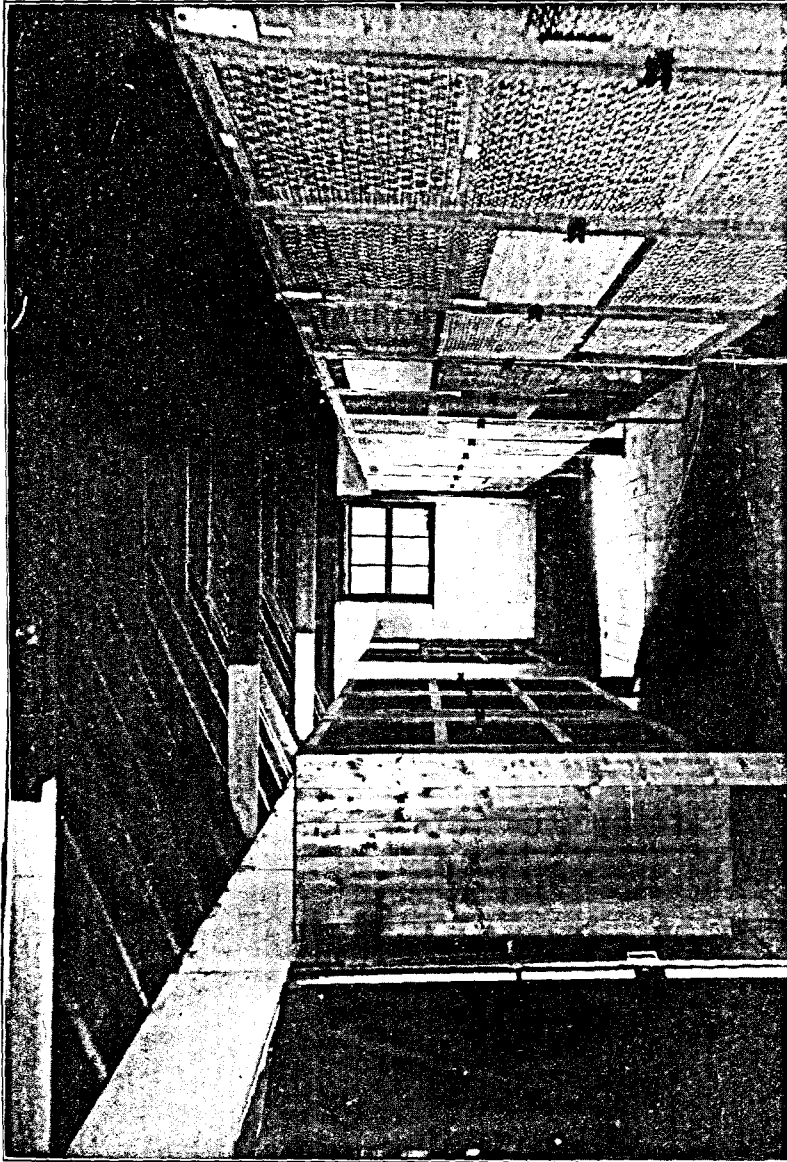
White Angoras are more popular for wool production than those with coloured coats, although the mills will purchase blue, black, fawn and grey wool on similar conditions to the white. The white Angora rabbit is an albino, its beautiful, thick coat contrasting with the "eye colour"; and its wool, of very fine texture, may attain a length of as much as 9 inches if allowed to grow to its full extent. Tufts of the fluffy wool in many cases surmount the ears of prolific wool-producing Angoras, while a forelock may hang down between the eyes, and the hair may also grow freely on the feet in the tufted manner. Although these tufted Angoras are frequently found in purely commercial rabbitries, there are many good specimens which do not carry such prominent "furnishings." The animal does, however, give the impression that it carries thousands of fibres to the square inch upon back, sides and much of the under part of its body. The arrangement of the fibres is also noteworthy, there being, scattered about amongst the bulk of the coat, longer and stronger fibres which help to protect the remainder of the wool from contact with dirt or contaminating matter and also from wear. If one of the finely textured fibres is isolated and closely examined it, will be seen to be crinkly; and it is this preponderance of zig-zag, or crinkly, appearance, which distinguishes the English Angora rabbit wool from that produced by the breed on the Continent. The fecundity of the Angora rabbit is normal, while the does are efficient mothers.

Housing and Feeding.—Hutches for woolling Angoras may be of several different kinds; the general type used for other



A litter of six young white Angora rabbits. Although these appear to be quite large, their bulk is mainly "wool."

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The modern rabbitry at the National Institute of Poultry Husbandry, Harper Adams Agricultural College. The hutches are arranged in stacks, three tiers high, there being one large door to three hutches, the working of the rabbitry being appreciably facilitated by this means.

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breeds is, however, quite suitable. Some commercial plants have hutches with perforated floors, and other special hutches may be used if there is a difficulty in securing suitable litter. The hutches need not be expensive, but they should be proof against both draught and damp. If they are arranged in a building, the conditions are more pleasant and suitable for efficient working, but the rabbits will thrive quite well without the hutches being under cover.

For bedding and absorbent material, straw and chaff can be used if other litter is not available; but for commercial use the most suitable litter is wheat straw. This can usually be obtained without much trouble in most districts, and if it is free from weeds and soil it assists very materially in keeping the wool free from dirt and matting.

Foodstuffs which are generally available on farms are suitable for the breed, the bulk of the ration being of a vegetable nature. Of this, hay and green foods, with roots in winter, form the largest part so far as bulk is concerned, whilst concentrated material, such as whole cereals and miller's offals, supply the remainder of the popular rabbit ration.

Care and Treatment of the Wool.—In the production of Angora rabbit wool, it is not necessary to grow the wool to its full natural length. The spinners ask for wool of $2\frac{1}{2}$ to 3 inches long; and, as this length of staple can be grown in about three months, it is usual to secure four crops per year from woolling rabbits. During the third month of growth, it is customary to groom the wool in order to keep it as clean as possible. There are two practical ways of grooming; the more general method is to brush the coat with a small bristle brush having a pneumatic cushion, which is made for this special purpose. The other method requires the use of an automatic blower or fan, which has some resemblance to the drying apparatus used by hairdressers. Such a machine is expensive, however, and only likely, therefore, to interest those who keep large stocks of Angoras. The rabbits may be kept clean with the special brush, if they are groomed for two or five minutes every second or third day; but, on the last two days previous to taking a wool crop, rather more time and attention should be given to the operation.

The crop of wool may be obtained either by clipping or plucking, but very few people in this country pluck their rabbits. Plucking only becomes possible when the coat has grown to its full natural length, and has ripened in readiness for

a moult. Clipping, on the other hand, is possible whenever it may be needed. As soon, therefore, as the coat reaches the length most suited to the requirements of the spinners, namely, $2\frac{1}{2}$ to 3 in., the crop of wool is shorn off. The shearing is performed with a pair of scissors, those with tapering blades, such as barbers use, being quite suitable. By parting the wool down the back of the animal, the operation can be commenced without difficulty. Should the rabbit happen to carry a little unclean wool, the crop should be carefully graded, the process being quite simple if carried out at the time of gathering the wool. Any soiled or damaged wool can be placed on one side or in a special receptacle as it is shorn off, and the clean crop can then be packed away in a box, jar or tin until sufficient has been accumulated to make a suitable consignment for disposal.

Value of the Wool.—The price now paid by the spinners for first grade British Angora rabbit wool is thirty-four shillings (£1 14s. 0d.) per pound. To rank as first grade, the wool must, obviously, be clean and free from matts or clotted sections of fibre. Wool containing vegetable matter or which is slightly stained is graded second or third quality, according to the degree of damage, and the price paid is reduced accordingly. First grade wool is that most sought after by the manufacturers, and it is this grade which yields the best return to the rabbit owner. Since the maintenance of a good rabbit is unlikely to cost more than a bad or indifferent one, the wisdom of breeding only from suitable breeding stock can scarcely be over-emphasized. The amount of wool grown by individual specimens naturally varies, but mature animals are quite capable of yielding from 8 to 10 oz. in one year. Where special attention is given to small stocks, heavier yields may be secured, but such cases cannot be considered in relation to the general average of wool growers.

Utilization of the Wool.—The wool is spun at the mills into a yarn, the resulting manufactured "wool" being used principally for knitting articles of clothing for women and children. Little suits for infants are frequently made of this material; but other articles, such as hats, caps, scarves, jumpers, dresses, suits, gloves, socks, etc., are also manufactured of rabbit wool, and are of sufficient strength to withstand certain processes of washing.

* * * * *

CANADIAN WHEAT POOLS

(The following statement, descriptive of a Canadian Wheat Pool, has been supplied to the Ministry by the Canadian Co-operative Wheat Producers, Limited, and may be of interest to farmers at a time when the possibilities of central selling, through organizations of this type, are under discussion.)

THE Canadian Wheat Pool is a non-profit co-operative association with a membership of 138,000 farmers in the three prairie provinces of Manitoba, Saskatchewan and Alberta. There are three provincial pools, each one a separate entity, self-controlled in every respect, with its own plan of organization and management, its own officials, administering its own internal affairs and collecting its own grain. The Central Agency handles the grain collected by the three pools. This Central Selling Agency handled during the crop year 1925-26 the enormous total of 215,016,000 bushels of grain, made up of 187,500,000 bushels of wheat, 11,024,000 bushels of oats, 13,221,000 bushels of barley, 1,597,000 bushels of flaxseed and 1,674,000 bushels of rye.

The three provincial wheat pools handled more than 56 per cent. of the entire wheat crop of Western Canada. The approximate gross returns to the provincial pools was \$271,500,000, of which \$22,500,000 went to Manitoba, \$188,500,000 to Saskatchewan, and \$60,500,000 to Alberta. This did not, of course, all go back to the farmers, as it included, for example, freight and local handling charges on wheat shipped through private elevators. Of the grain handled, 27,000,000 bushels went through pool terminals. Shipments were made to 25 different countries. The overhead selling cost of the Central Selling Agency amounted to one-fifth of a cent per bushel.

The movement for a voluntary wheat pool was started as soon as the western farmers had to abandon their efforts for the re-establishment of the Dominion Wheat Board, which handled very much to their satisfaction the entire wheat crop of Canada in 1919. Organization campaigns were conducted in the three provinces in the summer and fall of 1923, with 50 per cent. of the wheat acreage in each province set as the objective.

The Alberta Pool was the first to commence operations, with approximately 46 per cent. of the wheat acreage of the

province for 1923, or a total of 2,602,797 acres under contract. The first carload of pool wheat was accepted on October 29, 1923, and the world's largest co-operative marketing enterprise had hung out its shingle and started on its business career. Both the Manitoba and the Saskatchewan Pool commenced operations the following fall [autumn].

Membership in the provincial pools is open to those who are directly or indirectly engaged in the production of wheat. Every member on joining the pools pays a fee of two dollars, which goes to pay organization expenses, and also pays one dollar for a nominal share in the organization, to comply with the company laws of the province. He signs a five-year contract binding himself to deliver all the wheat which he produces directly or indirectly to the pool. All present contracts terminate with the 1927 crop. Those who joined the pool since the first year have, therefore, signed only for the balance of the period. An exception to this is the case of members signing a contract with the Manitoba Pool in connection with the acquisition of pool elevators. All such contracts are for the full five-year period.

These contracts form the foundation of the organization, and through the democratic methods which prevail, in the election of delegates and directors to the central bodies, members are in continual touch with and control of the entire organization. Each provincial pool is self-governing, and while the general form of organization, the terms of the contracts, and the methods of business are similar in all three pools, there are certain differences in detail.

The provincial pool has complete control of its members' wheat from the time of delivery at the country point of shipment until it reaches the terminal elevators at Fort William or Vancouver, as the case may be. At these terminal points the grain is turned over to the Central Selling Agency, which is under the control of a board of directors consisting of nine members, three from each of the provincial boards of directors.

The federal charter for the Canadian Co-operative Wheat Producers, Limited, the official title of the Central Agency, was issued in August, 1924. The keynote of the whole movement is outlined in the second clause of this charter, which states the purpose of the Central Selling Agency as follows:—

To be an agricultural organization instituted for the purpose of mutual help to serve as the Central Marketing Organization for the corporations and persons mentioned in Section A hereof, but for no others; to improve methods and reduce costs of marketing grain, to reduce speculation, manipulation and waste,

and all unnecessary transactions in such marketing; to increase consumption, build up new markets and develop new uses for grain; to market same directly and with regularity, so as to furnish it economically to the users thereof, and to preserve for the growers and the public their proper profits.

The Canadian Wheat Pool had no elevators when they started operations, but a clause in the contract provides for a deduction of two cents per bushel for the purpose of acquiring facilities for the handling of grain. The Saskatchewan Pool constructed or purchased outright 90 elevators in 1924-25, and by an agreement with the shareholders purchased in 1926 for a little over eleven million dollars the Saskatchewan Co-operative Elevator Company's system, and now owns and operates 587 elevators, including several terminals. The Alberta Pool already has 42 elevators under their control, and have now decided to build or acquire 100 additional country elevators in the province in time to handle the 1927 crop. The Manitoba Pool now owns 30 elevators, and should double this number by the end of the present year. In addition, the Alberta Pool has leased the terminal elevator at Prince Rupert, and another at Vancouver. The terminal elevators owned by the Saskatchewan Co-operative Elevator Company system are included in the deal of eleven million dollars between the pool and this company. The Central Selling Agency has three terminal elevators at Fort William, Ontario, with a total capacity of more than 2,000,000 bushels.

Referring to the relationship of the Central Selling Agency to the provincial pools, Mr. E. B. Ramsay, member of the Central Board, and secretary of that body, states:—

The Central Selling Agency is not an institution apart from the Provincial Associations, but is owned—lock, stock and barrel—by them. The ownership is based on capital stock, which is owned in the proportion of one-third by each of the three prairie pools, irrespective of the proportion of grain handled in the individual pools. The Central Selling Agency is directed by a Board which is nominated annually by the provincial associations, and each member pool nominates from its own Board three representatives. These nine men constitute the governing body of the Central Selling Agency, and this system enables the Provincial Boards to keep in close touch with all the policies and activities of the Central Selling Agency in a manner which would be impossible to a separate board of directors at Central. It also insures that the viewpoint of the country will be the guiding factor in determining the policies of the Central Board and maintains a unity throughout all pool developments which is an essential part of an organization that, in three short years, has developed business activities in all parts of the wheat importing world.

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JULY ON THE FARM

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Agricultural Organizer for Derbyshire.

Seasonal Notes.—The farm, whether pastoral or arable, looks its best in July. The horses have recovered the gloss that they lost during the pressure of spring cultivations; the cattle, including the yearlings, have put on their short, sleek summer coats and show the effects of Nature's best forage—June pasture; the cornfields are full of tall, waving verdure, and the root and potato crops begin to extend their rich foliage across the rows and cover the bare ground. The stack yard also looks less deserted than it did in June, some, if not all, of the hay harvest having been gathered in; and, if all has gone well during haymaking, time has perhaps been found to clean up, paint and put away in proper order, the various machines and implements that have been employed in the spring tillage operations.

July, however, gives an aspect to the countryside distinct from that of May and June. The trees and hedgerows now show a darker, more mature greenness, and, the mating season being over, the birds' songs have ceased. Pasture land enters on its second period, when the grasses tend to produce less leaf than during May and June and the clovers produce flower heads, which, while they yield the beekeeper his harvest, are perhaps not so valuable as leafy herbage to the grazier. Certainly the stock-carrying power of grass land is generally smaller in July than in June; and, where heavy stocking is practised, the farmer is glad when fattening cattle and sheep have made good progress, so that the pastures may be relieved of many of these before July is far advanced. In dry seasons, keep may begin to get short in this month and, whatever may be the virtues of nitrogenous top-dressings applied early enough, little relief is to be obtained from their application to short pasture during a dry period; in fact, I have known sulphate of ammonia produce a scorching effect when applied under these conditions.

The weather of this month is subject to wide variations, but most farmers, excepting those wholly dependent on cattle fattening, prefer a moderately dry month. The bulk of the hay is made in July; the final cleaning and horse-hoeing of the root crops cannot be done effectively in constantly wet weather, and the bare-fallow may be almost a failure if the sun lacks its customary July power; but the dread of wild wet weather in this month is proverbially expressed in the

old couplet, "No tempest, good July, lest the corn look ruey." In this month corn crops go through the process of transferring food materials from their leaves and stems to the ears. Moisture is essential to this process and, as is well known, weather which is too hot and dry, and which brings harvest time forward too rapidly, results in light, husky grain, and light yields. On the other hand, when the crop becomes laid, the loss due to badly fed grain is aggravated by the increased cost of harvesting and by the dragging on of the harvest season, so that little opportunity is left for stubble cultivations and weed killing. There are, of course, important differences in the standing power of different varieties of cereals, but these differences are not determined wholly by the shortness and stiffness of straw.

The need for caution in the horse-hoeing of early sown root crops, after a certain stage of growth has been reached, has been stressed in these notes on previous occasions. The idea that deep grubbing between root rows is necessarily beneficial to the crop is, however, still widely held, and practised with ill effects. In an experiment with sugar beet, last summer, the yield was in almost inverse ratio to the number of horse-hoeings given. Some soils tend to become capped and crusted, and for that reason may require more hoeing than other soils that have better texture; there is also the question of hoeing necessary to kill weeds; but the value of *deep* horse-hoeing as a means of conserving soil moisture is at least doubtful, and the injury that may be done by cutting through root fibres by injudicious tillage is indisputable.

July is not a time when much seeding is done. Where rape and rotation grass seeds are sown after a half-fallow, good sheep-keep for autumn feeding and a good take of seeds may be obtained by sowing at this time of the year. Some west-country farmers sow a mixture of swedes and thousand-headed kale, which they feed off with ewes and lambs in spring. Considerable areas of common turnips are sown in this month, while land cleared of early potatoes is put down with catch crops for forage or for green manuring. The prevalence of bulb fly in wheat following bare-fallow makes one wonder whether the sowing of mustard on the fallow land in July might not be a means of preventing the trouble; for it is known that the fly lays on bare ground. Possibly the supposed insecticidal effects of a crop of mustard are partly attributable to its covering ground that would otherwise be attractive to the bulb fly for egg laying.

As regards green manuring for the purpose of enriching the soil in humus and increasing the yield of the succeeding crop, it has to be admitted that the results of recent experiments have been most disappointing. Having regard to the well-known apparent benefit of ploughing in turnip tops, grass turf, and other fresh vegetable matter, it is almost inconceivable that a crop of mustard, rape or rye ploughed under should fail to increase the yield of the next crop; but, in the twelve experiments recorded in the *Journal of the R.A.S.E.* for 1926, p. 297, seven showed the effect of the green manure to be that of depressing the yield of the following cereal or potato crop.

Hot Stacks.—In wet seasons the farmer's chief aim in haymaking is to secure the fodder in such a condition that it will afterwards cut up free from mustiness, mould and bitter flavour, which are the results of low-temperature fermentation of damp, dead material. In good seasons this type of "sweating" occurs only when over-made hay has been stacked while damp with dew or other external moisture: the more common problem after fast-drying weather is to prevent high-temperature fermentation. This is due to stacking nutritious herbage before the cell sap has been sufficiently dried and before a certain amount of loss of soluble and fermentable constituents has taken place. The richer and more leafy the herbage, the more likely it is to heat in the stack, but over-ripe fibrous fodder has less fermentable constituents and is more easily dried to a condition of stability.

There is no doubt that from the chemical point of view all heating and sweating is wasteful of nutritive matter. All heat produced in a stack is generated at the expense of food constituents that might have yielded the same quantity of heat, or its equivalent in fat, etc., in the body of an animal. Drying a crop by sweating the moisture out of it is a most extravagant method of haymaking. The direct and indirect losses due to dangerous over-heating and spontaneous combustion, however, are enormous. A recent investigation of the matter in Germany reveals that the annual loss from this cause in that country is about £1,000,000. The greatest number of fires occurred in July and August, but the figures for October and November were high; and fires were more numerous after good than after bad haymaking seasons.

There is still much to be found out regarding the causes of spontaneous combustion in hay stacks, but two methods

are known whereby it is possible to prevent the hay from heating to dangerous temperatures. The first is that of drying the fodder sufficiently before leading it to the rick; the second is that of making the ricks small, circular and placed on raised staddles, so that the heat produced can readily escape. There is less risk of over-heating when the hay has been more gradually cured in cocks than when it has been rapidly dried in swath and windrow and carted direct from the row.

Various suggestions have been made with the object of preventing over-heating of hay that is being stacked in doubtful condition. Observation of the effects of different methods was made in the German investigations mentioned above, and the conclusion was arrived at that the introduction of layers of dry straw and the use of salt were valueless; and the provision of ventilation in the stack was not a certain preventive of over-heating. The treatment recommended was that of spreading the hay as soon as it is observed to have attained an abnormal temperature.

Last year I drew attention to the wisdom of recording the actual temperature of the heart of stacks for some time after stacking, and several correspondents inquired for further particulars of the use of the maximum thermometer recommended. It will therefore be of interest to explain that a fairly rapid rise of temperature to 120° F. need cause no alarm, but the rate of increase should then slow down and 140° F. should not be exceeded, for at this heat the hay begins to turn brown. Should the temperature remain high, the stack should be kept under observation, for the danger of firing may persist for three or four months. There is no doubt that by boring holes down into the centre of the hot stack the escape of excess heat and moisture are facilitated, and if this step is taken in time it should not be necessary to adopt the more drastic measure of spreading the hay, which is itself sometimes attended with the risk of conflagration.

Live Stock.—Sheep management varies considerably in the matter of time in different districts, but in the Midland and Northern counties and with regular breeding flocks of longwools, which lamb in March, both ewes and lambs are dipped in July and the lambs are weaned about the end of the month. The ewes are placed on poor keep and now receive no concentrates, the object being to reduce milk secretion, but the modern shepherd does not consider it necessary to milk

the ewes to relieve the congestion of their udders. The lambs, however, are put on to fairly good grazing but not rich clovery pasture, as this is apt to cause scouring. The chief rules in lamb management at this stage are frequent change of field, avoiding ground recently grazed by older sheep, allowance of $\frac{1}{4}$ lb. to $\frac{1}{2}$ lb. of concentrated food, cleanliness, and a sharp look-out for maggot fly and husk.

On the best feeding pastures the first lots of bullocks go off fat in July and the fields are allowed to rest and sweeten for a week or two before the second lots are brought in. Apart from the above two cases of change, the management of live stock in July differs little from that in June. Cows in full milk now require some artificial food to maintain their yield and condition on the less abundant grazing. There can be no hard and fast rule regarding the "cake" allowance, but a little liberality may be recommended on the grounds that experiments have shown the benefits of summer-feeding to extend into the winter. Cows that are dry at this time of the year are on some farms very subject to a severe form of mammitis or garget known as "autumn bag." In South Derbyshire the practice of sealing the end of the teat with a special strength of collodion has been found to be a useful preventive measure.

Other ailments of stock that require preventive measures in July are hoven or blown and husk or hoose. Last summer one farmer lost five heifers with hoven, as a result of their having been allowed to eat their fill of damp clover after-math.

Husk or hoose, when it appears early in July, as it did last year, is frequently not recognised as the parasitic form of the trouble. In this disease early recognition and treatment are of double importance, firstly in the interests of the animals attacked, and secondly to reduce the risk of infecting other cattle.

On farms where husk is troublesome, it may be better not to turn spring-born calves out during their first summer. I have, however, seen cases of husk in calves that have never been out of doors; the calf-house had been occupied during the previous winter by husking cattle, and had not been properly disinfected afterwards. Apart from the prevention of husk, calves out at grass in July should now receive an allowance of concentrated food, otherwise they lose bloom and condition. Small calves, of course, receive little if any benefit from running out on pasture at this season.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ending June 15					Cost per unit at London
	Bristol	Hull	L'pool	London		
	£ s.	£ s.	£ s.	£ s.	s. d.	
Nitrate of Soda (N. 15½%)	13 15	..	13 10	13 12	17 7	
" " Lime (N. 13%)	..	..	..	11 15†	18 1	
Sulphate of ammonia :—						
Neutral (N. 20·6%)	12 6*	12 6*	12 6*	12 6*	11 11	
Calcium cyanamide (N. 19%)	9 16*	9 16*	9 16*	9 16*	10 4	
Kainit (Pot. 14%)	3 2	2 17	2 17	2 15	3 11	
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0	
" (Pot. 20%)	3 12	..	3 9	3 2	3 1	
Muriate of potash (Pot. 50·53½%)	9 10	8 5	8 13	9 0	3 4	
Sulphate " " (Pot. 48·51½%)	11 10	10 5	10 16	10 17	4 3	
Basic Slag (T.P. 32%)	..	..	..	..	..	
" (T.P. 30%)	..	3 2§	3 1§	..	..	
" (T.P. 28%)	..	2 11§	2 10§	..	..	
" (T.P. 26%)	..	2 7§	2 6§	..	..	
" (T.P. 24%)	..	2 2§	..	..	..	
Ground rock phosphate (T.P. 58%)						
Very fine grade¶	2 15	..	..	2 10d	0 10	
Fine grade||	2 10	..	..	2 7d	0 10	
Superphosphate (S.P. 35%)	3 9	..	3 12	3 2	1 9	
" (S.P. 33%)	..	..	3 9	..	..	
" (S.P. 30%)	3 2	2 15	3 5	2 17	1 11	
Bone meal (N. 3½%, T.P. 45%)	8 15	8 10	8 10	8 0	..	
Steamed bone flour (N. ½%, T.P. 60·65%)	6 0†	6 2†	6 5	5 17	..	

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate
Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire.

¶ Fineness 80% through standard screen of 14,400 holes to the square inch (120 mesh sieve).

|| Fineness 80% through standard screen of 10,000 holes to the square inch (100 mesh sieve).

d Price for 4-ton lots f.o.r. at Northern London Stations. At G.W.R. and S.R. London Stations the cost to purchasers is 2s. 6d. per ton extra.

NOTES ON FEEDING STUFFS FOR JULY

E. T. HALNAN, M.A.,
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The Nutritive Value of Feeding Stuff: A Retrospect.—

Since the first issue of these notes, considerable progress has taken place in our knowledge of the feeding of stock, and both the manufacturer and the farmer give more attention to the scientific principles involved in the production and use of purchased feeding stuffs. It may perhaps be claimed that these notes have contributed to this improvement.

In the past, the law has to some extent protected the farmer from the pecuniary loss involved in the purchase of inferior or worthless feeding stuffs by making the manufacturer of compound cakes and meals declare the percentages of albuminoids and oil present in such products, such a declaration enabling the farmer to make a rough and ready estimate of the value of such products as compared with the value of a cake, such as linseed cake, with which he was already familiar. This declaration was all the more essential because a considerable number of the meals and cakes offered to the farmer were compounded from mixtures of cakes or meals which the manufacturer considered it necessary to keep secret, in most cases in order to avoid undue competition from others in the trade. Most of these formulæ were derived from educated and experienced farmers who had found certain mixtures of feeding stuffs to give good results in practice, and the success of the proprietary cakes and meals then offered proved that, in the main, the manufacturers of these products were fulfilling an essential and valuable service to the farming community.

The necessity of secrecy, however, enabled unscrupulous individuals to market products the nutritive value of which was altogether disproportionate to the price charged for them, and tended to throw into discredit even the products of honest manufacturers. This state of affairs was alleviated to some extent, but not entirely, by the provisions of the Fertilizers and Feeding Stuff Acts. The rapid growth of agricultural education, and particularly the dissemination among farmers by Agricultural Organizers and central institutions, of information on the scientific principles underlying feeding practice, couched in language divested of all scientific technicalities, enabled the farmer to appreciate the real connexion between practice and science, and the better to assign to its true cause any trouble he experienced in the feeding of stock.

With the knowledge thus obtained, the farmer was in a position to compound his own feeding cakes and meals, and the readiness with which he availed himself of this position emphasized the fact that he was no longer content to feed materials in regard to the composition of which he was ignorant. This change of practice impelled the manufacturers of compound cakes and meals to review the situation, and to consider whether a departure from the old attitude of secrecy was not desirable in the interests of business. The writer, some time ago, was informed by a manufacturer of repute that he was obliged to change his methods. "In the past," he stated, "the word of our traveller was sufficient to sell our goods, but now the farmer insists on asking questions about starch equivalents, nutritive value and digestibility, and we have been obliged to take steps to meet this demand." In several instances, manufacturers have taken on their staffs people trained in the scientific principles of feeding to answer all inquiries of this nature received from farmers. In addition to this, the latest results of research are scanned with a view to improving the cakes and meals offered, and, in most cases, the cakes or meals are thoroughly tested out in practice before being offered for sale.

Last, but not least, the manufacturers are now tending to abandon the old idea of secrecy. In America, for some time past, compound cakes and meals of declared content have been placed on the market, and the co-operation of the agricultural advisory staffs invited for the production of suitable feeding stuffs formulæ. That is to say, not only is a full chemical analysis of the cake or meal given, but, in addition, the cakes and meals and the respective proportions present, are also given. This information enables the farmer to appraise very closely the value of the material offered, and also enables him to avoid mixing incompatible materials with it in making up his rations. In England, at least one material of this nature is now being marketed, and the manufacturer will possibly find that his enterprise has been justified by results. A big future for such a policy is assured, since smallholders and small farmers are unable for market reasons to compound their own rations, although they may have the requisite knowledge. It is obvious, however, that such smallholders and farmers will prefer to buy compound cakes and meals of declared content for admixture with their home-grown products rather than to buy cakes or meals the composition of which they do not know. It will also have another

important effect, since the declaration of content will enable agricultural organizers and other advisory staffs to give to inquirers an honest opinion of the value of such products for feeding purposes, an opinion which the present practice of secrecy does not admit.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follow:—

	Starch equivalent	Protein equivalent	Per ton
	Per cent.	Per cent.	£ s.
Barley (Imported)	71	6.2	10 19
Maize	81	6.8	8 2
Decorticated ground nut cake	73	41.0	11 5
" cotton cake	71	34.0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2.55 shillings, and per unit protein equivalent, 1.04 shilling.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9.6	9 14
Oats	60	7.6	8 1
Barley	71	6.2	9 7
Potatoes	18	0.6	2 7
Swedes	7	0.7	0 19
Mangolds	7	0.4	0 18
Beans	66	20.0	9 9
Good meadow hay	31	4.6	4 4
Good oat straw	17	0.9	2 4
Good clover hay	32	7.0	4 9
Vetch and oat silage	13	1.6	1 15
Barley straw	19	0.7	2 9
Wheat straw	11	0.1	1 8
Bean straw	19	1.7	2 10

DESCRIPTION	Price per qr.	Price per ton	Manu- rial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Pro- tein equiv.
	s. d.	lb.	£ s.	£ s.	£ s.	s. d.	d.	%
Wheat, British	—	—	13 7	0 15	12 12	72	3 6	1.87
Barley, British feeding	—	—	11 10	0 12	10 18	71	3 1	1.65
" Canadian No. 3 Western	41 0	400	11 10	0 12	10 18	71	3 1	1.65
" " No. 4	40 0	—	11 3	0 12	10 11	71	3 0	1.61
" Persian	36 9	—	10 5	0 12	9 13	71	2 9	1.47
Oats, English, white	—	—	10 13	0 13	10 0	60	3 4	1.78
" " black and grey	—	—	10 0	0 13	9 7	60	3 1	1.65
" Scotch white	—	—	11 10	0 13	10 17	60	3 7	1.92
" Canadian feed	23 9	320	8 7	0 13	7 14	60	2 7	1.38
" American	25 3	—	8 17	0 13	8 4	60	2 9	1.47
" Argentine	28 3	—	9 18	0 13	9 5	60	3 1	1.65
" Chilian	29 0	—	10 3	0 13	9 10	60	3 2	1.70
Maize, Argentine	34 6	480	8 2	0 12	7 10	81	1 10	0.98
Beans, English winter	—	—	10 10	1 10	9 0	66	2 9	1.47
Peas, Japanese	—	—	22 0	1 6	20 14	69	6 0	3.21
Dari, Egyptian	—	—	11 10	0 14	10 16	74	2 11	1.56
" Persian	—	—	10 15	0 14	10 1	74	2 9	1.47
Millers' offals—								
Bran, British	—	—	7 15	1 6	6 9	42	3 1	1.65
" broad	—	—	8 15	1 6	7 9	42	3 7	1.92
Middlings, fine, imported	—	—	10 0	1 1	8 19	69	2 7	1.38
" coarse, British	—	—	9 0	1 1	7 19	58	2 9	1.47
Pollards, imported	—	—	8 5	1 6	6 19	60	2 4	1.25
Meal, barley	—	—	11 15	0 12	11 3	71	3 2	1.70
" maize	—	—	9 7	0 12	8 15	81	2 2	1.16
" " germ	—	—	9 10	0 18	8 12	85	2 0	1.07
" " gluten feed	—	—	8 15	1 5	7 10	76	2 0	1.07
" locust bean	—	—	8 10	0 11	7 19	71	2 3	1.20
" bean	—	—	12 0	1 10	10 10	66	3 2	1.70
" fish	—	—	20 0	4 1	15 19	53	6 0	3.21
Maize, cooked flaked	—	—	10 10	0 12	9 18	85	2 4	1.25
Linseed—								
" cake, English 12% oil	—	—	12 0	1 16	10 4	74	2 9	1.47
" " " 10% "	—	—	11 12	1 16	9 16	74	2 8	1.43
" " " 9% "	—	—	11 7	1 16	9 11	74	2 7	1.38
Soya bean	—	—	11 5*	2 11	8 14	69	2 6	1.34
Cottonseed cake	—	—	6 10	1 13	4 17	42	2 4	1.25
" " Egyptian, 5 1/2% "	—	—	6 5	1 13	4 12	42	2 2	1.16
Decorticated cottonseed meal, 7% oil	—	—	11 2†	2 11	8 11	74	2 4	1.25
Coconut cake, 6% oil	—	—	9 7	1 9	7 18	79	2 0	1.07
Ground-nut cake, 7% oil	—	—	9 10†	1 14	7 16	57	2 9	1.47
Decorticated ground-nut cake, 7% oil	—	—	11 5*	2 12	8 13	73	2 4	1.25
Palm kernel cake, 6% oil	—	—	8 10	1 2	7 8	75	2 0	1.07
" " " meal, 6% oil	—	—	9 10†	1 2	8 8	75	2 3	1.20
" " " meal 2% oil	—	—	7 17	1 3	6 14	71	1 7	0.85
Feeding treacle	—	—	6 5	0 9	5 16	51	2 3	1.20
Brewers' grains, Dried ale	—	—	6 17	1 2	5 15	49	2 4	1.25
" " " porter	—	—	6 7	1 2	5 5	49	2 2	1.16
" " " Wet ale	—	—	0 16	0 8	0 8	15	0 6	0.27
" " " porter	—	—	0 11	0 8	0 3	15	0 2	0.09
Malt culms	—	—	7 10	1 12	5 18	43	2 9	1.47

Prices at London except where otherwise stated.

* At Hull.

† At Bristol.

‡ At Liverpool

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of May and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manual value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manual value per ton figures are calculated on the basis of the following unit prices: N, 12s. 0d.; P₂O₅, 3s. 10d.; K₂O, 3s. 0d.

MISCELLANEOUS NOTES

THE Ministry's Annual Report on the prices and supplies of agricultural produce and requirements in 1926-27 was issued last month. This report discusses the movements in prices of the different commodities during 1926, and price changes are compared over a series of years by means of index numbers. The

Report shows that, during the cereal year 1925-26, prices of agricultural produce averaged 53 per cent. above 1911-13 or about 5½ per cent. less than in the previous twelve months, while in the seven months, September, 1926, to March, 1927, the index number fell further to 50 per cent. above pre-war. The detailed information as to each of the different forms of agricultural produce shows that most commodities declined in price, but in varying degrees. Prices of feeding stuffs declined from 60 per cent. above pre-war in 1924-25 to only 28 per cent. in 1925-26, and, in the seven months, September, 1926, to March, 1927, were only 27 per cent. above 1911-13. Fertilizers, generally, remained very steady in price and in the last twelve months have averaged only 13 per cent. above pre-war. The Report also contains references to agricultural wages, and the prices of seeds and machinery.

The action taken by the Ministry as a result of the passing of the Markets and Fairs (Weighing of Cattle) Act, 1926, is reviewed in this Report. It is shown that, as compared with two years earlier, the number of markets and marts fitted with auto-dial machines had been increased by nearly 70 by the end of March, 1927, and the number would be further increased when the new machines were fitted in other markets and marts where such machines were on order at that date.

Tables are appended to the Report showing the monthly average prices in 1926 of most agricultural commodities, together with figures of the imports of live stock into Great Britain from Ireland over a series of years, and the imports into the United Kingdom of all the chief classes of agricultural commodities. The quantities imported from each of the chief countries in each of the last five years is also given for wheat, flour, barley, oats, maize, meat, butter, cheese and eggs.

The Report, which forms Part II of the *Agricultural Statistics*, and was issued in previous years as Part III, may be purchased through any bookseller or direct from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, price 1s. 3d. net, or 1s. 4d. post free.

VOLUME X of the Ministry's *Register of Dairy Cattle* was published on June 20, and contains particulars of 7,500 cows selected for their milk performances during the year ended October 1, 1926. The qualification necessary for a cow to be eligible for entry in the Register was that its milk yield was not less than the standard prescribed for its breed or type. The standard yields for the year ended October 1 last were as follows :—

Friesian	.. .. .	10,000 lb.
Ayrshire, Blue Albion, Lincoln Red Short-horn, Red Poll, and Shorthorn	.. .. .	9,000 lb.
All other breeds or types	.. .. .	8,000 lb.

The cost of producing the Register again necessitated the restriction of the number of entries to 7,500, which is only 48 per cent. of the total number of cows eligible. Of these cows, 25 gave between 8,000 and 9,000 lb. of milk during the year; 472 between 9,000 and 10,000 lb.; 3,127 between 10,000 and 11,000 lb.; 1,924 between 11,000 and 12,000 lb.; 1,008 between 12,000 and 13,000 lb.; 473 between 13,000 and 14,000 lb.; 220 between 14,000 and 15,000 lb.; 227 between 15,000 and 20,000 lb.; and 24 over 20,000 lb. Twenty recognized breeds or types are represented in the volume, 64 per cent. being of the Shorthorn type; 18 per cent. Friesian; and 4 per cent. Guernsey.

The Register also contains a list of 276 cows which have been awarded Certificates of Merit. To be eligible for a Certificate of Merit a cow must have calved not less than three times during a period of three consecutive milk-recording years, and have given, during those years, not less than the prescribed yield of milk, which for the three years ended October 1, 1926, was 30,000 lb. for Friesians and 27,000 lb. for Shorthorns.

Particulars are also given of pedigree bulls of proved milking strain. The condition of entry of a bull in this section of the Register is either (a) that its dam and sire's dam must have given the standard yield prescribed for their breed or type during a milk-recording year, or (b) that it has two or more daughters which have given not less than the standard yield prescribed for their breed or type in a milk-recording year. Entries relating to 66 bulls are given in the volume, 48 of which qualified under condition (a) and 18 under condition (b).

The volume contains, also, an up-to-date list of the Milk Recording Societies in England and Wales, with full particulars of each Society and the name and address of the Secretary.

Dairy farmers and others desirous of acquiring pedigree or non-pedigree animals of proved dairy breeding with authenticated milk records should find the Register a valuable book of reference.

The Register is priced 1s., post free, and can be obtained from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, or through any bookseller. A copy of the volume is issued free to all members of Milk Recording Societies.

* * * * *

AN account of the Empire Shopping Week held at Belfast from 23rd-28th May was given in the JOURNAL for June, p. 193. The lower photograph opposite

Display of Empire Produce at Belfast gives a general view of one side of the Ulster Hall, the Great Britain section occupying the three centre bays on that side. The top photograph shows the

display of home produce in greater detail. The centre portion comprised fruit products; on the left-hand side were bacon, hams, packed meats and dairy produce; on the right-hand side were cereal products and various other packed foodstuffs, and in the foreground around the pillars, hothouse tomatoes, cucumbers and mushrooms were effectively displayed. Altogether about 50 firms contributed to this stand, which was greatly appreciated by the many visitors to the exhibition.

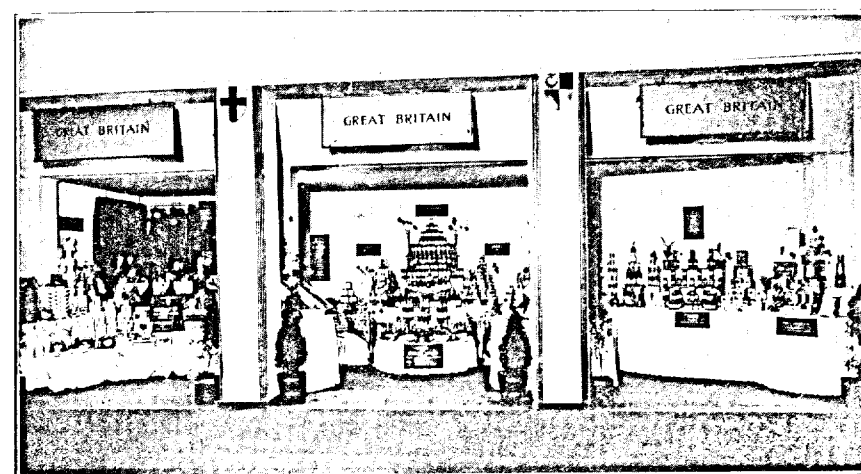
There is a danger that an effort of this kind may become merely a "nine days' wonder." It is understood that a certain amount of new business in home products has already eventuated as a direct result of the display, and it is for producers and manufacturers in this country to follow up the advantage gained in order to ensure that the effort is permanent.

* * * * *

PRICES of agricultural produce during May were on the average 42 per cent. above those in the corresponding month of the years 1911-13, as compared with

The Agricultural Index Number 43 per cent. in April and 50 per cent. a year ago. The reduction in the general index number in May resulted from the

drop in the average contract price of milk in the Manchester area and the continuance of the decline in fat pig prices. Grain and potatoes on the other hand increased in price, following upon a period of about five months during which little change in values had occurred.



Detail view of the Great Britain Section.



General view of the Display of Empire Produce, Ulster Hall, Belfast.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1922 :—

				Percentage Increase compared with the Average of the corresponding month in 1911-13					
Month				1922	1923	1924	1925	1926	1927
January	..	..	..	71	67	60	71	58	49
February	..	..	..	75	63	61	69	53	45
March	..	..	..	73	59	57	66	49	43
April	..	..	..	66	54	53	59	52	43
May	..	..	..	69	54	57	57	50	42
June	..	..	..	64	49	56	53	48	—
July	..	..	..	67	50	53	49	48	—
August	..	..	..	68	52	57	54	49	—
September	..	..	..	59	52	61	55	55	—
October	..	..	..	61	50	66	53	48	—
November	..	..	..	63	51	66	54	48	—
December	..	..	..	61	55	65	54	46	—

Grain.—Wheat prices after falling slightly during March and April rose in May to 12s. 1d. per cwt., an increase of 7d. per cwt. on the month. The rise, however, was practically proportionate to the increase in May of the base years 1911-13, and the index number was only one point higher at 53 per cent. above pre-war. An increase of 4d. per cwt. in the price of barley brought the relative index figure to 46 per cent. above the level of the base years, a rise of 5 points on the month, while oats were 1s. 1d. per cwt. dearer than in April, the index figure rising by 9 points to 27 per cent. more than pre-war rates.

Live Stock.—The average prices obtained for fat cattle in May varied little from those realized in April, and store cattle practically maintained the values ruling in the previous month, the index figures for fat and store cattle standing at only 24 per cent. and 23 per cent. above pre-war respectively. Dairy cows, however, showed a decline of about 8s. per head. There was the customary spring fall in fat sheep prices and the index figure remained unaltered at 53 per cent. above pre-war, but there was a small decrease of 2 points in the index figure for store sheep. Bacon pigs declined by 4d. and porkers by 8d. per 14 lb. stone, the average prices being 58 per cent. and 66 per cent. respectively above pre-war. Prices of fat pigs have now declined to about the same level as at the end of August, 1925. Store pigs also show a fall in price, but although cheaper than in recent months they are still making about double pre-war rates.

Dairy and Poultry Produce.—Egg prices averaged the same as in April, but the rise in May in the base years caused a

decline of 9 points in the index number to 28 per cent. above pre-war. Butter was reduced about 2d. per lb., although as a proportionate reduction occurred in the base years there was little alteration in the index number; but cheese, contrary to the usual movement at this season, was a little dearer and the index number rose 10 points to a level of 46 per cent. above 1911-13. The reduction to 10d. per gallon in the average price of milk delivered under contract in the Manchester area affected the index number of this commodity to the extent of a fall from 63 per cent. above pre-war in April to 53 per cent. in May.

Other Commodities.—Vegetables were about 26 per cent. dearer than in May, 1911-13, as compared with 19 per cent. in April, and hay was a trifle higher in price and index number. A rise of about 10s. per ton in the price of potatoes occurred during May after a period of comparatively steady trade, and the index figure appreciated considerably to 74 per cent. above pre-war, the corresponding figure a year ago being only 15 per cent. Wool prices declined slightly in May to 31 per cent. dearer than 1911-13.

Index numbers of different commodities during recent months and in May, 1925 and 1926, are shown below :—

Percentage Increase as compared with the Average
Prices ruling in the corresponding months of
1911-13

Commodity	1925	1926	1927			
	May	May	Feb.	Mar.	Apr.	May
Wheat	59	67	60	57	52	53
Barley	36	22	37	38	41	46
Oats	36	30	16	14	18	27
Fat cattle	49	43	30	26	25	24
Fat sheep	100	67	44	45	53	53
Bacon pigs	60	88	63	63	61	58
Pork pigs	60	90	75	76	73	66
Dairy cows	48	36	26	25	26	24
Store cattle	40	29	30	27	23	23
Store sheep	99	55	48	41	40	38
Store pigs	55	122	125	116	108	99
Eggs	48	38	62	39	37	28
Poultry	55	61	39	34	25	41
Milk	55	60	62	56	63	53
Butter	54	52	40	40	43	42
Cheese	70	83	36	36	36	46
Potatoes	124	15	94	85	60	74
Hay	3	9	-2*	—	-1*	2
Wool	50	29	32	33	34	31

* Decrease.

Farm Workers' Minimum Wages.—Meetings of the Agricultural Wages Board were held on May 23 and June 14, at 7 Whitehall Place, S.W. 1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages and proceeded to make the following Orders carrying out the Committees' decisions :—

Bedfordshire and Huntingdonshire.—An Order, to come into operation on May 30, continuing, until further notice, the existing minimum and overtime rates, but providing that all employment on Good Friday, Easter Monday, Whit Monday, August Bank Holiday, Christmas Day and Boxing Day should rank as overtime employment and be paid for at the overtime rate applicable to Sunday work. The minimum rate in the case of male workers of 21 years of age and over is 30s. 6d. per week of 48 hours in winter and 50 hours in summer, and overtime at 9d. per hour on weekdays and 11d. per hour on Sundays and on the six public holidays mentioned above. In the case of female workers of 18 years of age and over the minimum rate is 6d. per hour for all time worked.

Hampshire and Isle of Wight.—An Order fixing special differential rates of wages for overtime employment of male workers on the corn harvest in 1927, the rate in the case of workers of 21 years of age and over being 9d. per hour.

Hertfordshire.—An Order, to come into operation on June 18, fixing special differential rates of wages for overtime employment of male and female workers on the hay harvest in 1927, the rate in the case of male workers of 21 years of age and over being 10d. per hour, and for female workers of 19 years of age and over 7½d. per hour.

Norfolk.—(1) An Order continuing, from June 2 until December 31, 1927, the operation of the existing minimum and overtime rates of wages for male and female workers. The minimum rates in the case of male workers of 21 years of age and over are 30s. per week of 50 hours in summer and 48 hours in winter, with, in addition in the case of teamsmen, cowmen, shepherds or yardmen, 5s. 6d. per week, and, in the case of sheep-tenders and bullock-tenders, 4s. 6d. per week in respect of employment in connexion with duties of feeding, cleaning, milking, bedding down or mucking out stock, or for similar duties in connexion with the immediate care of animals. The overtime rates for all classes of male workers are 9d. per hour on weekdays and 11d. per hour on Sundays. In the case of female workers of 18 years of age and over the minimum rate is 5d. per hour, with overtime at 6½d. per hour on weekdays and 7½d. per hour on Sundays.

(2) An Order fixing special minimum and overtime rates of wages for employment of male workers on the corn harvest in 1927. In the case of workers of 21 years of age and over who are employed throughout the full period of the harvest a sum of £11 is payable in respect of the harvest month, whilst in the case of workers of the same age who are not employed throughout the whole period payment must be made at the ordinary minimum rate, with overtime at 9½d. per hour.

North Riding of Yorkshire.—An Order varying, as from June 20, 1927, the existing minimum and overtime rates of wages for male and female workers, which will continue in operation until further notice. The rates fixed in the case of male workers of 21 years of age and over are 33s. per week of 48 hours in winter and 52½ hours in summer, with special hourly rates, in certain cases, for workers who are required to perform work on the care of and attendance

upon animals, the rates being 3d. per hour for workers who are boarded and lodged by their employer and 6d. per hour for workers who are not so boarded and lodged (instead of 4d. and 8d. per hour respectively as at present). The overtime rates for male workers of 21 years and over are 10d. per hour on weekdays and 1s. per hour on Sundays. In the case of female workers of 18 years of age and over the minimum rate is 6d. per hour for a week of 44 hours, with overtime at 9d. per hour.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

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Special Minimum Rates of Wages for the Hay Harvest.—Further to the note, in the June issue of this JOURNAL, as to hay harvest rates, the Hertfordshire Agricultural Wages Committee have now fixed special overtime rates for male and female workers employed on the hay harvest, the rates in the case of male workers of 21 years of age and over being 10d. per hour, and for female workers of 19 years of age and over 7½d. an hour.

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Special Minimum Rates of Wages for the Corn Harvest.—Special rates of wages for employment on the corn harvest in 1927 have been fixed by eight Agricultural Wages Committees, viz., Derbyshire, Devonshire, Dorsetshire, Hampshire and Isle of Wight, Norfolk, Somersetshire, Wiltshire, and the East Riding of Yorkshire. In each case similar rates were fixed last year. In the cases of Cambridgeshire and Isle of Ely, Essex, Hertfordshire, and Suffolk, where special rates were fixed last year, no proposals in regard to corn harvest rates have yet been issued, but meetings of these Committees have been arranged to discuss such rates.

The rates fixed apply only to male workers except in the case of the East Riding of Yorkshire, where provision is made for female workers also. Except in the case of Norfolk, the special harvest rates apply only to overtime employment, the harvest overtime rate for adult male workers being 9d. per hour in the case of Derbyshire, Hampshire and Isle of Wight, and Wiltshire, and 10d. per hour for Devonshire, Dorsetshire, and Somersetshire. The special overtime rates for the East Riding of Yorkshire are in the case of male workers of 21 years of age and over who are not boarded and lodged by their employer 1s. 3d. per hour, and in the case of male workers who are boarded and lodged by their employer, and who are engaged to perform duties usually assigned to foremen, beastmen, shepherds and waggoners, 1s. per hour. In the case of female workers of 16 years of age and over, in that area, the special overtime rate is 11d. per hour. With regard to Norfolk, special minimum and overtime rates of wages have been fixed, and in the case of adult male workers who are employed throughout the full period of the harvest an inclusive sum of £11 is payable in respect of the harvest month. Where workers of the same age are not employed throughout the whole period, payment must be made at the ordinary minimum rate, with overtime at 9½d. per hour.

Lesser rates are fixed for younger workers in all the areas concerned.

Copies of the Orders in full may be obtained free of charge on application to the Secretary of the Agricultural Wages Board, 7 Whitehall Place, London, S.W. 1.

In the areas where the Agricultural Wages Committees have not fixed any special rates for the corn harvest employment on such work must, of course, be paid for at not less than the ordinary minimum and overtime rates.

Enforcement of Minimum Rates of Wages.—During the month ending June 15, legal proceedings were instituted against five employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases are as follows:—

County			Court	Fines			Costs			Arrears of wages			Workers concerned
				£	s.	d.	£	s.	d.	£	s.	d.	
Sussex	..	Petworth	..	3	0	0	2	2	0	34	4	8	2
"	..	"	..	—			—			49	18	3	3
Kesteven	..	Bourne	..	0	5	0	—			26	5	0	1
Carms	..	Whitland	..	—			—			12	0	0	1
Devon	..	Lifton	..	2	0	0	—			15	0	0	1
				£5	5	0	£2	2	0	£137	7	11	8

In the case heard at Lifton, the Chairman of the Bench said that, as this was the second case before the Court, he wished the Press to emphasize the fact that farmers must adhere to the provisions of the Act and the Orders made by the Committee. As the Orders had been in force some considerable time, there was no excuse for any employer not knowing the provisions thereof.

* * * * *

Importation of Raw Cherries from France: Prohibition Order.—In last month's (June) issue of this JOURNAL (p. 279) a recapitulation was given of the reasons which led the Ministry to issue an Importation of Raw Cherries Order in June, 1926, the provisions of which were briefly noted in this JOURNAL for July of that year (p. 293). Particulars were also given of the arrangements made subsequent to that Order by the French Government, which it was hoped would effectually prevent the export to this country of French cherries infested with cherry fruit fly. In view of these arrangements, the Order of 1926 was replaced by the Importation of Raw Cherries Order, 1927, details of which were given in the note referred to. The examination, however, of samples from consignments of French cherries, taken by the Ministry's Inspectors on the markets last month, revealed the presence of some heavy infestations by the maggot of the cherry fruit fly; and, in answer to a question by Sir G. Wheeler in the House of Commons on June 16, 1927, the Minister stated that he had decided, in consequence, that the importation of cherries grown in France must be stopped for the remainder of the season. This action was necessary to avoid the risk of the establishment of the pest in British cherry orchards. An Order giving effect to this decision came into operation on June 24.

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Foot-and-Mouth Disease.—The country continues free from outbreaks of foot-and-mouth disease, no case having been confirmed since that at Ellel, Lancashire, on April 6 last.

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Glassware Used in Dairy Chemistry.—The National Physical Laboratory, Teddington, have issued a new edition, dated April, 1927, of their pamphlet, *Tests on Volumetric Glassware used in Dairy Chemistry*. This contains the regulations for Class B tests on such glassware submitted to the Laboratory for testing and marking. The pamphlet sets out the construction and marking required for the following: Gerber butyrometer for milk testing; Gerber butyrometer for cream testing; Gerber butyrometer for cheese testing (van Gulik type);

Babcock milk test bottle; Babcock cream test bottle; Leffmann-Beam milk test bottle; milk pipettes, cream pipettes, etc. Drawings of the apparatus and the charges for testing are also given.

* * * * *

International Competition for Machines to Cut Reeds, Rushes, etc.—L'Union des Syndicats de l'Etang, a Parisian Society, is organizing, from July 19 to 26, 1927, in the neighbourhood of the French capital, an international competition for mowing machines and apparatus specially adapted for destroying vegetation, reeds, rushes, etc., obstructing rivers, canals, ponds and watercourses. Particulars of the competition may be obtained on application to the representative of the Union at 1, rue de Castiglione, Paris.

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NOTICES OF BOOKS

Composition and Distribution of the Protozoan Fauna of the Soil. By H. Sandon, M.A. (Edinburgh: Oliver and Boyd. 1927. 237 pp., 6 pl. Price 15s. net.)

Although agriculture is among the oldest of the arts practised by man it has been slow in enlisting the aid of the sciences, and has preferred to act on a system based on experience and empiricism. In recent years, however, the tendency has been to appeal more and more to the scientist for counsel and aid, and a place has been found for almost all the special sciences. The latest recruit is a new branch of a new subject, namely that of Protozoology, that is the study of protozoa, the smallest and most primitive types of animal life, which bear the same relation to the animal kingdom as do bacteria to the vegetable creation, and the new branch is the study of those protozoa which inhabit soils.

Serious interest in these organisms only dates from 1909, when Russell and Hutchinson published their theory of partial sterilization of the soil, which was based on the action of protozoa as devourers of bacteria. Since that time the progress of knowledge of these forms has not advanced so much as one would wish, but the difficulties are very great for many reasons, of which the chief is perhaps the great diversity of varieties which occur. Even if the varieties were few or very simple, however, the problem would be no easy one because of the number and extent of the other variables such as weather conditions, cultivation procedures, or type of vegetation; while no agriculturist needs to be reminded of the great differences which exist between different samples of soils. A soil from one area may vary considerably in its physical, and indeed in its chemical, condition from time to time throughout the year, becoming more or less acid, or containing more or less nitrogen. These factors in themselves are apparently of little direct importance, but by exerting an influence on the available food supply, which is in most cases composed of the bacterial flora, they control the numbers, and perhaps also the species, of the protozoa present.

In adding the volume mentioned above to their series of Biological Monographs and Manuals, the editors, Drs. F. A. E. Crew and D. Ward Cutler, have filled an obvious space in the literature of this growing subject, and in Mr. H. Sandon they have found an excellent exponent. The book deals shortly with the influences affecting the numbers and distribution of the various species of protozoa in the soil—of which some 250 species have already been recorded—and with the soil protozoal community, and then devotes the major portion

to a systematic account of the protozoa found in the soil, giving keys to their identification. This is perhaps the most valuable part of the work, since no proper agreement can be reached by different investigators unless there is some standard by which they may be certain of the species under examination, and avoid overlapping of descriptions under various names. Six excellent plates, figuring from eleven to twenty-five protozoa each, amplify the descriptions, and three folder charts give the geographical distribution of the three classes of Mastigophora, Rhizophora, and Ciliata. A bibliography of over 120 references completes the volume. One can justly say that the book is a necessity for all workers on the micro-organisms of the soil, and it has the added advantage of being pleasant to handle and read, for the format and fount are very well chosen.

The Individuality of the Pig. By Robert Morrison. (London: John Murray. 1926. Price 7s. 6d. net.)

In this book, which is really a comprehensive treatise on pig husbandry, the author has succeeded in combining, in a most readable form, the practical and scientific aspects of breeding, feeding, rearing, and management—the whole happily seasoned with an intuitive understanding of the qualities and characteristics that constitute individuality. Such knowledge is derived from daily contact with animals and close study of their idiosyncracies.

The appearance of this book, at a time when farmers are looking hopefully to pigs as a means of succour in their troubles, is most opportune. For a beginner, the book is eminently suitable, and even the experienced pig-keeper may learn much from it. The beginner wants to know what breed he should keep and how many head; whether his stock should be pedigree, pure-bred or cross; whether to buy weaners, gilts ready for service, or gilts in pig; whether to breed for sale as weaners, or for pork or bacon; and how to house—whether in sties or in shelters with free range, or partly one and partly the other. To all these questions and many more he will find reasoned and convincing answers.

The principles of feeding, and the characteristics of the commoner feeding stuffs, are also fully dealt with, and tables of analysis are given. Mixtures of different composition are rightly recommended for different ages and classes of stock; but the deliberate omission of itemized examples of what the author would consider suitable rations may be misconstrued. The omission is particularly noticeable in the light of the author's final observation to the effect that he will make arrangements with local millers "to buy, grind and mix the various mixtures for your supply at fair market prices, provided that among you and your friends in any one district or county a minimum guarantee be given that one hundred tons (100 tons) of meals per annum will be ordered and paid for through that miller."

The Cattle-Breeder's Handbook. By James A. Scott Watson, B.Sc., James Cameron and G. H. Garrad, N.D.A. *Farmer and Stock-breeder Manuals.* (London: Ernest Benn, Ltd. 1926. Price 6s. net.)

This book aims at placing before farmers the results of scientific thought and research in matters relating to the breeding, rearing and feeding of cattle for beef and milk. It opens with a description and discussion of the beef, dairy and dual purpose types of animal, the treatment of this aspect being characterized by acute observation and sound reasoning. Regarding dual purpose cattle, the authors point out that the feeding has a marked influence on conformation, and that an animal can often be so developed as to show a considerable

measure of beef or milk conformation at the will of the rearer; further, that "the sharp wither, lean thighs, capacious barrel and general thinness of flesh," characteristic of the dairy type, is, to a large extent, the consequence and not the cause of heavy milk production. From which it follows that the antagonism between beef points and milk production is not so fundamental as has been commonly supposed. Systematic breeding on dual purpose lines is comparatively recent, and long-continued selection is necessary to ensure fixity of type. But the dual purpose animal is not ruled out, either genetically or economically; indeed, so long as sterility and abortion are prevalent, and the period of a cow's usefulness is, in consequence, only a matter of a few years, the practical breeder may be on safe ground in ignoring, to some extent, purely theoretical considerations.

The vexed question of "breed characteristics" also comes under critical examination, and the authors plead for a strict sense of proportion in regard to the various objects in view, so that the more important may not be sacrificed for the less important ones. They point out, rightly, that the recognized standard of non-economic characters, such as colour, horns and so forth, should be fixed as permanently as possible, so as to avoid waste of effort on the part of the breeder in endeavouring to keep his herd "in the fashion." Farmers and students, alike, will welcome this clear and simple exposition of the principles of breeding, as set out by acknowledged authorities on the subject. Altogether, a readable and useful publication.

The Evolution of the English Farm. By M. E. Seebohm, F.R.Hist.S. (London: George Allen & Unwin, Ltd. 1927. Price 16s. net.)

As a popular introduction to the history of English farming, this book is likely to find a wide public. Efforts of the kind are usually more ambitious in the planning than in their fulfilment, and this work is no exception to the rule. For any one person to attempt the history of some sixty centuries in the small space of 364 pages obviously leads to considerable sparseness of detail, if not throughout the work, then at constantly recurring intervals. Such an attempt is nevertheless worthy of commendation, if it presents as one coherent story the results of modern detailed investigations into special questions or comparatively brief periods. It is a little unfortunate, however, that in this instance the story is not told quite so coherently as might be wished.

It traces the progress of agriculture in England from the Stone Age to the twentieth century. Much of the earlier part could be subjected to the obvious criticism of all such work. The conclusions of the archaeologists are accepted with little examination, imaginative though they frequently are. A particular example of this acceptance of authority is the comparison of the so-called oak hand-plough found in the Glastonbury lake village with the *caschrom*, which was used up till the nineteenth century in the Western Highlands: but that the Glastonbury piece of oak was a plough or an agricultural instrument of any sort is just a guess and nothing more. So far as we know the English breast-plough—not very dissimilar to the *caschrom*—was a comparatively modern invention, and no reference to it in the Middle Ages has been found.

All the early history of the English farm, until the Norman Conquest, is covered in the first five chapters, and is largely based upon secondary authorities. The next three chapters deal with the period from the Norman Conquest to the end of the fifteenth century, and again we find the acceptance of other people's conclusions without a sufficient examination of the original evidence or reference to the most recent work on the subjects treated. In particular the Black Death is regarded

as catastrophic, although the general trend of modern investigation is to show that the conventional view of the effects of the plague is exaggerated. Nor is there a scrap of evidence for the statement that "the great underlying cause of the breakdown of the manorial system was the increasing exhaustion of the soil": since the land had been continuously cropped as far back as the Roman period and before, it would have been remarkable if the soil had suddenly shown signs of exhaustion in the fourteenth or fifteenth century. But the writer is not a biologist and seems to have had no guidance from anyone with biological knowledge: otherwise not only her treatment of soil fertility, but her attempt to trace the history of live stock would have been different. From the sixteenth century onwards, we begin the modern phase of English agriculture, and it is easier to tell a story without danger of distorting the facts: but there are many contemporary authorities which the author might have consulted, but has somehow missed. She might, however, reasonably retort that one cannot read everything, that the task of sifting the grain from a vast deal of chaff was not worth while for an elementary treatise and that she has not given bad measure.

The chief merit of the book is that it reads easily and, for those who have neither the time nor the inclination to study special monographs, it will be instructive. It is unfortunate that so many statements need qualification which the uninstructed reader will not be able to supply. Perhaps one day the book will be rewritten in the light of fuller knowledge.

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ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Seebohm, M. E.—The Evolution of the English Farm. (376 pp. + 3 pl.) London: George Allen & Unwin, 1927, 16s. [63 (09); 63.17 (09).]

Gras, N. S. B.—A History of Agriculture in Europe and America. (444 pp.) London: Pitman & Son, 15s. [63 (09).]

Clapham, J. H.—An Economic History of Modern Britain. The Early Railway Age, 1820-1850. (623 pp.) Cambridge: at the University Press, 1926, 25s. [33.338 (42).]

Webb, S. and B.—English Local Government: English Poor Law History, Part I. The Old Poor Law. (447 pp.) London: Longmans, Green & Co., 1927, 21s. [336.28; 362.5.]

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The Culture and Manuring of Sugar-Beet.—Being the Report of a Conference held at Rothamsted on January 19, 1927, under the chairmanship of Lord Clinton. (56 pp.) London : Ernest Benn, 1927, 2s. 6d. (Rothamsted Conferences, No. IV.) [63.3433.]

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Maine Agricultural Experiment Station.—Bulletin No. 322 : Fertilization of Apple Orchards in Maine. (8 pp. + 1 pl.) Orono, 1925. [63.41-16.]

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Hilgendorf, F. W.—Weeds of New Zealand and How to Eradicate Them. (251 pp. + 42 pl.) New Zealand and London : Whitcombe & Tombs, 1927, 6s. 6d. [63.259.]

South-Eastern Agricultural College, Wye.—Leaflet No. 2 (New Series) : A Method for Destroying Wasps' Nests in Walls and Roofs of Wooden Bungalows. (1 p.) 1926. [63.29 ; 63.294.]

Live Stock and Feeding Stuffs

Darley, Matheson.—The Horse in Health, Accident, and Disease (235 pp.) London : C. A. Pearson, 1921, 5s. [63.61 ; 619.1 ; 682.]

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The Agricultural Co-operative Movement in Esthonia. (Int. Rev. Agr., 1, 1 (Feb., 1927), pp. 2-12.) [334 (4).]

Some Effects of Phosphatic Manures and Ground Lime on Acid Pastures. A. W. Ling. (Jour. Bath and West and S. Counties Society, 1 (Sixth Series), 1926-27, pp. 49-78.) [63.33-15 ; 63.33-16.]

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A Forage Crop System for Dairy Farmers: A Way to Cheaper Production. *J. C. Brown*. (Jour. Brit. Dairy Farmers' Assn., xxxix (1927), pp. 11-20.) [63.191; 63.711; 63.711:043.]

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Variations in the Proportion of Solids-not-Fat in Milk. *J. F. Tocher*. (Scottish Jour. Agric., x, 2 (April, 1927), pp. 201-208.) [543.2; 63.712.]

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Some Long-Time Effects of Co-operative Marketing. *R. S. Vaile*. (Jour. Farm Econ., ix, 1 (Jan., 1927), pp. 82-93.) [334.6.]

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AUGUST, 1927.

NOTES FOR THE MONTH

AN Imperial Agricultural Research Conference will be held in London in October next, and will be attended by some 70 delegates of high administrative and scientific standing from the oversea parts of the Empire, together with delegates and representatives of similar standing from Great Britain and Northern Ireland. The Conference will discuss subjects of great importance, for agricultural research affects everyone very closely. It is probable that but for the results that scientific workers have achieved in recent years, milk, butter, meat, fruit and vegetables would all cost more and be poorer in quality. Speaking generally, agricultural research has led to the production of larger and more quickly maturing cattle for the purpose of meat, cows with heavier milk yields, and wheats that produce a far more abundant harvest of choice flour, than were known to farmers two or three generations ago. It might, indeed, be interesting to speculate how our vast city populations could be fed to-day if agriculture had stood still after the industrial revolution of the eighteenth and nineteenth centuries. Thanks, however, to the patient skill and infinite ingenuity of research workers, agriculture has made great strides in all branches; but innumerable questions of the utmost practical importance still remain unsolved.

This holds true throughout the world and for each department of agriculture, but it applies with special force when we consider our own Empire. The lands within the Empire lie in many different latitudes, and thus present a great variety of agricultural problems. Many parts of the Empire are only on the threshold of development, and those who are engaged in adding to and improving the areas under cultivation are in constant need of scientific advice and assistance.

One successful experiment may conceivably extend the wheat-growing belt of Canada a hundred miles to the north,

thus bringing thousands of virgin acres to the service of food production; another may lead to the destruction of an insect pest that is ruining a cotton area, and incidentally occasioning great damage to our textile industry; and just as immunization against cattle plague enabled stock raising to be successfully carried on over large tracts of South Africa, so research now in progress may result in preventing foot-and-mouth disease, thus saving the large sums which that disease has, periodically, cost this country. These are but random examples of the benefits that may accrue to Imperial agriculture from scientific research. Yet, it may be observed, the sum devoted to agricultural research in the whole Empire is less than half the amount that is spent in the United States of America.

It is not often that sudden spectacular results are achieved, and, indeed, they are hardly to be looked for; but steady and valuable progress is being recorded, and it is of real importance that those who are engaged in this vitally significant work should be kept in touch with one another. This is an Empire need.

There are, at present, research stations in this country and in the Dominions and Colonies, very largely financed by their respective Governments, which are doing invaluable service. Much of the work being done by the research workers at these stations is of interest to the Empire as a whole. Although some links do exist between them, the system of intercommunication is far from adequate, and it is hoped that the Conference may be able to devise methods to secure the closest co-operation between the scientific workers in agriculture throughout the Empire.

The chief subjects to be discussed at the Conference will be the extension of the system of Imperial Bureaux from entomology and mycology to other departments of agricultural science; the interchange of information among agricultural research workers; the recruitment, training and interchange of workers; and the development of the chain of agricultural research stations throughout the Empire. The main meetings of the Conference will be held in London, Cambridge and Edinburgh.

The Empire Marketing Board has made a grant to cover the expenses of the Conference, for which the arrangements are being made by the Ministry and a representative Organizing Committee.

PERHAPS one of the most striking of post-war developments has been the increasing recognition of the importance of statistics in all branches of activity, in the organization and management of commercial and industrial enterprises as well as in the investigation of social and economic problems. Government publications are the most important of all sources of statistics in the United Kingdom from the point of view both of their scope and of their authority. The complaint used to be, however, that this valuable material was unknown and inaccessible except to the few who had specialized in the study of official publications.

The introduction of the *Annual Guide to Current Official Statistics*, the 1926 volume of which has just been issued by the Permanent Consultative Committee on Official Statistics, has removed all difficulties that may in the past have stood in the way of those who wished to avail themselves of this indispensable source of information.

The Guide is much more than a mere catalogue of publications. Its central feature is an index on novel lines, which not only directs the inquirer to those volumes which contain statistics bearing on his subject, but also indicates their scope and degree of detail. To trace all the statistics on the varied subjects dealt with in Government publications is a matter of a few minutes with the aid of the Guide, which should prove a handy work of reference for the business man, writer, librarian, student of public or social matters, and professional worker. Copies of the Guide can be obtained from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2. Price 1s. net, post free 1s. 4d., or through any bookseller.

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Advertising Exhibition.—Arrangements in connexion with the Advertising Exhibition held at Olympia were well advanced early in July. The Empire

Empire Displays : Marketing Board took 10,000 square feet of space, and adopted a design which proved both novel and striking. A good

proportion of the space devoted to the display of produce from home and overseas was allotted to Great Britain. The Ministry, in collaboration with the National Farmers' Union, the Food Manufacturers' Federation, the National Food Canning Council, the National Association of Cyder Makers, the British Glass-house Produce Marketing Association, and the Western

Curers' Association, organized a representative display of bacon, hams and packed meats, eggs, dairy produce, fresh fruit and vegetables, tinned and bottled fruit and vegetables, cereal products and glasshouse produce. On the outer sides of the Empire Marketing Board stand there were a number of decorative windows, seven of which were dressed exclusively with home produce. There were also two demonstration kitchens, in which full use of home products was made. One kitchen was secured exclusively for home products on each evening of the week. By courtesy of the management, the chef of the First Avenue Hotel demonstrated, on three evenings, some of the multitudinous ways of cooking potatoes, and the National Milk Publicity Council arranged for milk-cooking demonstrations on the other evenings.

A new feature was an exhibition of labels and containers. The appearance and clarity of a label plays an important part in selling the product, and it is, therefore, desirable for Empire producers to pay due attention to this aspect of salesmanship. A varied collection of labels was made and a representative committee selected the best specimens for display. In addition, a number of specially-designed labels were exhibited; these were offered for sale under certain conditions. This section of the Empire Marketing Board stand proved of considerable interest, and, apart from the merits of the labels shown, an appreciable amount of advertisement should result for the goods represented. Efforts were accordingly being made to secure as good a show for home products as possible among the labelled goods.

London Display Week.—An Empire Shopping Week was organized under the ægis of the Advertising Club, to synchronize with the Advertising Exhibition. About 60 London boroughs and districts participated in the scheme, which proved to be a great success. The Ministry was represented on the several committees which dealt with the matter, and, by this means, was able to keep home producers informed of the various proposals afoot. The editors of London and suburban newspapers having promised generous allocation of space in connection with the Display Week, the Ministry secured articles from the National Farmers' Union and other sources, or had articles prepared which drew attention in various ways to the excellence of home-grown produce, and formed a useful background for the slogan that "Empire buying begins at home."

Edinburgh Exhibition.—An Empire Exhibition is being held at the Waverley Market, Edinburgh, from July 27 to August 6. The Empire Marketing Board is staging a small display on this occasion, and the usual arrangements have been made by the Ministry for the participation of home produce.

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SOME five years ago, Mr. E. T. Halnan, of the Animal Nutrition Institute, Cambridge University, began to contribute monthly "Notes on Feeding Stuffs" to the

Notes on Feeding Stuffs pages of this JOURNAL. Lately, Mr. Halnan expressed a desire to hand over this work to a new contributor; and, in meeting his wishes, the Ministry desires to record its cordial appreciation of the extended and able service rendered by him.

The Ministry is glad to announce that Dr. H. E. Woodman, of the same Institute, has undertaken to furnish the "Notes on Feeding Stuffs" during the next twelve months, and his first contribution, which takes the form of a very explicit statement of the principles underlying the subject of feeding stuffs, will be found on p. 473 of this issue.

* * * * *

A COMPETITION in the judging of live stock, open to students of Farm Institutes in England and Wales, was held on May 26 last, on the farm of Messrs. W. C. and

Farm Live Stock Judging Competition A. J. Flowers, at Beachendon, Aylesbury, Bucks. The educational possibilities of stock judging contests have been clearly demonstrated, and it was thought that

the end in view would be greatly helped by the institution of an annual stock judging competition, open to teams of students from Farm Institutes.

In response, therefore, to a suggestion made by the Ministry, the National Farmers' Union agreed to offer a perpetual Challenge Cup for such a competition. The administration of the competition was entrusted to a committee representative of the National Farmers' Union, the Royal Agricultural Society of England, the County Councils' Association and the Ministry, and it was arranged that the Ministry should appoint the judges. The competition held this year was the first event of the kind and it was carried through successfully in every way under the direction of Mr. P. J. Bradshaw, County Secretary of the National Farmers' Union, and a number of stewards. The classes of stock selected for the competition comprised

Dairy Shorthorn Heifers, Dairy Shorthorn Cows, Shire Horses, Cross-bred Pigs, Border-Leicester and Cheviot Ewes, and Light Sussex Poultry. The animals and birds were judged by experts before the competition started and their decisions served as the standards for arriving at the final results.

Six Institutes sent teams: the East Anglian, Hampshire, Llysfasi (Wales), Northamptonshire, Staffordshire, and East Sussex. Each team consisted of three students, and all did well. The Challenge Cup was won by the Northamptonshire team, the Staffordshire team being second, and the Welsh team third. Mr. T. W. Baxter, the President of the National Farmers' Union, attended and presented the Cup to the winning team.

A useful feature of the competition was the presence, from outside farms, of noted specimens of Dairy Shorthorns and Shire Horses. The chairman, Mr. H. Gates, and other members of the Aylesbury Branch of the N.F.U. co-operated with Messrs. Flowers in making the competition as interesting, instructive and comprehensive as possible.

* * * * *

THE general level of prices of agricultural produce during June was 41 per cent. above 1911-13, or one point lower than in the previous month and seven points below the figure of 48 per cent. for June, 1926. The fall of one point on the month was due principally to the reduction in the prices of fat sheep and pigs, and to the lower prices for old crop potatoes.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1922 :—

Month	Percentage Increase compared with the Average of the corresponding month in 1911-13					
	1922	1923	1924	1925	1926	1927
January	71	67	60	71	58	49
February	75	63	61	69	53	45
March	73	59	57	66	49	43
April	66	54	53	59	52	43
May	69	54	57	57	50	42
June	64	49	56	53	48	41
July	67	50	53	49	48	—
August	68	52	57	54	49	—
September	59	52	61	55	55	—
October	61	50	66	53	48	—
November	63	51	66	54	48	—
December	61	55	65	54	46	—

Grain.—Wheat was 7d. per cwt. dearer on the month and the index figure was 7 points higher at 60 per cent. above the prices ruling in June, 1911-13. Barley at 11s. 5d. per cwt. was 54 per cent. above the level of the base years as compared with 46 per cent. in the previous month and 21 per cent. in June, 1926, while oats, at 7d. per cwt. dearer than in May, were 33 per cent. above pre-war and 2 points above the level recorded a year ago.

Live Stock.—Fat cattle showed a slight improvement in price during June, the movement being reflected in the rise of the index number from 24 to 25 per cent. above pre-war. Dairy and store cattle were somewhat cheaper, however, the former declining by about 15s. and the latter by about 10s. per head. Fat sheep were reduced by $\frac{3}{4}$ d. per lb. estimated dressed carcass weight, as against a fall of $\frac{1}{2}$ d. per lb. in the corresponding period last year, and at 48 per cent. above pre-war were 5 points below the level of the previous month and 18 points lower than in June, 1926. Prices of store sheep have fallen slightly though much less than is usual at this period of the year; the index figure is 15 points higher on the month at 53 per cent. above 1911-13. Bacon pigs were 5d. and porkers 8d. per 14 lb. stone cheaper than in May, the index numbers being 54 per cent. and 60 per cent. above pre-war respectively. The corresponding figures a year ago were 87 and 90 per cent. Store pigs were also cheaper, but were still relatively dear compared with other items at 90 per cent. above pre-war.

Dairy and Poultry Produce.—During June egg prices hardened a little, and at 30 per cent. above pre-war were 2 points higher than in May and 4 points above the level of a year ago. Cheese was dearer by 1s. 6d. per cwt., and as there was a fall in price of 3s. per cwt. in the corresponding period of the base years the index figure rose by 8 points to 54 per cent. above pre-war. Butter was very slightly cheaper on the month at 41 per cent. above pre-war, and milk was unaltered in price or index number. Poultry prices were maintained at those ruling in May and the increase of 12 points in the index figure is due entirely to the fall in price in June of the base years.

Other Commodities.—There was an average reduction in prices of old potatoes of 4s. 6d. per ton during June, and the index figure fell 13 points to 61 per cent. above pre-war. Hay was little altered and wool was a little dearer at 33 per cent. above pre-war. Gooseberries have averaged practically the same prices as in 1926, but strawberries and cherries have been

dearer than last year. During June, gooseberries averaged 43 per cent., strawberries 54 per cent., and cherries 94 per cent. above 1911-13 in each case.

Index numbers of different commodities during recent months and in June, 1925 and 1926, are shown below :—

Percentage Increase as compared with the Average
Prices ruling in the corresponding months of
1911-13

Commodity	1925	1926	1927			
	June	June	Mar.	Apr.	May	June
Wheat	62	71	57	52	53	60
Barley	38	21	38	41	46	54
Oats	38	31	14	18	27	33
Fat cattle ..	50	40	26	25	24	25
Fat sheep ..	93	66	45	53	53	48
Bacon pigs ..	54	87	63	61	58	54
Pork pigs ..	53	90	76	73	66	60
Dairy cows ..	47	38	25	26	24	21
Store cattle ..	43	28	27	23	23	21
Store sheep ..	115	71	41	40	38	53
Store pigs ..	55	134	116	108	99	90
Eggs	52	26	39	37	28	30
Poultry	61	70	34	25	41	53
Milk	55	60	56	63	53	53
Butter	57	54	40	43	42	41
Cheese	78	80	36	36	46	54
Potatoes	76	-5*	85	60	74	61
Hay	3	9	—	-1*	2	3
Wool	30	25	33	34	31	33

* Decrease.

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THE article which appeared in last month's (July) issue of the JOURNAL, dealing with "Agriculture and the International Economic Conference," contained a verbal

Agriculture and the International Economic Conference error on page 309. In the second paragraph on that page, and the eleventh line from the bottom, the word "prohibitions" was inadvertently given instead of the word "protection." The

particular passage should, therefore, read: "to the reduction of customs protection both for industry and agriculture," etc.

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THE RESIDUAL VALUES OF FEEDING STUFFS AND FERTILIZERS*

Foreword.—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 fertilizers 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, and the report of this Committee will be found in Appendix B within. This report was then reviewed from the point of view of practicability by a Joint Committee including representatives of the various professional bodies. The constitution of this Joint Committee will be found within.

The Joint Committee agreed to present the report which follows to the various Associations represented. The representatives of the National Farmers' Union 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.

Constitution of the Joint Committee.

The Joint Committee was composed of the following :—

<i>Scientific Committee</i>	Sir A. D. Hall, K.C.B., LL.D., F.R.S. (Chairman).
	Sir E. J. Russell, D.Sc., F.R.S., Rothamsted Experimental Station.
	Prof. R. A. Berry, College of Agriculture, Glasgow.
	Dr. C. Crowther, Harper Adams Agricultural College.
	Dr. B. Dyer.
	Prof. J. Hendrick, Marischal College, Aberdeen.
	Dr. A. Lauder, College of Agriculture, Edinburgh.
	Mr. H. J. Page, Rothamsted Experimental Station.
	Dr. J. A. Voelcker.
	Prof. T. B. Wood, F.R.S., School of Agriculture, Cambridge.

* In accordance with the intention expressed on the formation of the Committee, the Report has been submitted to the Ministry of Agriculture and Fisheries and to the Board of Agriculture for Scotland. The Ministry of Agriculture and Fisheries does not propose to take any further action thereon.

APPENDIX A.
VOELCKER AND HALL'S TABLE
TABLE SHOWING THE COMPOSITION, MANURIAL AND COMPENSATION VALUES OF FEEDING STUFFS
(Revised from Lawes and Gilbert's Tables, 1897, and Voelcker and Hall's Tables, 1902 and 1914)

No.	Foods	Valuation per Ton as Manure										Compensation value for each ton of food consumed	
		A Nitrogen			B Phosphoric Acid			C Potash				(1) Before one crop has been grown or removed	(2) After one crop has been grown or removed
		Per cent. in food	Value at 14s. per unit	40 per cent. of value to manure	Per cent. in food	Value at 4s. per unit	Three-quarters of value to manure	Per cent. in food	Value at 3s. 6d. per unit	Three-quarters of value to manure			
1	Decorticated cotton cake ..	6.90	s. d. 96 7	s. d. 38 8	3.10	s. d. 12 5	s. d. 9 4	2.00	s. d. 7 0	s. d. 5 3	s. d. 53 3	s. d. 26 7	
2	Undeovorticated cotton cake (Egyptian) ..	3.54	49 7	19 10	2.00	8 0	6 0	2.00	7 0	5 3	31 1	15 6	
3	Undecorticated cotton cake (Bombay) ..	3.10	43 5	17 4	2.50	10 0	7 6	1.61	5 8	4 3	29 1	14 6	
4	Linseed cake..	4.75	66 6	26 7	2.00	8 0	6 0	1.40	4 11	3 8	36 3	18 1	
5	Lalseed ..	3.60	50 5	20 2	1.54	6 2	4 7	1.37	4 9	3 7	28 4	14 2	
6	Soya-bean cake ..	6.85	95 11	38 4	1.30	5 2	3 11	2.20	7 8	5 9	48 0	24 0	
7	Palm-nut cake ..	2.50	35 0	14 0	1.20	4 10	3 7	0.50	1 9	1 4	18 11	9 5	
8	Coco-nut cake ..	3.40	47 7	19 0	1.40	5 7	4 2	2.00	7 0	5 3	28 5	14 2	
9	Earth-nut cake ..	7.62	106 8	42 8	2.00	8 0	6 0	1.50	5 3	3 11	52 7	26 3	
10	Rape cake ..	4.90	68 7	27 5	2.50	10 0	7 6	1.50	5 3	3 11	38 10	19 5	

No.	Foods	Valuation per Ton as Manure										Compensation value for each ton of food consumed D	
		A Nitrogen			B Phosphoric Acid			C Potash					
		Per cent. in food	Value at 14s. per unit	40 per cent. of value to manure	Per cent. in food	Value at 4s. per unit	Three- quarters of value to manure	Per cent. in food	Value at 3s. 6d. per unit	Three- quarters of value to manure	(1) Before one crop has been grown or removed	(2) After one crop has been grown or removed	
11	Compound Cakes, Meals, &c. — (a) exceeding 15 per cent. but not exceeding 20 25 30 30 (b) " 20 "												

APPENDIX A.
VOELCKER AND HALL'S TABLE (continued)
TABLE SHOWING THE COMPOSITION, MANURIAL AND COMPENSATION VALUES OF FEEDING STUFFS
(Revised from Lawes and Gilbert's Tables, 1897, and Voelcker and Hall's Tables, 1902 and 1914)

No.	Foods	Valuation per Ton as Manure										Compensation value for each ton of food consumed D	
		A Nitrogen			B Phosphoric Acid			C Potash					
		Per cent. in food	Value at 14s. per unit	40 per cent. of value to manure	Per cent. in food	Value at 4s. per unit	Three-quarters of value to manure	Per cent. in food	Value at 3s. 6d. per unit	Three-quarters of value to manure	(1) Before one crop has been grown or removed		(2) After one crop has been grown or removed
25	Clover hay ..	2.40	s. d. 33 7	s. d. 13 5	0.57	s. d. 2 3	s. d. 1 9	1.50	s. d. 5 3	s. d. 3 11	s. d. 19 1	s. d. 9 6	
26	Meadow hay ..	1.50	21 0	8 5	0.40	1 7	1 2	1.60	5 7	4 2	13 9	6 10	
27	Wheat straw ..	0.45	6 4	2 6	0.24	1 0	0 9	0.80	2 10	2 1	5 4	2 8	
28	Barley straw ..	0.40	5 7	2 3	0.18	0 9	0 6	1.00	3 6	2 7	5 4	2 8	
29	Oat straw ..	0.50	7 0	2 10	0.24	1 0	0 9	1.00	3 6	2 7	6 2	3 1	
30	Mangels ..	0.22	3 1	1 3	0.07	0 3	0 2	0.40	1 5	1 1	2 6	1 3	
31	Swedes ..	0.25	3 6	1 5	0.06	0 3	0 2	0.22	0 9	0 7	2 2	1 1	
32	Turnips ..	0.18	2 6	1 0	0.05	0 2	0 1	0.30	1 1	0 9	1 10	0 11	

TABLE OF COMPENSATION FOR FERTILIZERS APPLIED
FROM SUCH DATA AS ARE AVAILABLE THE FOLLOWING SCALE OF COMPENSATION MAY BE TAKEN AS SOME GUIDE

	On Arable Land				On Grass Land					
	After 1st crop	After 2nd	After 3rd	After 1st year	After 2nd	After 3rd	After 4th	After 5th	After 6th	After 7th
	of cost	of cost	of cost	of cost	of cost	of cost	of cost	of cost	of cost	of cost
*Superphosphate ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
*Bones (raw and steamed) ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Dissolved bones ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
*Basic slag and ground mineral phosphate ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Bone manures ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Compound manures not containing bone ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Peruvian guano ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Fish guano ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Meat meal ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Shoddy and wool waste, fur waste, hair, hoofs and horns, greaves, &c. ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Manure cakes ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Dried blood, sulphate of ammonia, nitrate of soda, nitrate of lime, cyanamide ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Kainit and potash salts ..	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Lime: Deduct 4 cwt. of pure lime (or 7 (wt. of carbonate of lime) per acre per annum	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

* The Valuer must exercise his discretion as to the suitability of these manures when used upon grass land.

These tables are based on the assumption that the manure in question is one suitable for the land. The tables can only be interpreted with considerable latitude, depending upon such varying factors as the nature of the soil, the course of cropping pursued, the climatic conditions, &c. Further, when it is clear from the invoice, or when expert opinion has been brought to show that an excessive price has been charged for a manure purchased by an outgoing tenant, the Valuer is justified in exercising his discretion as to the deduction he may make in the original price charged, and on which the compensation to be paid shall be based.

The tables are intended, therefore, for general guidance, to be modified as circumstances demand.

When the dung had been applied but no crop had resulted, *e.g.*, in the case of dung applied for a turnip crop that failed, the residues would be regarded as exhausted in the same way as if a crop had been grown. Catch crops would not be taken into account.

Some valuers, however, have paid no attention to the crops grown, but consider only the year in which the feeding stuffs had been consumed, awarding the higher values for those consumed in the last year of the tenancy and the half values for such as were consumed in the previous year, without taking into account exhaustion by cropping.

The recommendation of assessment according to crops grown is the more accurate; the method, by years, is more easily applied and in some cases gives substantially the same results.

The tables will still require re-assessment from time to time in accordance with the variation in the market price of manures. To this end, the Committee recommends that the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland should jointly appoint a standing Committee consisting of two scientific men, one valuer and two farmers to recalculate the tables each year.

APPENDIX B.

REPORT OF THE SCIENTIFIC COMMITTEE.

The Committee, appointed to consider the revision of Voelcker and Hall's tables of manurial values from the purely scientific point of view, consisted of Sir Daniel Hall, Sir John Russell and Mr. H. J. Page of Rothamsted, Professor T. B. Wood of Cambridge, Dr. J. A. Voelcker, Dr. B. Dyer, Dr. Crowther of the Harper Adams College, Dr. Berry of the West of Scotland Agricultural College, Dr. Lauder of the Edinburgh and East of Scotland Agricultural College, and Professor Hendrick of the North of Scotland Agricultural College. After consideration of the scientific evidence available, the Committee made the following recommendations :—

Compensation for Feeding Stuffs Consumed by Cattle or Pigs Making Farmyard Manure.

(1) Compensation should be limited to feeding stuffs consumed within the last two years of the tenancy, provided that not more than one crop has been grown on the land to which the dung has been applied, or provided that such compensation has not been paid for otherwise.

(2) If no crop has been grown, the table of compensation should be constructed on the same basis as that adopted by Voelcker and Hall, except that the amount of nitrogen in the feeding stuff that is to be regarded as passing to the land should be taken as 40 per cent. of that contained in the food-stuff instead of 50 per cent. as taken by Voelcker and Hall. The proportions (three-quarters) of phosphoric acid and potash adopted by Voelcker and Hall should be retained.

(3) As regards the unit values to be attached to nitrogen, phosphoric acid and potash, it is recommended that a small standing committee should be appointed to fix these values each year. As regards nitrogen, the value should be that derived from the current London price of sulphate of ammonia or whatever analogous (*i.e.*, concentrated soluble) nitrogenous fertilizer is cheapest at the time. As regards phosphoric acid, one-half of the current price of phosphoric acid in super-phosphate is to be taken, and, as regards potash, the value of the unit of potash in potash salts.

(4) The compensation value for feeding stuffs consumed in the penultimate year of the tenancy should be one-third of the values that would be attached to them if no crop had been grown, instead of one-half as now given.

Compensation for Feeding Stuffs Consumed by Dairy Cattle.

(5) The Committee specially considered the value of the manure resulting from the feeding of dairy cattle. It was unanimous that some deduction from the 40 per cent. of nitrogen passing to the manure, which it had adopted for feeding cattle and pigs, should be made in the case of dairy cattle. In cases where the urine is not received in the dung-heap or otherwise applied to the land, the Committee recommends that valuers should be instructed to make a heavy deduction varying with circumstances, but under the best farming practice the Committee is of opinion that the compensation values to be allowed for feeding stuffs consumed by dairy cattle should be put at two-thirds of the values adopted for other stock.

Compensation for Feeding Stuffs Consumed upon Grassland.

(6) Experience has gone to show that where cattle and sheep are fed on grass, the improvement cannot be assessed at as high a figure as the authors of the previous tables had accepted. The evidence on the subject is not altogether conclusive, but the Committee agreed that grassland, especially when poor or very rich, may sometimes derive little benefit from the feeding of cake or corn upon it, and recommends that the maximum

rate of compensation in such cases should be at not more than one-half of the usual rates of compensation.

Compensation for Feeding Stuffs Consumed by Sheep upon Arable Land.

(7) In cases, however, where the feeding stuffs are consumed by sheep fed on arable land, the usual rates of compensation should be applied.

Compensation for the Unexhausted Values of Fertilizers.

(8) With regard to purchased fertilizers, the Committee felt that it had not sufficient data which would lead it to suggest a revision of the method of calculation used in the former table. The Committee decided to recommend, however, a slight modification in respect of the third year in the case of phosphates, other than basic slag, which should now be taken at one-sixth of cost.

Compensation for the Unexhausted Value of Lime, etc.

(9) Lime and the various forms of carbonate of lime, in the opinion of the Committee, require special treatment for the purposes of assessing compensation. Following the method adopted in this connexion by a recent Scottish Committee which investigated the subject, the Committee recommended that valuers should be instructed to allow for a rate of exhaustion of 4 cwt. per acre per annum in the case of lime, and of 7 cwt. per acre per annum in the case of carbonate of lime.

(10) The Committee recognizes that an improvement in the fertility of a farm can have been effected by the use, even in the earlier years of the tenancy, of fertilizers like nitrate of soda or sulphate of ammonia, which are not included in the table. In these cases, however, no residuum is left in the soil to which a value may be directly attached. The improvement, if any, like that due to continuous good farming, must be assessed by the valuer on the evidence that is laid before him.

(11) In addition to the compensation payable for consumed feeding stuffs, compensation may still be awarded for the amount of farmyard manure actually left upon the farm, but this should be determined by the work that may be regarded as having been spent in making the manure.

The Committee has taken as the basis of its recommendations the direction of the Agricultural Holdings Act of 1908 that the compensation payable to the outgoing tenant should be "such as fairly represents the value of the improvement to an incoming tenant." It would appear to follow from this instruc-

tion that it is not allowable to attach a value to materials left in the soil or upon the farm by the outgoing tenant should the circumstances of the farm render it impossible for the incoming tenant to derive any benefit from those materials.

As regards all its recommendations, the Committee desires to lay stress upon the fact that the values given are to be regarded as maxima under good ordinary farming conditions, to be modified at the discretion of the valuer on the evidence before him of the conditions prevailing upon the particular farm.

The Committee presents these recommendations as the scientific conclusions to be drawn from the evidence available. It will be for the wider Committee to decide to what extent they can be adopted for practice. The Committee would again wish to emphasize the fact that the figures represent maximum values, from which considerable deductions may require to be made according to the conditions prevailing on each farm.

* * * * *

HERBAGE SEED PRODUCTION IN NEW ZEALAND:

III.—COCKSFOOT

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COCKSFOOT was one of the first grasses to be used in quantity by the first settlers in New Zealand. It was largely employed for the original seeding out after burning the bush. It succeeded and maintained itself well on the richest lands, and for many years, with perennial rye-grass, was regarded as a pivotal species for such purposes. Subsequently, it has been found not to retain its hold on all classes of soils as long as earlier experience seemed to indicate, and recent investigations conducted by Mr. Bruce Levy, of the Fields Division of the Department of Agriculture, under the guidance of Mr. A. H. Cockayne, the Director of the Division, have led to a considerable modification of the mixtures employed, especially on the poorer lands. Regard being had to the needs of the country as a whole, less reliance, in consequence, is being placed on cocksfoot than formerly.

Before 1914, New Zealand had become self-supporting in the matter of cocksfoot seed and was, moreover, at the commencement and during the early years of the century, a large exporter of this seed to Europe. At that period, about

30,000 acres were devoted to seed production, and the crop of dressed seed frequently exceeded 2,000 tons. The area under seed crops has gradually dwindled and now seems, at least temporarily, to have stabilized at no more than approximately 11,500 acres with an output, in 1925, of but 845 tons and an export of only 65 tons. An appreciable quantity of the latter amount would have been absorbed by Australia, so that New Zealand has ceased to be an important producer of cocksfoot seed for the European market. The Dominion does not, in fact, now satisfy her own local demand, and much more cocksfoot seed (chiefly of Danish origin) is imported than is exported.

Economic Considerations.—This great change has been due to a number of contributory causes, of which the following are the most important :—

(1) The methods of specialized seed production adopted in Denmark have made it possible for Danish seed of high viability and purity to be put on the market not only in Europe, but in Australia and New Zealand, at a lower price than is possible under the New Zealand methods.

(2) The development of the New Zealand dairy industry has provided new openings for utilizing much of the cocksfoot-seed producing area in the Dominion.

(3) Difficulties connected with harvesting seed on rough and hilly country and the high cost of labour—since much of the seed must be harvested by hand.

(4) The viability of the New Zealand seed is on the average lower than that of Danish, while the bushel weight is also lower and the general appearance of the seed less attractive to the eye.

(5) A lack of appreciation in the Dominion itself, in Australia, and in Europe, of the particular purposes for which New Zealand cocksfoot is pre-eminently suited. In regard to seed transactions, the question of strain has been much neglected, price having been the dominant consideration. The only factors (other than cost of production and cost of placing on the world's markets) influencing large-scale demand have been germination, purity and bushel weight, in respect to all of which (as well as cost of production) New Zealand seed tends to be at a considerable disadvantage compared with Danish and American.

(6) The use of modified and better-balanced mixtures for the first sowing out on many classes of land in the Dominion, and the fact that most of the areas best suited to cocksfoot

have been long since cleared and grassed out. There are indications, however, that, in proportion as long-duration leys, in the proper sense of the word, become more generally relied upon, cocksfoot will again come into greater demand.

Seed Production in Relation to Habitat.—The great bulk of the seed crop is taken from the Akaroa district of the Banks Peninsula, and from the Canterbury Plains. Seed is also harvested, to some extent, locally in Otago and Southland, and has also been harvested, chiefly for local consumption, and on a small scale, in isolated districts in the North Island.

It is very important to notice, and for reasons that will be explained in a subsequent section, that, in the main, seed is harvested from what are tantamount to, or have for years been, waste places, and not to any extent from well-cared-for temporary grass as understood in this country. That is to say, the seed has been harvested from areas long in cocksfoot and not from fields of a temporary nature, or from fields treated in a similar manner to pastures in this country. Even in the Canterbury Plains, probably over 90 per cent. of the cocksfoot is not taken from enclosed farm lands.

Akaroa.—The soil of this district is a deep, rich, volcanic loam, and the country is hilly, attaining to over 2,000 feet above sea level. The burning of the bush was started over 60 years ago, and during the past 40-60 years the entire area has been sown out with cocksfoot. Whole farms in the Akaroa district now consist of nothing but cocksfoot sown over 40 years ago on the original bush burn. The soil and the methods adopted have alike been favourable to the permanency of cocksfoot, and consequently we have the unusual phenomenon of a tract of country, which must considerably exceed 10,000 acres, consisting of an almost closed association of this grass. In the early days, cocksfoot seed production was the chief industry on the Banks Peninsula, large areas being devoted almost entirely for the purpose. The stocking, such as it was, was then exceedingly light. In recent years, since cheese-making has become more remunerative than the collecting of cocksfoot seed, the stocking has become heavier and more normal, with the result that even the areas devoted to seed production are now largely subservient to milk production.

The present, usual practice is to assign certain paddocks to seed production and to take a crop of seed every year for a large number of years. After cutting the seed, the long stubble is allowed to stand and, becoming mixed with an abundant aftermath growth, constitutes the main winter feed (*in situ*)

for the dairy cattle. The tendency, however, is to graze too long into the spring and not to put the paddocks up to seed early enough, with the result that the yields per acre on the Peninsula are not considered to be as high as formerly.

Some of those who still harvest cocksfoot seed put up different paddocks every year for seed, thus taking seed from fields which, in the matter of their general management, would to-day (but not necessarily during previous years) compare closely with that of a permanent pasture in this country.

The stock-carrying capacity of some of these all-cocksfoot farms is truly remarkable, the more so when it is realized that often no roots are grown and no hay made, the cattle being out-wintered on the pastures and on the cocksfoot stubble-aftermaths; and, although top dressing is now popular in New Zealand, the practice is not much in evidence on the Peninsula. As a typical example of stock-carrying capacity, a farm, visited by the writer, with a total area of 1,179 acres, of which 300 were devoted annually to seed and stubble-aftermath production, carried 150 dairy cattle, 40 fattening beasts, 70 dry cows, and about 12,000 sheep.

Canterbury Plains.—Akaroa has been very largely the distributing centre of cocksfoot seed all over the Dominion, so that "Plains" seed is to be regarded, to an appreciable extent, as Akaroa "once grown." Most of the Canterbury seed is harvested from the broad roadsides and railway sides and from areas of a similar nature. The ground is level and uniform and, in the main, this seed is now harvested with the self-binder.

Seed Production Trials.—Trials have been conducted by growing cocksfoot in spaced drills specially for seed production, on the Danish plan, and in some cases high and satisfactory yields have been obtained. No appreciable amount of seed, however, is grown at present on this basis, and the matter calls for further experimentation; the more so since, as the writer was informed, the cost of handling the crop was out of all proportion less than the costs of hand-harvesting on the Peninsula. It would also appear that high manuring, including nitrogenous fertilizers, has not been fully tested. The Danish trials have, however, shown that the seed yields are much increased when supported by adequate and complete manurial dressings.

Harvesting Practices.—In the Akaroa district, the paddocks are usually shut up for seed in September and harvested in December or early January. In this hilly country, the seed

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FIG. 1.—Typical Akaroa country. The whole area shown is dominated by cocksfoot. The light patch in the foreground to the left, and running up the hillside in a narrow rectangle, constitutes an area from which seed was harvested and was standing in stubble when the photograph was taken (June, 1926).



FIG. 2.—Typical Akaroa country. The whole area shown is dominated by cocksfoot (June, 1926).



FIG. 3.—Typical Akaroa country. The paddock beyond the fence had been harvested for seed and is shown in stubble. Note the large patches of yarrow near the fence and in the middle of the stubble paddock (June, 1926).

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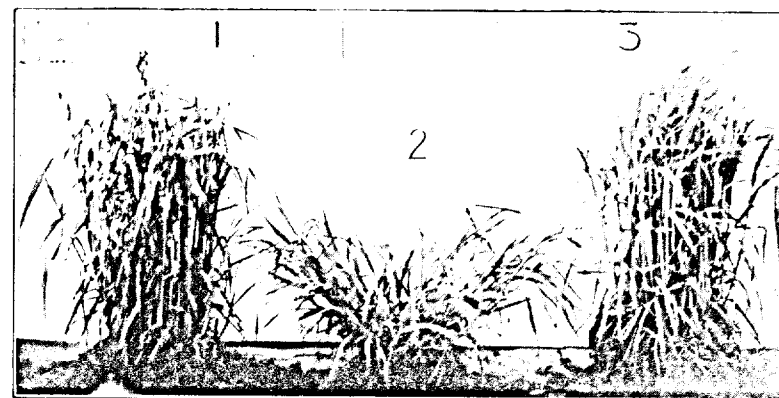


FIG. 4.—The most desirable types of cocksfoot met with from Danish seed. Note the stemmy nature of the plants and that panicles are already exerting (May 21, 1925).

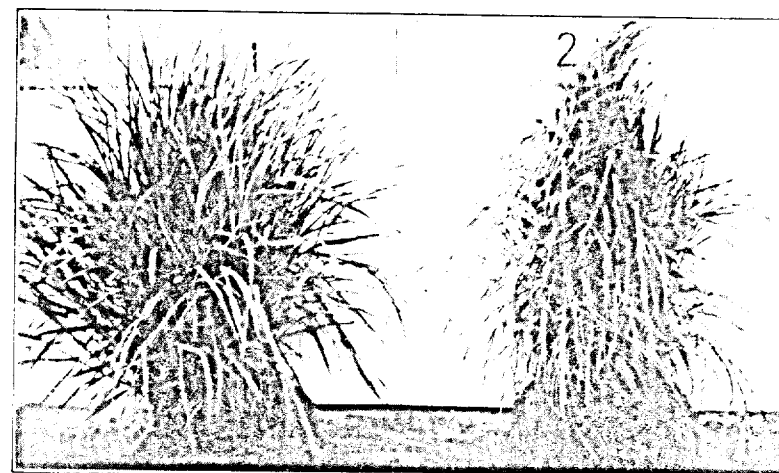


FIG. 5.—The more desirable types of cocksfoot chiefly met with from amongst seed collected from thickets and waste places in Britain, and from seed harvested in the Akaroa and Canterbury Plains districts of New Zealand. Note density and leafiness of plants and that panicle exertion has not commenced (May 21, 1925).

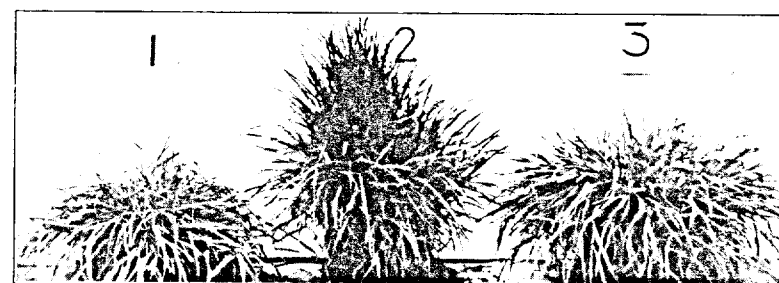


FIG. 6.—The more desirable types of cocksfoot chiefly met with from collections made on the Leicestershire fattening pastures and from other old pastures in Britain. Note the excessively dense and cushion-like growth of the plants and that panicle exertion has not commenced (May 21, 1925).

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is wholly—as much of it necessarily must be—cut by hand with sickles. It is cut at a convenient height for collecting the heads and brought to suitable centres on the paddock, where the seed is usually thrashed by hand with the flail. Small mills, however, driven by a 4 h.p. motor, are now used to a certain extent.

On account of the cost of labour, insufficient care is often paid to harvesting the different hillsides (sunny and dark faces) as and when the seed is ripe; because of the risk of shedding, due to high winds, the tendency appears to be to cut too green. It was easier to regulate these matters when seed was harvested on a large scale and when considerable gangs of men were employed for the purpose. The crop per acre runs at about 150 to 200 lb., although, on some of the better paddocks, yields of 400 lb. are not unusual. The chief plants other than cocksfoot are Yorkshire fog and yarrow, with a certain amount of brown top (*Agrostis vulgaris*) and yellow suckling clover; while red clover is still surprisingly abundant (although never sown since the original bush burn) on some of the paddocks. Cocksfoot is, however, always the dominant plant, and is frequently the only grass occupying large areas of ground.

Characteristics and Agricultural Usefulness.—Different lots of New Zealand cocksfoot do not show so much variation as is the case with New Zealand white clover. In the main, New Zealand cocksfoot is wholly a product from land not recently ploughed. Broadly speaking, it is a distinct commercial commodity, differing widely, in the aggregate, from either Danish, French, or American; and, while Danish cocksfoot is appreciably used in New Zealand, it would seem that seed crops are not to any extent taken from areas sown with Danish seed. There would also seem to be but little risk of the ordinary New Zealand stocks, as such, being cross-fertilized by Danish. It is probably true to say that not a single lb. of Danish seed has ever been sown in the Akaroa district; and since the majority of the leys in the Canterbury district are rye-grass-clover leys, and that the locally-produced cocksfoot is usually employed when this species is included in the mixtures, up to the present, at all events, the amount of Danish seed sown in that district must be very slight and almost negligible.

Extensive and critical trials conducted at Aberystwyth have, indeed, shown very little consistent difference between Akaroa and Plains cocksfoot, and this is largely what is to

be expected, having regard to the methods of seed production employed in the two areas. Akaroa, if preferable to Plains, is only so because seed from the former source is almost certain to be unrelated to Danish, while an occasional lot from the Plains may have grown in juxtaposition to a ley containing Danish cocksfoot or, conceivably, may have been Danish "once grown."

Emphasis has been laid on the fact that New Zealand cocksfoot, harvested for seed, is to a marked degree grown rather under thicket or waste place conditions than under temporary ley or normal permanent grass conditions. Seed is most usually taken year after year from the same positions and from areas not heavily grazed, or, at all events, from areas that, in past years, have more resembled thickets than intensively grazed pastures. The seed is, moreover, taken from areas long in cocksfoot. It is to be remembered, also, that when cocksfoot was first introduced into the Akaroa district, some 60 odd years ago, specialized seed production had not become established in Europe; consequently, the seed then going to New Zealand would scarcely have been of the modern Danish type but rather of the type associated with waste places and older grasslands from which it would in fact have been collected.

A critical comparison of representative plants of Danish (modern), New Zealand, British (indigenous) waste place, and British (indigenous) old sward (Leicestershire) shows exceedingly interesting differences. Certain types of individual plants will be common to all of the above sources of origin.

At the two extremes, however, we have on the one hand the early, rather stemmy, broad-tillered and lax strains most prevalent in the Danish, and on the other hand the very late short growing, excessively leafy and dense pasture types dominant in collections made from our Leicestershire and other old pastures. Intermediate between these we get forms which are more abundant amongst plants derived from New Zealand seed, and in collections made from our waste places and thickets, than in any other lots. There are also plants which are tall, leafy, exceedingly bulky and dense, and which, from an agricultural point of view, may be regarded perhaps as dual purpose—hay and pasture. The illustrations of single plants accompanying this article, and the descriptions given under them, show clearly the sort of differences that are met with amongst truly representative plants of each of the categories mentioned. In this connexion, it is not without

significance that a very large number of the plants selected at Aberystwyth for breeding purposes emanated from seed received from New Zealand.

There is, in short, not the least doubt that a large proportion of the strains produced by New Zealand seed approximate to and are hardly to be distinguished from much of our indigenous or wild cocksfoot, and abundantly represent strains which are bulky, leafy, high tillering and relatively persistent.

This conclusion is not only borne out by a critical examination of single-spaced plants but is equally confirmed by the behaviour of broadcast plots sown with New Zealand seed, when compared with indigenous strains under study at Aberystwyth and with ordinary Danish strains.

The above facts, taken in conjunction with what has already been stated in previous articles concerning white clover and red clover, afford an illuminating commentary on the relation of methods of seed production to the strains actually dominating the seed harvested. The difference between plants of cocksfoot, chiefly representative of types dominant on our fattening pastures and those representative of types dominant alike in New Zealand and in our thickets, is no less of biological than of agricultural interest and significance.

General Conclusion and Recommendations.—In view of the fact that the tendency more and more in this country, as in Australia and New Zealand, is to put land down to temporary grass for as many years as possible—a tendency which is strengthened by modern methods of more intensive manuring of grassland—it is to be deplored that the relatively short-lived strains of cocksfoot as represented by Danish seed have become the dominant strains which are sown on newly prepared leys. At equal price per pound, Akaroa cocksfoot cannot hope to compete in the world's market with Danish, because its viability and bushel weight are generally lower, and its appearance less attractive to the eye, than that of the latter. In the interests of the grasslands of the Empire, however, it is to be hoped that some stimulus could be given to the Akaroa growers to continue the production of seed. There is little doubt that seed production could be cheapened on the more accessible and more level of the paddocks, and that resort to adequate manurial dressings and greater specialization would lead to considerably augmented yields. There remains also the possibility of developing the cocksfoot

seed industry of New Zealand on the lines of "once growing" the best Akaroa strains under arable conditions, and in seed production drills (the Danish plan) on the Canterbury Plains or elsewhere, where the conditions are favourable to the growth and harvesting of this species. It is probable that methods demanding excess of manual labour can never again be remunerative and, consequently, developments can only take place on the lines of the scientific selection of areas for the production of "stock seed" and for the "growing on" of this seed under arable conditions, supported by a properly conceived system of inspection and registration.

In this connexion, it is legitimate to insist that the breeding and selection of true-breeding and ultra-superior strains is, at the best, a long process; and, in the meantime, it is wholly to the disadvantage of the British farmer that Denmark should have been allowed, to all intents and purposes, to completely replace New Zealand as a source of supply for the seed of such an important species as cocksfoot. The question to which the New Zealand grower and the British importer should, therefore, give serious attention is whether it is possible to stay the decline in the amount of New Zealand cocksfoot seed reaching this country.

* * * * *

LIVE STOCK IMPROVEMENT SCHEME: REPORT FOR THE YEAR ENDING MARCH 31, 1927

It is probably true that, during the year under review, agricultural conditions in many districts offered little inducement to the average farmer to venture upon any stage of development of his industry which involved an outlay beyond what was necessary to carry on his normal activities. The small farmer, with limited resources, for whose benefit, primarily, the Live Stock Scheme was started, has felt in varying degree the difficulty of making ends meet. His problem has been that of reducing expenditure rather than that of incurring additional liabilities on new ventures. The dispiriting influence of these conditions is not conducive to development, and, in the definitely progressive programme of the Live Stock Scheme, which makes a call upon enterprise and necessitates a measure of optimism in spending, it would not be surprising to find the effects of these conditions somewhat pronounced.

Under the necessity of reducing expenditure, the temptation to effect a saving at the sacrifice of development is naturally

a strong one, especially to those who do not realize the financial and other benefits that accrue from the use of pedigree sires and the adoption of a system of recording milk yields. It may, therefore, be regarded as one of the satisfactory features of the year's operation of the Live Stock Scheme that, in spite of the agricultural difficulties, there has been a measure of progress, not only in influencing new areas, but also in developing the good work already accomplished. The Scheme is slowly, but surely, penetrating into districts which have hitherto been too conservative in their methods to adopt it, and the location of a premium bull in a district so remote as the Scilly Isles may perhaps be regarded as a happy augury of further progress.

Bulls.—The total number of bulls available for service under the Scheme during the year ended March 31, 1927 (i.e., continued from the previous year with renewed grants, or provided for fresh districts during the year), was 1,287, an increase of 112 on the preceding year.

BULL SCHEME

SHOWING THE NUMBER OF BULLS SUBSIDIZED EACH YEAR SINCE
THE COMMENCEMENT OF THE SCHEME

Year (April 1-March 31)	No. of Bulls
1914-15*	497
1915-16	633
1916-17	659
1917-18	710
1918-19	721
1919-20	675
1920-21	668
1921-22	847
1922-23	947
1923-24	978
1924-25	1,069
1925-26	1,175
1926-27	1,287

* Including the period February 1, 1914, to March 31, 1914.

Considering the difficulties which confront the Ministry's Live Stock Officers in their efforts to extend the scope of the Bull Scheme, the progress made during the year may, on the whole, be regarded as satisfactory. Apart from the prevailing lack of funds, which deters farmers from paying the price required for a pedigree bull, local difficulties, more severe in some districts than in others, have retarded progress. For example, in districts which are almost entirely devoted to milk production little attention is paid to the breeding and conformation of bulls, with the result that the calves

produced are not fit to rear, and are usually disposed of at the first market after they are dropped. In some districts, too, there appears to be a general fear, usually without foundation, that the use of a premium bull is attended by risks of spreading abortion. Another factor which makes the location of sires difficult is the high cost of carriage. Unfortunately, in many districts where the location of good sires would be of great benefit, few pedigree herds exist, and, in consequence, good bulls have to be drawn from remote areas and the cost of transit in addition to the purchase price of a good bull discourages many farmers who might otherwise be disposed to keep a bull under the Scheme.

These considerations combine to induce many farmers to purchase bulls, for use in their own herds, which are often below the standard required to exert a beneficial effect on the live stock of the district. Even in these cases, the fact that the pros and cons have often been considered by the farmer is a hopeful indication, and it is not improbable that, in due course, growing evidence of the ultimate benefit of the use of good sires will lead to the purchase of better bulls. There is, indeed, ample evidence that premium bulls exercise an influence that reaches beyond the immediate districts in which the bulls are placed. While the awards obtained by premium sires and their progeny at the more important shows are a good advertisement for the Scheme, it is probable that the frequent successes of subsidized sires at numerous local shows are no less effective in demonstrating in their respective areas the benefit of using good sires. The list of such successes furnished to the Ministry by its Live Stock Officers each year is a growing one, and shows beyond doubt that the Scheme has an increasing educational value, and is effecting an improvement in stock breeding which is recognized by both breeders and dealers. Moreover, a marked preference for young stock sired by premium bulls is now reported very generally and is one of the most practical proofs of the ultimate benefits of the Scheme. A heifer calf sired by a Scheme bull was recently sold at 18 months old for £50, while two eight weeks old heifer calves realized an average of £8 10s. 0d.

The sequel is often more instructive than the event, and it is in the activities which are obviously prompted by the Scheme that its progress may be traced. A distinct advance has been made in one district by the adoption of a system of marking of calves sired by premium bulls, and if this practice proves a financial success it will probably be tried

in many other districts. It is satisfactory, also, to record that the provision of classes for premium bulls at shows has increased, and that the very desirable practice of extending such classes to include the progeny of premium bulls has been further adopted.

While it is encouraging to find that, in many districts, where the Scheme has operated successfully for several years, breeders have continued to make use of pedigree sires, it should be remembered that the funds available for the provision of premium bulls are quite insufficient to provide sires in sufficiently large numbers to have a widespread effect on the general grading up of the commercial cattle of the country. The question of the elimination of the scrub bull remains as important as ever and cannot be solved by the Premium Scheme. As to the introduction of legislation to secure this object; there is still strong agricultural opposition, but there are indications that the proposal is growing in favour in some districts.

Breeds and Prices.—The following table compares the numbers and prices of bulls according to breeds with the preceding year and the first year of the Scheme. The Shorthorn breed furnishes nearly 60 per cent. of the total number of bulls, the increase in this breed alone being equivalent to about 80 per cent. of the total increase for the year.

NUMBERS AND PRICES OF BULLS OF EACH BREED

Breed	1914-15			1925-26			1926-27		
	No.	Average Cost		No.	Average Cost		No.	Average Cost	
		£	s. d.		£	s. d.		£	s. d.
Aberdeen Angus	—	—	—	1	52	10 0	3	48	3 4
British Friesian	—	—	—	3	58	8 4	2	58	12 6
Devon ..	16	40	17 6	128	55	6 11	136	54	6 4
Galloway ..	—	—	—	—	—	—	1	19	19 0
Guernsey ..	—	—	—	13	48	0 0	12	43	19 11
Hereford ..	63	33	7 6	121	48	3 9	142	48	4 1
Lincoln Red ..	33	31	10 0	132	59	0 7	141	48	3 10
Red Poll ..	—	—	—	1	21	0 0	—	—	—
Shorthorn ..	337	37	17 0	644	55	4 3	716	52	6 3
South Devon ..	6	36	11 6	14	43	16 8	14	43	2 8
Sussex ..	—	—	—	1	44	2 0	—	—	—
Welsh Black ..	35	29	9 0	67	43	18 6	69	45	1 6
All breeds	497	£36	0 0	1125	£53	19. 9	1236	£50	19 6
	*						†		

* Including 7 "other breeds" not specified.

† 1,287 bulls were located, but grants in respect of 51 were in suspense at the end of the year.

Service Fees.—With three exceptions exceeding 10s., the bulls served at fees ranging from 2s. 6d. to 10s. While little change is shown in the number of bulls serving at fees other than 5s., there was a very substantial increase in those serving at that amount.

Year	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6
1914-15 ..	265	57	41	42	3	88	—	—	—
1925-26 ..	55	50	25	74	13	616	5	108	2
1926-27 ..	67	52	34	78	13	691	7	108	3

Year	7/-	7/6	8/-	8/6	9/-	9/6	10/-	Over 10/-
1914-15 ..	—	1	—	—	—	—	—	—
1925-26 ..	8	140	4	5	1	1	15	3
1926-27 ..	12	140	5	4	1	1	17	3

Boars.—The number of boars provided for service under the Scheme during the year ended March 31, 1927 (*i.e.*, continued from the previous year with renewed grants or located in fresh districts during the year), was 844, an increase of 134 over the preceding year.

BOAR SCHEME

SHOWING THE NUMBER OF BOARS SUBSIDIZED EACH YEAR SINCE THE COMMENCEMENT OF THE SCHEME

Year (April 1 to March 31)	Societies	Individuals	Total number of Boars
1914-15*	115	—	115
1915-16 ..	180	—	193
1916-17 ..	186	15	216
1917-18 ..	172	92	264
1918-19 ..	156	167	350
1919-20 ..	120	225	399
1920-21 ..	135	285	441
1921-22 ..	113	416	550
1922-23 ..	93	451	569
1923-24 ..	78	541	638
1924-25 ..	68	587	655
1925-26 ..	57	649	710
1926-27 ..	54	790	844

* Including the period February 1, 1914, to March 31, 1914.

On the whole, the year under review was a good one for the pig breeding industry. A rise in prices realized for pigs and an increased demand for pig products gave an impetus to the keeping of breeding sows. The history of this industry, however, does not encourage the hope that this improvement will be constantly maintained, and, with any serious drop in prices, no doubt the interest of a number of farmers in this side of farming will be decreased or cease altogether. This uncertainty in the pig breeding industry may possibly be checked to some extent by an effort, which appears to be growing, to establish a better understanding between breeders on the one hand and the bacon factory and the market on

the other. It appears to be clear that, unless something in this way is accomplished, pig breeding will continue to fluctuate and remain with most farmers a side line, active only when the market is good.

Breeds and Prices.—The following table shows the number and average prices of boars of each breed. It will be readily apparent that the Large White breed, which has always been predominant under the Scheme, has further increased in popularity.

There was a slight rise in the average price paid for most breeds, which resulted in a small increase in the average price for the total number provided.

NUMBERS AND AVERAGE PRICES OF BOARS OF EACH BREED

Breed	1914-15		1925-26		1926-27	
	No.	Average Price	No.	Average Price	No.	Average Price
		£ s. d.		£ s. d.		£ s. d.
Berkshire ..	10	8 0 0	15	13 5 2	17	15 9 8
Cumberland ..	—	—	41	12 0 11	48	12 5 6
Essex ..	—	—	1	25 4 0	2	12 2 6
Glos. Old Spot ..	7	7 1 0	9	16 2 11	7	12 3 5
Large Black ..	18	7 5 6	70	11 11 10	65	11 10 7
Large White ..	64	7 3 0	315	13 12 4	462	13 16 1
Lincoln Curly Coated	4	8 4 6	35	9 19 6	29	11 9 5
Middle White ..	12	6 17 0	105	13 0 9	108	12 15 5
Large White Ulster ..	—	—	6	14 16 8	5	14 17 0
Tamworth ..	—	—	2	14 8 6	1	14 14 0
Wessex Saddleback ..	—	—	21	12 19 7	16	12 10 11
Welsh ..	—	—	41	12 3 4	48	12 6 1
Long White Lop-eared	—	—	7	13 4 8	12	14 1 8
All breeds ..	115	£7 5 3	668	£12 19 5	820*	£13 4 8

* 844 boars were located, but grants in respect of 24 were in suspense at the end of the year.

Service Fees.—The service fees, as in previous years, varied from 2s. 6d. to 10s., and there was a remarkable increase in the number of boars serving at 5s. or 6s. In fact there appears to be a tendency, as under the Bull Scheme, to standardize the service fee at 5s.

Year	2/-	2/6	3/-	3/6	4/-	4/6	5/-	5/6
1914-15 ..	21	62	10	5	6	—	2	—
1925-26 ..	—	8	11	20	57	3	414	1
1926-27 ..	—	6	11	21	57	5	543	1

Year	6/-	6/6	7/-	7/6	8/-	8/6	10/-
1914-15 ..	—	—	—	—	—	—	—
1925-26 ..	53	3	—	91	—	1	6
1926-27 ..	70	4	5	91	—	1	5

Horse Breeding.—Heavy Horses.—Notwithstanding the continued decline in horse breeding generally, as shown by the Annual Agricultural Returns furnished to the Ministry in June, 1926, the Heavy Horse Breeding Scheme appears to be making steady progress. The figures given in the following statement suggest that the setback which resulted from the temporary withdrawal of grants for the two years ending March 31, 1923 and 1924, has been recovered. Although the number of stallions subsidized in 1926 was slightly less than in 1921, the number of mares served was appreciably greater, and it may be added that the demand for grants, which has been received by the Ministry in respect of the service season of 1927, gives promise of further progress.

HEAVY HORSE SCHEME						
Year	No. of Stallions	Total No. of Mares served	Average No. of Mares served	No. of assisted nominations	Average hiring fee of Stallions	Average service fee
				£	£	£ s. d.
1914-15 ..	72	6,365	68	1,503	231	2 8 6
1915-16 ..	97	9,122	94	2,430	241	2 9 6
1916-17 ..	108	9,995	92	2,181	244	2 11 0
1917-18 ..	110	10,556	96	2,151	258	2 16 3
1918-19 ..	122	12,281	100	2,165	285	2 15 8
1919-20 ..	118	10,920	96	1,996	317	3 6 3
1920-21 ..	105	9,133	87	1,839	345	3 13 1
1921-22 ..	101	7,888	78	1,943	333	3 13 7
1924-25 ..	87	6,098	70	—*	178	2 7 0
1925-26 ..	96	7,413	77	1,723	194	2 8 4
1926-27 ..	98	8,165	83	2,171	208	2 8 6

* No grant was made by the Ministry for assisted nominations (except to the Cumberland Society) for the year 1924-25.

The above figures do not include the activities of the Cumberland and Westmorland Society, which was formed in 1915 for the purpose of issuing only assisted nominations to selected stallions. The numbers of such nominations issued by this Society since 1915 are as follows:—

Year	No. of assisted nominations	Year	No. of assisted nominations
1915-16 ..	385	1920-21 ..	254
1916-17 ..	394	1921-22 ..	255
1917-18 ..	328	1924-25 ..	121
1918-19 ..	321	1925-26 ..	197
1919-20 ..	264	1926-27 ..	220

The decline in the number of assisted nominations issued by the Society from 1919 to 1921 was due to the increase in service fees which automatically increased the value of an assisted nomination and, consequently, reduced the number available from the Ministry's grant. The Society ceased

operations after the withdrawal of the Ministry's grant, and upon its revival in 1924-25 the grant was reduced to one-half. With the subsequent extension of the Society's activities, additional grants have been given, and the result is reflected in the increase in the number of nominations issued.

While existing conditions do not suggest that Heavy Horse Breeding will assume the same importance as in the past, it is evident that more breeding is necessary in order to maintain the number of working horses at the present level. Owing to the depressed state of the Horse Breeding industry during the last few years, the number of individual owners who travel stallions has decreased. Many districts are, therefore, now dependent on stallions travelled by Societies, and it is hoped that the assistance which the Ministry gives to such Societies will encourage them to carry on and develop their good work.

Horse Breeding Act, 1919.—Although the number of stallions, licensed during the year ended October 31, 1926, continued the decline which has taken place each year since 1921, it will be noted that the rate of decrease has again slackened.

Year (ending October 31)	Number of applications for Licences	Number of Licences issued	Number of refusals
1920 ..	4,153	3,749	404
1921 ..	4,060	3,816	244
1922 ..	3,644	3,479	165
1923 ..	2,897	2,761	136
1924 ..	2,285	2,210	75
1925 ..	1,908	1,849	59
1926 ..	1,664	1,608	56

Of the 1,608 stallions licensed in 1926, 1,499 were pedigree animals, and the remaining 109 were horses that were not entered or accepted for entry in any recognised stud book.

The following tables show the number of stallions of each breed concerned that were licensed or rejected, and the number of refused licences in respect of the various prescribed diseases or defects:—

NUMBER OF STALLIONS LICENSED OR REFUSED						
			Pedigree		Non-Pedigree*	
Heavy			Licensed	Refused	Licensed	Refused
Shire ..	..	..	797	32	32	—
Clydesdale ..	..	..	117	3	5	—
Suffolk ..	..	..	139	5	—	—
Percheron ..	..	..	41	4	—	—
Others ..	..	..	—	—	22	—

Total Heavy (see next page) 1,094

44

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NUMBER OF STALLIONS LICENSED OR REFUSED (continued)				
	Pedigree		Non-Pedigree*	
	Licensed	Refused	Licensed	Refused
Heavy (see previous page)	1,094	44	59	—
Light				
Hackney	95	5	13	—
Thoroughbred	136	4	2	—
Arab	20	—	3	—
Hunter	4	—	1	—
Cleveland Bay	5	—	—	—
Yorkshire Coach	2	—	—	—
Welsh Roadster	1	—	—	—
American Trotter	—	—	2	—
Others	—	—	4	—
Ponies (including Welsh Cobs)	142	2	25	1
Totals	1,499	55	109	1

* Non-pedigree stallions are arranged as far as possible under types.

NUMBER OF STALLIONS REJECTED FOR THE PRESCRIBED DISEASES

AND DEFECTS			
Roaring	10	Stringhalt	2
Whistling	16	Shivering	3
Sidobone	11	General unsuitability	1
Cataract	4		
Ringbone	4	Total	56
Bone spavin	5		

Seven appeals were made against refusals of licences, and in four cases the appeals were successful.

Twelve cases of infringement of the Horse Breeding Act were reported during the year. In three cases unlicensed stallions were found to be travelling for service, and prosecutions which followed in two of these resulted in one being imposed in one case, while the other was dismissed on payment of costs. Seven licensed stallions were reported as travelling unaccompanied by licence, and in two cases owners failed to notify change of ownership.

Sheep grants, up to a maximum of £10 for each ram killed and at the rate of 3s. 4d. per ewe served, were again made by the Ministry to a number of Societies in Wales for the encouragement and improvement of breeding of Welsh mountain sheep. Twenty-five Societies provided a total of 25 rams. The total number of ewes served was 1,471, an average of 59 per ram. The average hiring fee of the rams was £9 16s. 0d., and the average service fee 1s. 6d.

This scheme has been in operation since 1919, and the reports, which the Ministry has received, show that its operation has been uniformly successful. Welsh Mountain Sheep are an important factor in farming in many parts of Wales, and

notwithstanding the need for improving the standard of the flocks, no systematic improvement on co-operative lines appears to have been attempted until the Ministry's scheme was introduced. The scheme has effected marked improvement in several districts, and has created an interest which has led to a healthy rivalry among breeders, and to additional attractions in the form of special classes for sheep at local shows.

Milk Recording.—The figures given below show an increase in the total membership of Societies, and in the number of herds and cows recorded.

	Year*	Societies	Members	Herds	Cows
April 1 to March 31	1914-15	16	264	306	7,331
	1915-16	20	350	398	9,811
	1916-17	22	441	495	12,950
	1917-18	25	503	555	14,404
Oct. 1 to Sept. 30	1917-18	27	639	708	19,793
	1918-19	38	1,191	1,332	37,880
	1919-20	46	2,075	2,312	61,323
	1920-21	52	3,328	3,664	97,903
	1921-22	55	3,949	4,362	117,023
	1922-23	55	4,365	4,767	127,151
	1923-24	52†	4,764	5,209	138,086
	1924-25	50†	5,081	5,516	148,905
	1925-26	49†	5,174‡	5,656‡	154,322

* Before October 1, 1917, there was no uniform year for Societies.

† The decrease in the number of Societies is due to amalgamation.

‡ Including 29 members recording goat herds only.

For a year which was in some respects a difficult one for milk recording propaganda the increase shown is not unsatisfactory, especially in view of the somewhat larger number of resignations which took place during the year. Two principal causes seem to have brought the numerical progress of several Societies almost to a halt. The necessity for economy in expenditure has led many farmers to withdraw from their Societies. There is reason, however, to believe that many of them continue to record and that the practice of private recording has much increased during the last year or two. Though the resignation of members may be unfortunate from a Society's point of view, it should be borne in mind that the main object of the Scheme is achieved when farmers are converted to the practice of recording. Further discouragement was given to recording during the year under review by the somewhat low prices and the over-production of milk in some districts, with the consequent difficulty of disposing of the surplus. That these conditions should discourage recording

NUMBER OF STALLIONS LICENSED OR REFUSED (<i>continued</i>)				
	Pedigree		Non-Pedigree*	
	Licensed	Refused	Licensed	Refused
Heavy (<i>see previous page</i>)	1,094	44	59	—
Light				
Hackney	95	5	13	—
Thoroughbred	136	4	2	—
Arab	20	—	3	—
Hunter	4	—	1	—
Cleveland Bay	5	—	—	—
Yorkshire Coach	2	—	—	—
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indicates how little in some directions the functions of milk recording are understood.

Over-production does not necessarily imply economical production, and when milk is realizing low prices it is obviously more than ever desirable that it should be produced as economically as possible. Milk recording and its allied practices of rationing and testing for butterfat are the surest means of effecting economy in milk production, and it is satisfactory to find that while the numerical progress of the Scheme may be slackening there is a growing tendency to take advantage of the advice given by the Agricultural Organizers and others on questions of rations and economy of management.

Average Yield of Recorded Herds.—Of the 154,322 cows and heifers recorded under the Scheme 81,669, *i.e.*, 53 per cent. (as compared with 51 per cent. in the previous year) were cows which had been retained for the full year. The following table compares the average yield of (1) all cows and heifers recorded, and (2) cows recorded for the full year, for each year since the uniform milk recording year was fixed.

Year Oct. 1 to Oct. 1	No. of Societies	Particulars of all cows and heifers recorded			Particulars of cows recorded for full year			
		No. of cows and heifers	Total yield	*Average yield	No. of cows	Percentage of total cows and heifers	Total yield	*Average yield
			gal.	gal.			gal.	gal.
1917-18..	27	19,793	8,426,958	426	8,775	44	5,255,923	599
1918-19..	38	37,880	16,204,941	450	17,989	47	10,543,516	579
1919-20..	46	61,323	29,344,887	479	27,266	44	17,363,347	637
1920-21..	52	97,903	48,512,380	495	48,248	49	30,892,620	640
1921-22..	55	117,023	60,463,617	517	63,318	54	41,208,073	651
1922-23..	55	127,151	67,904,224	534	68,349	54	46,956,565	687
1923-24..	52	138,086	73,963,165	535	73,338	53	50,299,884	685
1924-25..	50	148,905	76,419,498	513	77,132	51	51,695,291	*670
1925-26..	49	154,322	81,623,788	529	81,669	53	56,102,434	*687

*Before 1924-25 the average yield was calculated at the equivalent of 10½ lb. to a gallon and subsequently at 10¼ lb.

The average yield of the full-year cows was 7,098.4 lb. (687 gal.), which is the highest attained since the scheme was started.

The increased production was fairly general, only eight Societies showing a lower average than in the previous year. More interesting and instructive from the individual farmer's point of view is the increased average obtained by herds which have been recorded over a number of years. In the examples given below the improvement secured is translated into terms of cash, which suggest that in these cases, which are typical of many, milk recording has proved a sound investment.

Herd	No. of years during which records were taken	Average yield per cow in first year	Average yield per cow in last year	Increase in annual average yield per cow	No. of cows in last year of period	Cash value of increase of last year over first year at 1/- per gallon	
						Per cow	Per herd
		gal.	gal.	gal.		£ s.	£ s.
A. (Pedigree Friesian) ..	5	634	1,010	376	17	18 16	319 12
B. (Pedigree Guernsey) ..	6	579	849	270	18	13 10	243 0
C. (Pedigree Park Cattle) ..	6	479	752	273	14	13 13	191 2
D. (Mainly pedigree Shorthorn) ..	5	525	983	458	22	22 18	503 16
E. (Non-pedigree Shorthorn) ..	5	787	973	186	23	9 6	213 18
F. (Non-pedigree Shorthorn) ..	5	563	1,067	504	11	25 4	277 4
G. (Non-pedigree Shorthorn) ..	5	612	909	297	42	14 17	623 14

While the milk recording scheme covers all breeds without distinction the individual farmer or breeder is naturally more concerned with the performances of the breed in which he is particularly interested. The following analysis showing the average yield of full-year cows of each breed or type recorded under the Scheme may, therefore, be of interest.

Statement showing the total number of Cows and Heifers of each breed recorded in England and Wales during the year ended October 1, 1926, and the number and average yield of Cows of the various breeds recorded for the full year, together with the percentage of full-year Cows.

Breed or type	Total number of cows and heifers recorded	Particulars of Cows recorded for full year			
		Number	Percentage of total cows and heifers	Total yield	Average yield
				lb.	lb.
Aberdeen Angus	49	26	53.0	201,946	7,767
Ayrshire ..	1,376	624	45.3	4,605,800	7,381
Blue Albion ..	1,616	1,048	64.8	7,878,703	7,518
Devon ..	1,631	912	55.9	5,305,118	5,817
Dexter ..	337	196	58.1	891,828	4,550
Friesian ..	20,154	10,873	53.9	89,598,773	8,240
Galloway ..	42	6	14.2	46,542	7,757
Gloucester ..	54	28	51.8	150,396	5,371
Guernsey ..	6,227	3,040	48.8	19,269,261	6,339
Hereford ..	235	149	63.4	1,103,998	7,409
Jersey ..	4,640	2,253	48.5	13,869,204	6,156
Kerry ..	664	354	53.3	1,974,622	5,578
Lincoln Red ..	3,104	1,674	53.9	11,645,315	6,957
Longhorn ..	10	3	30.0	29,131	9,710
Park Cattle ..	101	57	56.4	410,442	7,201
Red Poll ..	4,251	2,531	59.5	17,194,766	6,794
Shorthorn ..	100,532	53,702	53.4	378,953,947	7,057
South Devon ..	2,829	1,321	46.6	8,227,435	6,228
Sussex ..	18	7	38.8	58,690	8,384
Welsh Black ..	1,291	690	53.4	3,942,235	5,713

Milk Record Certificates.—The number of milk record certificates issued for the year or part year ended October 1, 1926, was 206 as compared with 353 in the preceding year. This continued drop is not surprising, as a certificate is not necessary, as it was originally, as a condition of entry in the Ministry's Register of Dairy Cattle, and the charge for a certificate is, moreover, a strong deterrent to application. While these considerations have naturally tended to reduce the demand for annual record certificates, it is interesting to find that the Ministry's Certificate of Merit is becoming more appreciated. This form of certificate, which is a record of proved milk yielding and breeding qualities for a period of three consecutive years, is obviously of value, and in view of the qualifications necessary to obtain it, it is satisfactory to record an issue of 276 certificates of merit as compared with 197 in the preceding year.

Of the 276 certificates of merit issued for the period ending on October 1, 1926, 120 were in respect of cows which yielded

30,000 lb. or over during the three-year period. This number includes 56 Shorthorns, 18 Friesians, 16 Red Polls and 7 Ayrshires. The highest yield certified was 59,960½ lb. given by a non-pedigree Shorthorn cow, while a non-pedigree Friesian cow gave 48,908½ lb. and a pedigree Shorthorn 48,035½ lb.

Register of Dairy Cattle.—The tenth volume of the Ministry's Register of Dairy Cattle, which has been issued in respect of the milk recording year ending October 1, 1926, contains particulars of 7,500 cows. The entries consist of the highest yielding cows selected from the Annual Returns of members of the various milk recording societies, arrangements being made for the inclusion of cows of each breed. Twenty recognized breeds or types are represented in the volume, 64 per cent. being of the Shorthorn type, 18 per cent. Friesian and 4 per cent. Guernsey.

The limitation of the number of entries in the Register to 7,500 necessitates the exclusion of very many cows which reached the qualifying standard for their respective breeds. In all 15,577 qualified for entry, and whereas the lowest yield prescribed for any breed is 8,000 lb. slightly more than 7,000 of the cows entered gave 10,000 lb. or over; 67 per cent. yielded between 10,000 and 12,000 lb.; 20 per cent. between 12,000 and 14,000 lb.; and 6 per cent. between 14,000 and 20,000 lb. Twenty-four cows gave 20,000 lb. or over.

Particulars of 276 cows which were awarded certificates of merit are also included in the Volume.

The number of bulls entered in the Volume was 66 as compared with 38 in Volume 9. Of these 28 were entered in the Register for the first time. Forty-eight of the 66 bulls entered qualified under the requirement that their dams and sire's dams have given not less than the standard yield prescribed for their breed or type during a milk recording year, and 18 were entered as having two or more daughters which have given the prescribed yield.

Rationing.—Much useful work has been done by County Agricultural Organizers and the Ministry's Live Stock Officers in urging members of milk recording societies to devote more attention to the methods of feeding, and one of the most encouraging features of the year under review is the manifestly increased interest in this matter. Advice on rationing can now be readily obtained from County Agricultural Organizers whose valuable assistance is much appreciated, and it is frequently found that farmers take up recording as members

of societies or privately in order to secure the benefit of the advice of the County Organizers on food rations.

Testing for Butterfat.—From information furnished by milk recording societies, it appears that butterfat testing is making progress. During the year ended October 1, 1926, the number of samples taken and analyzed was 108,335, as compared with about 95,000 in the preceding year. Of these, about 90,000 were samples of milk from individual cows. For reasons given in last year's report, official recognition of butterfat tests has not hitherto been considered practicable. The importance of this question is fully appreciated by the Ministry and continues to receive careful consideration.

Calf and Bull Marking.—There was a substantial increase in the number of calves marked under the scheme, the number being 16,917 as compared with 15,416 in the previous year. The number of bulls marked was 81 as compared with 117. Reference has been made above to the marking of calves by Bull Societies, and although such calves are not included in the above figures the innovation is worthy of mention as illustrating the progress made in this direction.

Cost of Milk Recording.—The cost of recording varies considerably throughout the country. The average cost per cow to the member ranged from 2s. 1d. in one society to 9s. 6d. in another, while the average cost per cow to the society varied from 3s. 11d. to 11s. 2d. In the average cost of recording per cow over the whole country there was very little change from the preceding year, the cost being 4s. 4d. and 6s. 4d. to the member and society respectively as compared with 4s. 3d. and 6s. 3d. Local conditions, no doubt, are largely responsible for variations in cost, but it is highly probable that more uniformity could be attained and the cost reduced by more economical management on the part of some societies. Several societies have improved in this respect during the year, and, in view of the deterrent effect of high levies, especially at the present time, the matter is one which all societies will be well advised to keep under constant review.

Exportation of Live Stock to Countries Abroad.—There was, during the year under review, no relaxation of the prohibitions of importation passed by the various governments abroad owing to the existence of foot-and-mouth disease in this country, and the export of live stock continued, therefore, to be much restricted. Inasmuch, however, as the position has improved, it is probable that some relaxation of these pro-

hibitions may be made. The Ministry continues to supply information with regard to the regulations in force at the time in any particular country, upon inquiry by intending exporters. Particulars of the number and declared value of animals exported are published at the end of each quarter in this JOURNAL.

The following memoranda, which give detailed information concerning the Live Stock operations of the Ministry, can be obtained (single copies free of charge) on application to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1.

Leaflet 282: Scheme for Improvement of Live Stock.

Leaflet 146: The Value of Records of the Milk Yields of Cows.

No. 609/T.L.: Bull Grant Regulations.

No. 392/T.L.: Milk Recording Regulations.

No. 466/T.L.: Boar Grant Regulations.

No. 89/T.L.: Heavy Horse Regulations.

MILK RECORDING SOCIETIES

STATEMENT GIVING PARTICULARS OF FORTY-NINE MILK RECORDING SOCIETIES OPERATING DURING THE YEAR ENDED OCTOBER 1, 1926.

(The Societies are arranged in order of total number of animals recorded.)

Society	No. of members	*No. of herds	*Total No. of animals recorded	No. of cows recorded for full year	Average yield of cows recorded for full year
Somerset and North Dorset	288	326	9,969	5,789	7,042
Essex County	229	263	9,561	5,132	7,612
Hampshire	258	284	8,909	4,971	6,830
East Sussex	209	240	6,928	3,536	6,835
Norfolk	232	260	6,916	4,031	7,513
North Wilts	129	154	6,743	3,672	7,029
Berkshire	156	179	6,558	3,412	6,866
Kent	189	210	5,832	2,966	7,094
Hertfordshire	166	192	5,513	2,673	7,222
Dorset	94	123	5,319	3,270	6,619
Suffolk	204	221	4,921	2,572	7,463
West Sussex	130	154	4,754	2,419	7,133
Surrey	173	184	4,744	2,325	6,863
Oxfordshire	121	131	4,048	1,875	7,310
Leicestershire and Rutland	147	155	3,908	2,028	6,933
Warwickshire	155	159	3,880	2,092	7,249
South Wilts	71	91	3,829	2,432	7,672
Lancashire County ..	104	112	3,161	1,226	7,072
Carried to next page	3,055	3,438	105,493	56,421	—

* Goats are not included.

MILK RECORDING SOCIETIES (continued)

Society	No. of members	*No. of herds	*Total No. of animals recorded	No. of cows recorded for full year	Average yield of cows recorded for full year
Brought over from previous page ..	3,055	3,438	105,493	56,421	—
Shropshire ..	75	82	2,930	1,652	7,393
Staffordshire ..	98	100	2,808	1,535	7,484
Gloucestershire ..	94	104	2,662	1,398	7,208
South Devon and District ..	117	121	2,603	1,181	6,238
Northamptonshire ..	96	102	2,483	1,271	6,710
Yorkshire ..	130	138	2,475	1,236	7,134
Bristol and North Somerset ..	107	109	2,434	1,334	6,995
Cambridgeshire and District ..	86	91	2,350	1,234	7,451
Derby and District ..	59	66	2,226	1,063	7,545
Cheshire County ..	62	68	2,198	1,101	7,137
Buckinghamshire ..	81	85	2,106	1,106	7,312
Worcestershire ..	87	90	1,812	929	7,364
Cumberland & North Westmorland ..	103	104	1,791	826	6,132
Nottinghamshire ..	55	58	1,695	839	7,003
East Devon ..	86	88	1,540	786	6,661
Bedfordshire ..	51	54	1,514	886	7,091
Denbigh & Flintshire ..	68	71	1,355	801	6,952
Cornwall ..	71	72	1,263	659	6,483
Lincolnshire ..	43	48	1,228	629	7,121
Peak (Derby) ..	57	57	1,169	589	7,326
United Counties ..	77	78	1,079	588	6,422
Kendal and South Westmorland ..	48	50	1,022	379	6,101
Northumberland ..	45	47	950	476	7,213
Durham County ..	32	36	923	379	7,647
Herefordshire ..	37	38	894	459	7,861
Campden Moreton & District ..	40	42	826	468	6,838
Monmouthshire ..	35	37	772	421	6,892
Anglesey and Carnarvonshire ..	64	64	751	428	5,929
Glamorgan ..	46	46	516	313	7,114
Montgomeryshire ..	20	21	302	183	6,696
Merionethshire ..	19	20	152	99	5,599
Totals ..	5,144	5,625	154,322	81,669	7,098

* Goats are not included.

* * * * *

THE CONTROL OF LIVER ROT OF SHEEP*

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DURING the past two years, much research concerning the control of liver rot of sheep has been in progress. These recent investigations have so considerably advanced our knowledge that it is opportune to discuss briefly the results obtained and their application. Effective control measures can now be recommended and the writer puts in a plea for a systematic attempt to abolish the disease as an epidemic.

Important Features of Liver Rot Bearing upon the Problem of Control.—Sheep pick up the encysted stage of the liver fluke in grazing. In the intestine, the young flukes emerge from these cysts, make their way to the liver and enter the bile ducts of that organ. There they mature and continue a parasitic existence, laying many thousands of eggs which, passing down the ducts, reach the outer world in the droppings of the sheep. Some time after reaching water, these eggs hatch and the free-swimming form seeks a certain fresh-water snail, *Limnaea truncatula* (also, possibly, *L. pereger*), which it enters. Within the snail, development and multiplication take place until a final stage, in which the organism bores its way out, is reached. Swimming actively, this form seeks a blade of grass, or portion of another plant, on which it forms an adherent cyst. These cysts, which are about the size of a small pin's head, may form free on the surface of water. The ingestion of this encysted stage by sheep (or other suitable host) completes the life cycle. The fresh-water snails mentioned are common inhabitants of wet places, the sides of ditches, pools, etc., particularly on clay soils.

The season of the year during which sheep may become infested is generally believed to be the late summer and autumn months, but it extends into the winter in wet open seasons. The period which elapses between the picking up of the encysted stage and the development of the fluke to egg-laying maturity does not appear to have been carefully investigated hitherto. As a result of certain preliminary

* In this paper, liver rot of sheep is limited in its application to cover only disease due to infestation with *Fasciola hepatica*. Infestation by *Dicrocoelium dendriticum* appears to occur only rarely within the British Isles, and the writer has had no opportunity of studying its control.

observations, the writer believes that this phase of development occupies a period of about ten weeks. We may assume, then, for the purposes of control, that flukes picked up during the late summer will mature to the egg-laying stage early in October, and that those picked up later will have matured by April 1. Future work may necessitate a modification of this view which is simply accepted as a working hypothesis.

It should be noted that cattle and rabbits may be infested with flukes and become, therefore, distributors of eggs. Considerable numbers of cattle harbour flukes without showing marked evidence of disease. During liver rot epidemics, many rabbits die in affected areas as a result of infestation, but the writer believes that, in the great majority of cases, their death occurs before the flukes have reached the egg-laying stage. It is very probable that cattle and rabbits play a much smaller part in the distribution of eggs than do sheep.

General Principles Applicable to the Control of Liver Rot.—

(1) It is obvious that sheep and cattle should be kept away from land on which they may become infested. Very often this is impossible, and the fluke must be attacked at vulnerable points in the cycle of its life history.

(2) Since the fresh-water snails, mentioned above, must be available before the liver fluke can multiply and spread, steps may be taken to destroy them.

(3) Attempts may be made to destroy the fluke within the sheep and other hosts, thus preventing the distribution of eggs and the propagation of the parasite.

It will be appreciated that any or all of these principles should be applied wherever possible. The third necessitates the use of anthelmintic drugs and success will depend on the efficiency of the system of dosage adopted. It must be realized also that such dosage must be comprehensive and not limited to any group or species in a community of infested animals. Investigations have been concerned, chiefly, with the practical application of the second and third principles mentioned above.

APPLICATION OF THE GENERAL PRINCIPLES ENUNCIATED ABOVE

(1) **Avoidance of Infestation.**—Since the earliest days, it has been recognized that low-lying damp land, especially on clay soils, is "dangerous" as regards fluke infestation. Undoubtedly the loss caused by liver rot has been minimized by

keeping sheep from such land. This precaution, which greatly reduces the value of so many grazings and renders others valueless for sheep, cannot, however, be widely observed. It may be possible, by means of fencing, to cut off small dangerous portions of fields which are otherwise sound. Fencing-out has been adopted with a certain degree of success, but, obviously, this is a method which can only be applied on a limited type of grazing.

(2) **Destruction of the Snails.**—(a) *The Value of Certain Birds.*—Certain birds, ducks and lapwings in particular, make fresh-water snails part of their diet. Where practicable, flocks of ducks may be given free range over damp pasture and the lapwing should certainly be protected.

(b) *The Value of Drainage.*—Efficient drainage has been recognized as, perhaps, the best method of reducing the number of snails on any pasture, and it will be generally agreed that drainage is the greatest need of large areas of land in these islands. Certainly the prosecution of many drainage schemes is costly and each field presents its own particular difficulties of levels and outflow, but, quite apart from the opening up of new drains, proper attention to existing waterways can considerably increase the value of many pastures and, incidentally, reduce the number of snails on the adjoining land. On many occasions, the flooding of an area of land in the vicinity of a partially-blocked ditch or drain, or a ditch whose sides have been broken down, has been responsible for the infestation of many sheep. If ditches are cut with straight or steep edges, and thereafter kept clear and the edges attended to, a reduction of the number of snails within that area may readily be effected.

(c) *The Use of Copper Sulphate.*—In the search for a substance which would destroy the snail, without spoiling the pasture or rendering it dangerous to stock, lime, salt and other materials were given a trial. None of these proved of value, but the discovery that very dilute solutions of copper sulphate are particularly inimical to fresh-water snails opened up new possibilities. At the suggestion of Daubney, Walton made his first tests with copper sulphate, under field conditions, in 1921, continued his work in 1923 and, in conjunction with Jones, further extended it during 1925.

These researches have convincingly shown that the proper application of copper sulphate is a cheap and practical method of wiping out the snail population of the area covered. The sulphate has been employed in three different manners.

Solutions may be sprayed over the area by means of a machine; either one of the large horse-drawn implements used to spray potato crops or to destroy charlock, or by one of the "knapsack" type employed by horticulturists. The strength of solution selected depends on the nature of the area to be sprayed. On fairly dry land, $\frac{1}{2}$ per cent. solution should be liberally applied that the whole area may be thoroughly wetted. On partially flooded land solutions of 1 per cent. or 2 per cent. should be used to allow for the further dilution which must occur before contact with the snail is effected. A smaller quantity per acre would suffice in this case. The amount of solution must also vary with the degree of protection afforded by herbage, being greater where the grass is long. Walton found amounts varying from 80 to 137 gallons per acre sufficient. Sprays may be used under a variety of conditions but the rather general absence, in affected districts, of suitable apparatus limits their use.

As a dust, one part of finely-ground copper sulphate to four parts of china clay, an efficient dressing may be applied to small areas—the sides of ditches, etc.

The broadcast sowing of finely-ground copper sulphate mixed with dry sand appears to be an admirable mode of application. Walton and Jones found mixtures of four and of eight parts of sand to one of the sulphate efficient when sown at the rate of $1\frac{1}{2}$ and $2\frac{1}{2}$ cwt. per acre respectively. These broadcast mixtures appear to be applicable to all types of "danger" spots and areas.

Copper sulphate dressings may be applied at any season but, very probably, their use during the month of June will be attended with greatest advantage. After an application, a careful watch should be maintained to determine whether snails have re-entered the area by migration or by carriage in water. Norris has shown that sheep may be allowed to graze sprayed pasture after seven days. Following a dust or broadcast application, it appears advisable to keep stock from the treated land until rain has fallen.

Despite the fact that more than four years have elapsed since the value of copper sulphate was demonstrated, it cannot be said that this method is widely used to control the ravages of liver rot. It would appear that one reason for its partial failure to meet the case is that, at the season of the year when the use of copper sulphate is attended with most advantage, the stimulus of being face to face with the disease is absent. Few farmers can be made to consider and apply active control

measures during the summer months. As the season during which they frequently experience loss approaches, their thoughts may more easily be directed to the control of the disease.

(3) **Destruction of the Liver Fluke Within the Sheep and Other Mammal Hosts.**—(a) *The Use of Carbon Tetrachloride in Sheep.*—Investigations directed towards the finding of a drug, which might be used in the destruction of the liver fluke infesting sheep, received relatively little attention, so far as these Islands are concerned, until the severe outbreak of 1920–21. Then a proprietary preparation of male fern named "Danistol" was introduced from abroad. Sold in carefully-regulated doses ready for administration it gained favour as an efficient remedy.

Liquid extract of male fern B.P. had been little used within the British Isles until its value was investigated during 1924–25 by the writer and by Norris. These researches showed that the drug could be employed provided reasonable care was exercised. During its extensive use that season, it was evident that certain factors affecting its toxicity were not properly understood and required investigation. Further work indicated that one factor was the age of the extract. Freshly prepared material is much more dangerous than old.

Experiments conducted at this centre during 1925–26 showed that pure carbon tetrachloride was highly efficient and very safe. The efficiency of dosage with 1 c.c. was established, and sheep, in the advanced stages of liver rot, tolerated perfectly doses as large as 50 c.c. While this investigation was in progress, Norris, in Ireland, was working along similar lines. He did not have opportunity to pursue his research very far but obtained evidence of the efficiency and safety of the drug.

It must be noted that the efficiency of these drugs is limited, for it has been shown that they only destroy those flukes which are approaching maturity to the egg-laying stage, and those actually mature. Certain less mature forms escape. Thus, sheep which are infested with flukes in various stages of development cease to pass eggs following dosage but, at the earliest, four weeks after treatment, eggs reappear in their droppings.

We must compare the apparent value of these three preparations—"Danistol," extract of male fern, and carbon tetrachloride—particularly from the points of view of efficiency, safety and economy, and select the most suitable. All have demonstrated high value in destroying mature, and most mature, flukes, and each has failed, in a degree at least

approximately equal, to destroy less mature forms. "Danistol" is acknowledged to be "safe." Extract of male fern has a safety factor too small to permit that degree of error which is liable to creep in when large numbers are treated. The range of safety when carbon tetrachloride is employed is so wide that this drug may be used with confidence. The cost of "Danistol" places it at a serious disadvantage and discourages considerably its use to "treat," let alone to "control," liver rot of sheep. The cost of extract of male fern is much smaller, but considerably greater than that of carbon tetrachloride, which involved the expenditure of but one or two pence per head each treatment. It may be added that the employment of carbon tetrachloride necessitates dosage on one morning only, whereas each of the other drugs must be administered on two consecutive days.

It is evident that carbon tetrachloride is by far the most valuable drug. Eminently suitable for the dosage of large numbers of sheep at intervals, it provides a means to kill all the flukes infesting even large flocks before they reach maturity to the egg-laying stage, thus preventing the distribution of eggs and the spread of liver rot.

The administration recommended is a single dose of 1 c.c. of pure carbon tetrachloride in soft gelatine capsule. It is the writer's practice to prepare the sheep for dosage by removing them from pasture in the late afternoon of the previous day. This preliminary period of starvation may, however, be omitted, as it does not appear to affect the efficiency of the administration. In either case the sheep may be sent to pasture immediately after the capsule has been given. This mode of treatment has been found efficient for sheep up to 140 lb. weight, and it is probable that its range of efficiency is much greater. Since this dosage destroys only those flukes which are mature or approaching maturity, it is necessary to redose after a period. Then those flukes which previously escaped, and have in the interval reached a stage of development at which they may be assailed by the drug, will be destroyed. The evidence at present available indicates that this interval should be one of about four weeks. Dosage of a flock at monthly intervals during the season when flukes may mature would, therefore, prevent the deposit of eggs on the pasture.

The extent to which this drug is employed in future years to prevent the outbreak of epidemics of liver rot must depend upon the realization by farmers in those districts which are menaced by the disease of the feasibility of materially reducing

by one simple measure their current loss from the disease and at the same time lessening its future incidence.

It must be realized that each administration to an affected sheep of an efficient drug is, in itself, a general control measure apart altogether from the treatment aspect. Such administration decreases the number of eggs which are distributed, decreases the opportunity for snail infestation and, therefore, the chance of stock becoming infested with flukes. In addition to those members of a flock which show evidence of infestation, it must be remembered that many others, if not all, are likely to be harbouring flukes and distributing eggs. *These considerations make it obvious that mass treatment (dosage of whole flocks, not of individual sheep) should be adopted and that such treatment is a means of control. The tendency to dose only the obviously affected sheep of a flock should be combated by pointing out the great advantages of mass treatment. The low cost of carbon tetrachloride makes this mass mode of treatment very sound economically.*

The actual system of dosage adopted must depend upon several conditions relating to the incidence of the disease and the opportunities for the collection of sheep on each individual farm. On the great majority of those farms which regularly have small losses, and frequently large ones, it would be advisable and easily practicable to dose every sheep at monthly intervals each year, commencing at the beginning of October and ending early in April. Under such a system the farmer might be assured that his loss from liver rot (other than from "acute" cases, which must soon disappear where such a system is practised) would be cut out. Each year, fewer and fewer snails would have opportunity to become propagators of the disease. He might well look forward to the time when dosage at such regular intervals, at least following normal summers, would be unnecessary.

Following wet summer seasons, dosage at monthly intervals should always be carried out on farms which suffer any loss from liver rot. There may be seriously menaced farms on which difficulties of collection or other considerations make it reasonable to vary the system after normal seasons to dosage at intervals of two months. On less seriously affected farms, it might be reduced to dosage on two occasions, probably once early in December and again in March.

When the existence of liver rot is detected in a flock, every member should be dosed at once, and this treatment repeated at monthly intervals until the whole of the original infestation

has certainly been cleared. If, after diagnosis, opportunity for infestation still exists, the monthly administrations should be continued until April.

(b) *The Use of Drugs in Other Animals.*—The study of the value of drugs in the destruction of liver flukes infesting cattle has not reached the stage which will permit the recommendation of systems of dosage comparable with those recommended for sheep. Norris found certain doses of male fern of value, and "Danistol," given in the doses recommended by the manufacturers, also appears an efficient remedy. Carbon tetrachloride appears to be rather a dangerous drug for cattle and cannot, at present, be recommended.

The prevention of the scattering of eggs by infested rabbits must be attempted along different lines. We cannot induce them to come to a fold for periodic dosage! Ruthless destruction must be advised and should be practised.

Summary.—From the earliest times, disastrous epidemics of liver rot, such as those of 1879–80, 1920–21, and 1924–25, have caused widespread and serious loss to British flockmasters. In many districts, loss from this disease occurs even in normal seasons, and even though the *proportion* of sheep affected may not be large the *total annual loss to the nation* is serious.

Although there are still gaps in our knowledge, it is now possible to recommend satisfactory measures, not only for the treatment of affected sheep, but also for the prevention of infestation and for the control of the disease, which if generally adopted would remove the pest from the list of serious menaces. These recommendations are discussed in the foregoing pages and may be summarized as follows:—

- (1) Keep sheep from land which is, or is likely to be, infested with the snails which act as the intermediate host of the common liver fluke.
- (2) Drain wet land and open up ditches, keeping their sides as clean and vertical as possible.
- (3) Protect such birds as the lapwing.
- (4) Dress snail-infested land with copper sulphate.
- (5) Administer carbon tetrachloride to sheep under a system which will prevent loss from the disease and also diminish or even prevent the distribution of eggs of the liver fluke.
- (6) Keep down rabbits and have infested cattle treated.

Particular consideration has been given to two of these recommendations, the fourth and fifth stated above. Carbon

tetrachloride must not be regarded simply as a drug of value in the treatment of sheep obviously affected with liver rot. It has a much higher value, and should be employed to reduce or eliminate general infestation, both current and future. It is now the duty of all interested to aid the application of the measures, recommended by those engaged in the study of the control of this disease, that the disastrous results which must, otherwise, follow in the wake of future wet summer and autumn seasons may be avoided.

Postscript.—Since the above was written, observations on the use of carbon tetrachloride in the "treatment" of some 20,000 sheep, located in many counties in these Islands, have been made and reported to the writer. *The dosage recommended (1 c.c. of carbon tetrachloride) has caused the death of sheep in certain flocks fed on artificial food or folded on special crops.* Excellent results have been obtained with sheep grazing natural pasture, and the administration of very large doses to such sheep has produced only transient effects. Until further investigation has explained this remarkable difference it is advisable to dose only a few representative members of the flock, particularly if not on free range, in the first place. Should these subjects show no illness, dosage of the whole flock may be undertaken with safety. If, however, the administration has caused serious illness in any of these sheep, a preparation of male fern should be employed.

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EMPIRE MARKETING BOARD ADVERTISEMENTS: POSITION OF HOME PRODUCE

THE advertisements issued by the Empire Marketing Board are attracting considerable attention. The general policy of the Board in this matter is to sensitize public opinion in favour of the purchase of Empire foodstuffs, first of home origin, when supplies are available, and then from overseas. Following representations made by the Ministry in regard to the direct advertisement of home products, five of the nine advertisements in the series inserted by the Board in leading popular newspapers during the months of June and July were devoted exclusively to home products; three dealing with milk and dairy products are here reproduced. It will be seen that Great Britain is now receiving an appreciable share of attention in this branch of the Board's activities.

For obvious reasons, a particular brand of any commodity cannot be advertised from Government funds unless it has national status and significance. The Ministry, after consultation with the National Farmers' Union, has secured the sanction of the Board to the principle that where an organization is open for membership to all producers of the commodity concerned and exercises an efficient measure of control over grading, packing and marking, it is proper to make mention of its brand or trademark in appropriate advertisements issued by the Empire Marketing Board. The British Glasshouse Produce Marketing Association and the Cheshire Cheese Federation fulfil these conditions, and their trademarks are specifically mentioned in two of the advertisements referred to.

Other special steps on behalf of home produce include the release of a very large coloured poster, of a simple and direct character, in favour of English soft fruits and salads; other posters are in course of preparation.

Within recent years, advertising has become a tremendous force in selling. Indeed, it is said in the business world that he who advertises succeeds; he who does not is advertised by the Official Receiver. Looking away from the individual, the task before British producers, as a whole, is clearly that of directing active demand to British produce in the British market. The spur of advertising cannot, however, give best results, and may even be ineffective, unless applied to the sale of standardized and branded goods. This has been duly realized by producers of glasshouse produce and of Cheshire cheese; it is for home producers generally to devise ways and means of following the lead thus given.

FROM THE HOME FARMS

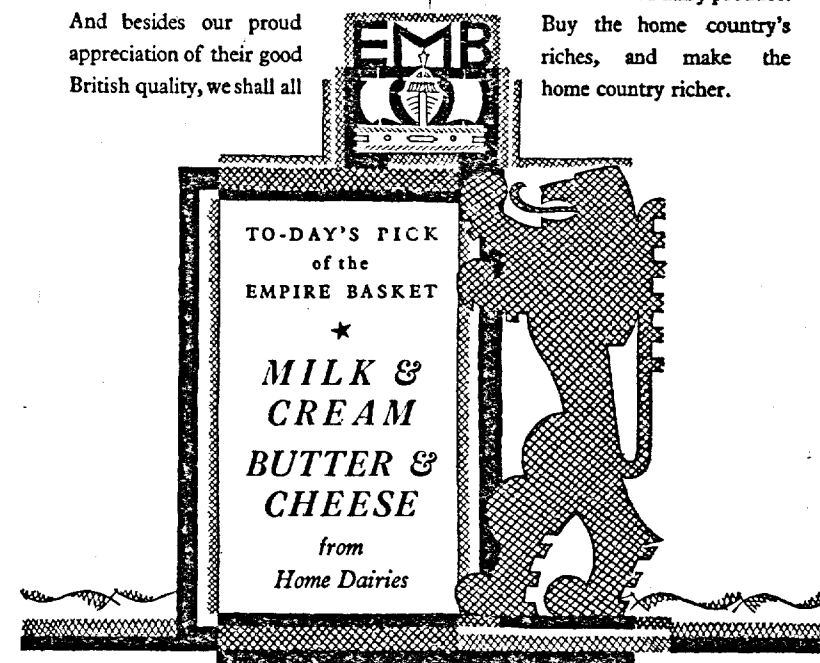
"Home-grown," "home-raised," "from the home farms"—there is no country in the world in which these phrases carry so strong and immediate a suggestion of high quality as in our own. And rightly so. What could be fresher or richer or cleaner than the butter and eggs, the milk and cheese and bacon that come to us from the farmlands of these islands, out of cool, clean dairies anywhere from Kent to County Derry, from Cornwall to Caithness?

And besides our proud appreciation of their good British quality, we shall all

of us be showing sound business common-sense if we give a thought to the story behind them. For farming is still our biggest industry, and by many centuries our oldest. Seven acres out of every ten in this Kingdom are farmlands; and on these acres far more than a million people earn their living by feeding us.

Ask for the food grown by your home folk. Enjoy the true British goodness of home-raised dairy produce.

Buy the home country's riches, and make the home country richer.



BUY EMPIRE PRODUCE

from Home and Overseas

ISSUED BY THE EMPIRE MARKETING BOARD



TO-DAY'S PICK
of the
EMPIRE BASKET

★

MILK
from
HOME DAIRIES

Give the family more milk and it will be just as good as giving them more sunshine. Among all the different kinds of food—meat, fruit, vegetables, bread—milk stands alone and by itself—the one perfect food. It contains, perfectly blended and balanced, something of everything that is needed for bodily warmth and weight and strength and growth.

Now, in the height of summer, all over Great Britain, the cows are out on the pastures, cropping the sweetest, tenderest grass that grows anywhere on earth. British milk, the richest in the world, is at its best.

Drink more Milk

BUY
EMPIRE PRODUCE
from Home and Overseas

ISSUED BY THE EMPIRE MARKETING BOARD

**THE MEN
TALK AND TALK, BUT—**

When Mrs. John Bull goes out to fill the larder, she carries in her purse a power that sets men working for her all over the world. There are ten millions of Mrs. John Bull—and because she must buy food for her family, farmers till the soil of a hundred countries, ships move in their thousands, wheels in their millions turn. She stands at the counter, and the

power in her purse begins to work; for the farmers dare not grow the food, nor the ships carry it, unless she—and the ten millions like her—will buy it. "No," she says—and somewhere an industry falters. "Yes," she says—and rich fields are turned by the plough, new factories tower into the sky. "Empire, please!" she says—and a great Empire takes on new strength.



TO-DAY'S PICK
of the
EMPIRE BASKET

★

**MILK &
CREAM
BUTTER &
CHEESE**
from
Home Dairies

BUY EMPIRE PRODUCE
from Home and Overseas

ISSUED BY THE EMPIRE MARKETING BOARD

A CENSUS OF AN ACRE OF ROOTS

THE RELATION OF REGULARITY AND DENSITY OF PLANTS TO YIELD PER ACRE

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Introduction.—It has always been recognized that the yield of any particular crop depends to a certain extent on the density and regularity of the plants on the ground. Thus, the inspection of fields of wheat in the spring may lead farmers to express the opinion that the crop in one case is too thin, in another too thick and, in still another, too patchy; and that the harvest results will be proportionately affected. In extreme cases, it may be decided that the prospects do not justify leaving the crop till harvest, and it is accordingly ploughed up. Such conclusions, whether with cereal or root crops, are arrived at as the result of experience, but it must be admitted that actual yields do not always confirm earlier pronouncements. There are, however, degrees of plant density, and of variation in density from place to place, which cannot be appraised by the eye; such differences are either unnoticed or taken for granted. The extent and effect of these have recently been determined by Engledow in the case of the wheat crop, and the principles on which these investigations were based are equally applicable to other crops.

With roots a great deal of interest has centred round the question of their most profitable spacing in the field. Seed rate, distance between rows, and interval between plant and plant in the row, have proved to be of great practical importance. It is generally recognized that with roots, as with corn and other crops, the average size of a single plant becomes less as the number of plants per acre is increased. Thus, to get the maximum possible yield from an acre, the plants must be so spaced as to give the most favourable combination of root size and number of plants to the acre. General discussion of this subject has naturally been in terms of "averages." To say, however, that the average weight of a beet for a ten-acre field is $1\frac{1}{2}$ lb. is to say very little about the actual state of affairs in the crop. Altogether, apart from distance between rows and plants and average size of a single root, there is a separate "spacing" problem of immediate practical interest.

This problem may be grasped without difficulty by walking up one of the rows in a field of roots at any time between

singling and harvest. The row may be roughly spaced out into equal lengths of about a yard by placing a walking-stick on the ground at a number of places and counting the number of roots on each of these equal lengths. In the first yard, four beets may be found, in the next, two; in the rest, five, and so on. Occasionally there will be found a yard-length with no plants at all. This may be where the horse hoe ran out and cut away the plants or where there were blanks from the start due to irregular seeding. Such a state of affairs leads one to ask what is the effect of such irregularities on the yield per acre. On the average, will a yard with five plants yield more than one with three plants or one with four plants? If we could grow beet or mangold crops with plants absolutely regularly arranged at two to the yard, or three or four, etc., this question might soon be answered. But, in practice, rigid regularity is never attained. There are always some places where the plants stand unusually thick, always some which are unusually thin, and always some blanks. What we require to know is the relative proportions of the thick, thin, and empty places in a typical field crop.

To appreciate these considerations fully it is essential to think of a field crop as made up of a vast number of small lengths, say yard-lengths, of rows. With plants in rows at 22 in. apart, and a cost of, say, £20 to be borne in growing an acre of sugar beet, there will be a charge of approximately one halfpenny to be debited against each yard-length. An acre of such rows may be looked on as made up of several thousand separate yard-lengths and the final result, in yield per acre, is the sum of the weights obtained from each of these units. On the one hand, the expenditure per unit is the same, on the other, the return per unit may show considerable variation. It is, therefore, desirable to know how many of the component lengths give the fullest possible crop, how many give no returns, and so on.

Sugar Beet.—The experiment to be described was made on a typical field of sugar beet at the Herts Institute in 1926. The soil shows considerable variation over the field and consists of veins of gravel, loam and clay loam which run across the rows. The ground was subsoiled, dunged and a complete dressing of artificials applied before seeding. Seed was sown on April 22 at the rate of 20 lb. per acre on the flat; the rows were 22 in. apart; the crop yielded just under 12 tons of washed beet per acre.

For a perfect test of the matter under discussion it would be necessary to divide a whole area into yard-lengths of row,

count the plants on every yard, and finally weigh the produce from every yard. This very big task may be reduced by drawing "sample lengths" in an approved way. Such a sampling procedure has been employed on crops of wheat* and barley,† and was adopted in the case of the beet crop under investigation. Counting was carried out before singling, after singling, and at harvest. The counts give a measure of the "plant population" of the crop much as, when a "census" is taken, the distribution of the population of the country is determined.

The Plants before Singling.—As sown, the plants stand very close and it was necessary to count them on sample lengths of one foot of row. For the whole area, the average number of plants per foot was twelve, i.e., the average spacing was one plant to every inch. This average value, however, does not disclose two interesting facts brought out by the counted samples. The average thickness of the plant was by no means the same for different rows. Thus on one row there was an average of eight and a-half plants per foot, on another fourteen plants. From what is known of common drill defects, it may probably be assumed that the difference was brought about by two spouts of the drill distributing seeds at very different rates. Where, as in sugar beet, regularity of plant is very important, the need for an improved drill deserves attention.

More important than average differences between two rows was the irregularity of the plant from point to point of the field. On some one-foot lengths there were two seedling plants, on others twenty, on others six, and so on. By aggregating all sample foot-lengths containing the same number of plants we may perceive what proportion of the whole area carried plants at the rate of two per foot, or six per foot, or thirteen per foot, and so on. It will be realized that all the lengths with, say, seven plants per foot were not situated close together but scattered over the field.

The "make-up" of the area before singling was in round terms as follows :—

					Plants per ft.
On an aggregate of one-fifth of the area there were from					0 to 6
"	"	"	"	"	7 to 10
"	"	"	"	"	11 to 14
"	"	"	"	"	15 to 20
"	"	"	"	"	21 to 49

* Engledow, F. L. : "A Census of an Acre of Corn," *Jour. of Agric. Science*, Vol. XVI., 1926.

† "A Census of an Acre of Barley," *Jour. R.A.S.E.*, 1927.

Thus a "plant" of beet, pronounced eminently satisfactory from the farmer's point of view, proved, on examination, to be extremely irregular. Similar results have been obtained with corn crops, irregularity in seeding being largely responsible in each case. Imperfections in the drill, in conjunction with unevenness in the seed bed, are doubtless the two main causal factors. Without attaching special importance to the figures, we may conclude that this field of beet, though presenting a pleasing appearance to the "practical" man, had in reality a very irregular distribution of plants. Observations suggest that beet crops in general are no less irregular.

After Singling and Horse Hoeing.—At this stage, the length of row sampled was 9 feet, and the figures to be given were based on 200 such samples. In no crop should the final regularity of the plants be greater than in sugar beet, for great care is exercised at all the stages, including singling.

For the whole area there was an average of 7.7 plants per 9 feet, i.e., an average spacing of 14 inches between plant and plant. As before, two important kinds of irregularity were found. For one row of plants the average spacing between plant and plant was 12.8 inches; for another row it was 15.6 inches, and so on. This difference must probably be set down to the difference in judgment of two men engaged in singling. It is significantly great, and suggests the need for precision in singling. Presenting the area in five roughly equal aggregates as before, it may be said that the following distances from plant to plant were about equally common over the whole area :—

From 54 to 18 inches; 15½ inches; 13½ inches; 12 inches; from 11 to 8 inches.

The singled crop was thus decidedly irregular. To decide how far horse hoeings were responsible for gaps and irregularities, separate counts would have to be made after each hoeing, and this will be done in future investigations. It is interesting to note that the "doubles" (two plants at one point) amounted to 10 per cent. of the total number of plants. This statistical result deserves special mention as more than ordinary care was taken in singling, and farmer visitors commented most favourably on the success attained in this respect. Apparently a much higher standard of efficiency could, with advantage, be aimed at.

At Harvest.—As the season advanced, the crop presented a very attractive appearance, although one could not but notice the spectacular display made by a number of roots

which had run to seed. The counts, however, proved that appearances were deceptive as only 3 per cent. of the roots had bolted.

The number of roots actually lifted averaged 7.5 per 9 foot length—a very small reduction on the number present after the last horse hoeings. At individual points on the field the number varied from 2 up to 11 per 9 foot length. For simplicity we may group the number from 2 to 11 in pairs, and consider what proportion of the field carried 2 or 3 plants per 9 foot lengths, what proportion 4 or 5, and so on; and, in addition, the average size of the beet and the rate of yield for these separate proportions of the whole area. Table I presents the facts.

TABLE I.—SUGAR BEET

Number of plants per 9 ft. length	Approximate distance from plant to plant	Aggregated proportion of field	Average weight of a root (lb.)	Equivalent yield per acre (tons)
2-3	43 in.	2 per cent.	2.6	8.6
4-5	24 "	10 "	2.1	11.5
6-7	16 "	28½ "	1.9	14.6
8-9	12½ "	49 "	1.5	15.1
10-11	10 "	10½ "	1.4	16.1

On these figures, the average yield for the whole area is 14.6 tons and the average weight of a single beet is 1.65 lb. The yield as determined by weighing 16 plots, each one-twentieth acre, straight off the field proved to be 16.4 tons per acre. The difference between the two yields is doubtless due in large measure to the fact that the roots from the "sample" lengths were partially cleaned before being weighed.

No serious attention can be paid to yields at the rate of 8.6 tons from 2 per cent. of the area and 16.1 tons from 10½ per cent. of the area, as these represent small proportions of the whole area. It may, however, be suggestive that the yield per acre rose rapidly up to a certain density of the plants on the ground, and thereafter very slowly. On this supposition, only 12 per cent. of the area, namely, that portion with from 2.5 plants per 9 foot length, was substantially less productive than it should have been through lack of plants.

From the results obtained in this investigation there is one general inference which is justifiable. As the distance between plant and plant diminishes, the average weight of a single beet also grows less; but the number of beets per acre naturally increases. As the figures show, there

is a steady increase in rate of yield with lessening distance from plant to plant. This is the fact of immediate practical importance. It suggests that in this crop of beet—and possibly in many others—a bigger yield might have been obtained by ensuring more plants per acre. With plants uniformly at 12½ in. apart over an acre, the yield would have been 15.1 tons instead of 14.6 tons. The difference—half a ton—is not to be despised in a valuable crop like sugar beet. Moreover, most growers would probably consider 12½ in. unduly far apart for beets. The figures suggest that with plants uniformly at 9 in. or even 10 in. a yet greater increase in yield might result.

Probably also, had a shorter length been used from which to take the samples, i.e., less than 9 ft., it would have been found that the gaps and irregularities were greater than the numbers given suggest. It is broadly true that small and mid-sized roots have higher sugar percentage than the larger ones. To illustrate this point three samples of roots, 50 in each, were sorted out according to size and analysed with the following results. The analyses were kindly made by the Rothamsted Experimental Station.

Average Weight of Roots	Percentage of Sugar
3 lb.	18.0
2 lb.	18.7
1 lb.	19.1

Thus, it seems possible that the closer spacings may not only secure a heavier crop but also a higher percentage of sugar.

With rows 22 in. apart, a distance of 9 in.-10 in. from plant to plant would probably be regarded as satisfactory by most growers. This investigation suggests, however, that in practice the desired 9 or 10 in. is considerably exceeded, with consequent reduction in yield. In considering the spacing of beet, and, indeed, of all field crops, it is not only important to think in terms of averages, but also in terms of the many short lengths of plant row by which a field is made up. This mode of thought is particularly necessary in trying to ascertain how seed-bed preparation, sowing, singling, and hoeing may be so governed as to populate an acre evenly with that number of roots which will ensure the maximum monetary return.

Mangold and Marrow-Stem Kale.—A similar investigation was made on a piece of mangolds, adjoining the beet described above and similarly treated and manured. The rows were again 22 in. apart, but the rate of seeding was 8 lb. per acre. Before singling, the average number of plants per foot length

s found to be 4.6 compared with 12 in the beet crop. Or approximately equal (one-fifth) part of the area, the following numbers of seedling plants were found:—

0-1; 2-3; 4-5; 6-8; 9-21.

It is apparent that, on at least two-fifths of the area, the plant "was very thin (not more than three plants per foot). After singling and hoeing, irregularities were found corresponding to those described for beet. In the case of the beet out 50 per cent. of the area had roots at the rate of 8.9 or 9 foot of row, while the corresponding figure for mangolds is 6 to 7. The average distance at harvest between mangold plants was 16 in. How far the heavier seeding of the beet contributed to the greater number of beet plants per acre, compared with mangolds, is a matter for further investigation.

It is possible that the present-day stimulus to make the best of the sugar beet crop may throw fresh light on long-standing practices in the culture of mangolds.

The state of affairs at harvest will be appreciated from Table II, which may be understood from the explanation given above for Table I. Similarly, Table III gives the results of harvest from marrow-stem kale in the same field, but sown on ridges 27 in. apart and singled with less precision.

TABLE II.—MANGOLDS

Number of plants per 9 ft. length	Approximate distance from plant to plant	Aggregated proportion of field	Average weight of a root (lb.)	Equivalent yield per acre (tons)
Under 5	(say) 23 in.	25 per cent.	4.2	22.7
6	18 "	23½ "	3.4	24.0
7	15½ "	24 "	3.3	27.2
8	13½ "	16 "	3.0	28.3
9-11	11 "	11½ "	2.6	29.8

TABLE III.—MARROW-STEM KALE

Number of plants per 9 ft. length	Approximate distance from plant to plant	Aggregated proportion of field	Average weight of stem and leaf (lb.)	Equivalent yield per acre (tons)
Under 5	25 in.	20 per cent.	3.3	13½
6-7	17 "	30 "	3.41	21
8-9	13 "	30 "	2.93	24
10-11	10½ "	18 "	2.58	26
12-14	8 "	2 "		

The yield for mangolds and marrow-stem kale, calculated from these figures, is 25.7 tons and 21½ tons respectively. The whole of the mangolds and kale from a measured area (about two acres of each) were weighed as they were clamped or carted to the stock, and these weights indicated a yield of 27 tons per acre for mangolds and 21 tons per acre for the kale. Reasoning in the manner adopted for the beet figures, it may be inferred that, with the plants uniformly at 11-12 in. apart, and with no gaps in the rows, the yield of both crops might have been raised by about five tons per acre.

In viewing the results of any agricultural experiment, an important reservation must be made. On a different soil and in a different season, the results also might have been different. But our concern here is not the detail of the actual figures. There are two essential points of interest. First, that in root crops grown with care in the customary manner, the plant is highly irregular. Then, as a consequence of this, the actual yield falls significantly below the maximum possible for the land and the year. Published results from investigations on fields of corn reinforce these contentions in principle. It would appear from the results described that a full regular population of plants at a suitable spacing interval is worthy of special effort in fields of beet, mangolds, and marrow-stem kale.

For help and guidance in presenting the above results, the authors wish to place on record their most grateful thanks to Mr. F. L. Engledow, of the School of Agriculture, Cambridge.

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OBSERVATIONS ON SUBTERRANEAN CLOVER

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SUBTERRANEAN clover (*Trifolium subterraneum*) has, during the past decade, become an important plant in the economy of Australian grassland farming: its culture has been the subject of numerous observations, and a considerable amount of literature, having an important practical bearing thereon, has recently been published. Since 1920, its behaviour has been under continuous study at the Welsh Plant Breeding Station, where it has, in many ways, proved to be a plant of great interest.

The present paper is divided into two distinct parts: the first reviews in a general way some of the more important

Australian and other literature dealing with the agronomic culture of the clover; the second deals with results obtained at the Plant Breeding Station in the course of the last two years. The behaviour of this species during the earlier trials, viz., those of 1920-24, has already been reported upon by Stapledon and others (11, 15, 16).*

Description of the Plant.—Subterranean clover is a prostrate, softly hairy annual. The leaf has three heart-shaped leaflets and is on a fairly long stalk, the leaflets themselves being almost sessile. The two stipules at the base of each leaf stalk are roughly ovate with a short blunt tip. Both leaves and stipules are often flecked with red.

The flowers are white or pinkish, there being from 3-5 flowers in the head; each fertile flower gives rise to a single seeded pod. The flower stalks arise from the junction of stem and leaf, and at flowering time are shorter than the petioles, bearing individual flowers. After fertilization, however, they lengthen and become positively geotropic, turning down into the surface soil; it is this characteristic burying of the seed which has given rise to the name subterranean clover. Fibrous outgrowths are at this time developed at the base of the calyx and serve as "anchors" for the seed head, probably also assisting in pulling the head into the soil.

A single plant of subterranean clover is, under good conditions capable of spreading along the ground in all directions, producing a dense mat of leafage covering a circle 3-4 ft. in diameter, whilst individual runners may in extreme cases attain to a length of 6 ft. Under sward conditions the plants are normally smaller, but are invariably dense about the centre and flower most freely along the margin of the circle. The runners seldom, if ever, strike root at the nodes as in the case of white clover.

PART I

Review of Literature.—Subterranean clover is according to Stokes (12) of European or of South Asiatic origin. It is said to grow wild as a roadside plant in many parts of Europe, and in Britain is fairly widespread, but by no means abundant, occurring on many thin dry soils and on poor swards. The British variety seems to be a smaller and less vigorous plant than that grown from Australian seed, although it is not known how far this may be due to a difference in strain, and how far to general ecological factors such as soil and manurial treatments. The Australian variety seems to have been

* Numbers refer to bibliography at end of the article.

originally derived from Europe, having been imported into the Commonwealth as an impurity in agricultural seeds. So far as is known the introduction took place during the latter part of the nineteenth century, being recorded in Victoria as a naturalized alien in 1887-88.* At first the plant was considered useful only as a suppressor of undesirable annuals but during more recent years it has become better known and is now regarded as an important pasture plant. It is widely grown on the main coastal vegetation belt of Western Australia, South Australia, Tasmania, Victoria, and New South Wales. Deem (4) has reported that he did not find the clover growing in New South Wales or in Queensland, but its culture has already been begun in the former country, as is evidenced by the writings of Whittet (14).

Agricultural Value.—Subterranean clover is claimed to be the most valuable plant in Australia on almost every soil type where the annual rainfall is above 20 inches. It attains its greatest relative value, however, on second-class land and on hilly or stony ground; Mullett (7) expresses the view that on first-class land it may oust both alsike and white clovers species that he considers superior to it. Subterranean clover yields abundant and palatable pasturage, and according to Brunning (3) produces hay of a valuable kind. Palatable to both cattle and sheep in the green succulent state, Deem (4) and Brunning (3) claim that stock will eat and thrive on the old stems and unburied seed heads after the leafage has died down.

Much of the Australian literature emphasizes the weed suppressing capacity of the clover, as well as its ground holding power once it has firmly established itself, Quinlan quoted by Brunning (3), considering that once established on some soil types its eradication is difficult if not impossible.

Many writers, including Spafford (8, 9), claim that subterranean clover can be inoculated successfully into old grassland without previous ploughing; liberal dressings of superphosphate appear, however, to be essential to its success.

* This information was kindly communicated to Professor Stapledon by Dr. William Laidlaw, of the National Herbarium, Victoria.

† Subterranean clover sown in 1920 on the Plant Breeding Station was found to be present, although of course in quite small quantities in the sward in 1926, having withstood two ploughings in the intervening years. This field had been ploughed up in 1921 and used as seed-production area for perennial rye-grass. It was reploughed in 1925 to be put down to a seeds mixture which was in its first harvest year in 1926.

under such conditions.* This method seems worthy of extensive trial under British conditions; such a system, if successful, would increase very materially the productivity of many of our grasslands, especially during the winter and spring months.

The value of this clover in the suppression of bracken is indicated by Mullett (7), who states that if the bracken be cut, and subterranean clover, assisted by the liberal use of superphosphate, successfully established in its place, the fern can be cleared or at least lessened in amount. If an early establishment is ensured, with a consequent rapid growth of clover, this, assisted by the trampling by stock, will help to suppress the young ferns; grazing animals will also to a large extent eat the succulent young fronds when seeking the highly palatable clover.

According to records in Australian works the total failure of this species as an economic plant would appear to occur only under the following conditions:—

(i) Where the rainfall is too low. Brunning (3) and others agree that less than 20 inches of rain per annum is too low for its successful growth. Reports from the Texas (U.S.A.) Station (5) also indicate that the clover is not a drought resister and is unable to re-seed itself when the ground becomes hard and caked.

(ii) On the heavy black soils of South Australia (10).

Seeding: (a) *Time of Seeding.*—The solution of this problem in Australia seems to be to sow before the advent of the autumnal rains; a good tilth is possible at the close of the dry season, and if sown at this time the seed will germinate readily at the first rains, establishing itself quickly and throwing up a good deal of fodder on to which stock can be turned in early spring. If allowed temporary freedom from grazing at flowering time, the plant is able to re-seed itself successfully before the dry season is far advanced. These seeds lie dormant during the dry period, germinating in the following autumn. In this manner the life cycle may be continued indefinitely, provided that the ecological and other conditions are suitable.

Experiments conducted in Texas by Leidigh (5) confirm in general the results from Australia, but show in addition that the clover remains winter green at the low temperature of 18°F. This is somewhat below our average winter temperature:

* See also footnote on p. 461.

in Western Britain, although our grass minima often fall below 20°F. (Aberystwyth), and under these conditions the plant has proved to be among the most frost-resistant of all species.

Stokes (12) reporting upon the behaviour of the plant in Florida (U.S.A.) states that autumn sowings have been successful on lowland country, but a similar sowing date applied to conditions in the pine lands of Florida was a total failure in two consecutive years. It is probable that we have here differences of climate analogous to those exhibited when British and Australian conditions are compared. In Australia an autumn sowing is the best, and it is conceivable that climatic conditions in the lowlands of Florida are of a somewhat similar nature to those obtaining in Australia and that thus late autumn sowings may be successful there. The Aberystwyth trials already reported upon,* as well as those to be discussed in the latter part of this paper, have shown that in Britain the date of sowing must be considerably earlier in the season in order to ensure the establishment of a strong plant, that is, one sufficiently vigorous to withstand the winter. Growth conditions in the pine lands of Florida are presumably more severe than the lowland conditions in that State, and hence it would seem that an earlier sowing date is necessary in order to produce well-established plants to withstand the adversity of a more rigorous winter.

(b) *Inclusion in Mixtures.*—Mullett (7) writing of conditions in Victoria (Australia) advocates the sowing of a mixture of subterranean clover with Paspalum grass (*Paspalum dilatatum*), the latter providing summer keep, while the clover can be depended upon to provide an abundance of winter fodder, the two plants being in this manner complementary to one another. Mullett also refers to the success in New Zealand of a mixture of English grasses plus Paspalum plus subterranean clover, pointing out that as the English grasses die back the resultant sward becomes dominated by the two other species. Spafford (8) has indicated that, in South Australia, a simple mixture of perennial rye-grass with subterranean clover has been successful in the production of permanent leys of high productivity.†

* See Williams and Davies (16).

† Professor Stapledon, who has recently returned from a tour in Australia and New Zealand, informs the writer that he was much impressed by the excellent swards in the Auckland district of New Zealand, consisting either almost wholly of subterranean clover and

(c) *Rate of Seeding*.—There seems to be considerable diversity of opinion as to the rate of seeding of the clover. Makin (6) advocates as much as 12 lb. per acre when sown alone, whereas Deem (4) states that the custom in the Mount Barker district of South Australia is to sow 4-8 lb. per acre of cleaned seed, using a bushel per acre of oats as a nurse. Adams (1), on the other hand, advises the use of only 1 lb. per acre in Western Australia, whilst indicating that as little as $\frac{1}{4}$ lb. per acre can be used, if very careful grazing management is undertaken during the early harvest years. Adams strongly emphasizes the necessity of only light grazing during the first season, so as to ensure that a good initial establishment of the clover with abundant re-seeding shall take place.

Seed Production.—In Australia, paddocks are put up to seed in late spring. When the seed is ripe the paddock is either horse- or hand-raked, or more recently a special harvester is used. Not more than 70 to 80 per cent. of the seed heads are gathered even by the best of these methods, and hence the same paddocks can be put up to seed season after season without harming the stand of clover. The seed is cleaned out of the heads either by first chaffing and then using the usual huller, or latterly by means of specially constructed thrashers. It is stated by Deem (4) that 300 lb. of cleaned seed per acre is considered a good yield, well-harvested seed selling on the farm at 2s. 6d. per lb. in 1925. (South Australia.)

Manurial Treatment.—Phosphates appear to be highly beneficial to the growth of the clover, various writers advocating from $\frac{3}{4}$ cwt. to 2 cwt. per acre of superphosphate, to which, in Australia, it is said to respond better than to basic slag. Spafford (10) says superphosphate is essential under all conditions in the Commonwealth for the successful development of this species. The manure may be applied in the autumn on dry soils or in the spring on wet soils, usually as a top dressing. Mullett (7) advises the application of 2 cwt. superphosphate at seeding time, followed by a biennial top

Paspalum or of subterranean clover and English grasses. The former combination, under proper management, affords abundance of both winter and summer keep—the subterranean clover having the additional great advantage of very largely preventing the *Paspalum* from becoming sod-bound. Prof. Stapledon's experience, moreover, serves to emphasize further the extreme importance of the management factor in relation to the proper establishment and utilization of this valuable clover.

dressing of 1-2 cwt. per acre, whereas Brunning (3) states that $\frac{3}{4}$ to 1 cwt. per acre is sufficient.*

Breeding and Selection.—Little attention seems to have been given to breeding work on subterranean clover, but Adams (1) claims to have distinguished at least three main forms, classified by him as follows:—

(a) *Early Flowering*.—A strain with small leaves and a high percentage of stem. The leaves have white markings, often with red flecks. This form is said to be useful in the drier areas of Western Australia, being capable of maturing and setting seed early, thus completing the vegetative period before the drought, which sets in sooner than in many parts of the Continent.

(b) *Mid-season Strain*.—This is more leafy than the last, but has similar types of leaf markings; it is said to be the one most generally grown in Australia.

(c) *Late Flowering* ("Wenigup").—This flowers about a month later than the mid-season strain and is more vigorous in growth; it can be readily distinguished by the absence of leaf markings.

Observations made on plants of subterranean clover found growing wild about Aberystwyth show that they have both white and red leaf markings, and comparisons made on 10 plants of these with 10 plants of the Australian variety, grown at the Station, have shown that the latter were not so pronouncedly leaf-marked as the former, indicating that the two lots belong to distinct strains. The following statement demonstrates the difference in degree of leaf markings in the plants studied:—

		White leaf marks	Red flecks (anthocyanin)
'Wild' ex-Aberystwyth	..	100	100
Ex-Australian seed	..	59	12

* Professor Stapledon states that cases have come under his notice in Western Australia where subterranean clover has been sown on semi-cleared land without any cultivations whatsoever, which when supported by light dressings of superphosphate have given rise to quite remarkable stands of immense value for sheep feed. He also states that since the recognition of the importance of superphosphate in connexion with the clover a considerable stimulus has been given to seed production and that the average yield of dressed seed per acre has very materially increased. This fact, together with the introduction of improved harvesting and thrashing machines, has been largely responsible for subterranean clover now definitely ranking as a really valuable herbage plant of which the seed is an important commercial commodity.

Leidigh (5) refers to "cystogamous" seeds and in at least one instance claims to have found "seed pods" attached to the root of a subterranean clover plant but without finding seeds inside the "pods."

Diseases.—Subterranean clover is fairly free from diseases, both those caused by insect and by fungus pests. In Australia occasional damage is caused by the lucerne flea (*Smynturus viridis*) and also by the pea mite (*Motophallus bicolor*). According to the writings of Mullett (7) and of Spafford (8), heavy grazing of a pasture, or the spraying of a hay crop with arsenical or other sprays, is said to be means whereby these pests may be checked. Two root diseases, root-knot and "rhizoctonia" are reported upon by Stokes (12, 13).

PART II

The Aberystwyth Trials, 1924 to 1926.—As a result of trials already reported upon by Williams and Davies (16) further plots of subterranean clover were broadcast at two sowing dates in 1924, alone and in a mixture with Italian rye-grass. Four one-twentieth acre plots were laid out as follows:—

		Lb. of seed per acre			
Date of sowing:		April 25, 1924		June 16, 1924	
Number of plot:		1	2	3	4
Subterranean clover ..	..	4	4	8	8
Italian rye-grass ..	..	—	14	—	14

The experimental area had been ploughed in 1923 and reploughed in April, 1924, preparatory to the first sowing. By June, however, the unsown half had become very weedy, thistles (*Carduus arvensis* and *Sonchus oleraceus*) being especially abundant, and this necessitated a thorough scarifying of the surface before sowing the seeds. Scarifying did not, however, kill off the thistles, whose rapid spread was facilitated by reason of the wet summer of 1924. The take and establishment of the sown seeds were, however, satisfactory on all plots, being possibly better on the earlier sown plots. All plots were lightly grazed during the autumn of 1924 and the spring of 1925, the clover in plots 1 and 2 providing more autumn keep but less spring keep in those years than that on plots 3 and 4. Sheep grazed the area intermittently throughout the early summer, and the plots were not "put up" to hay until June 6, 1925, the light hay crop being cut on June 30. The green-weight yields of subterranean clover in the hay are given in Table I.

TABLE I.—Yields of subterranean clover in the 1925 hay cut; average green weights in lb. per acre (1st harvest year)

Plot		Average lb. per acre	Relative green weights
April sown	1 Without rye-grass ..	26	0.5
" "	2 With rye-grass ..	27	0.5
June sown	3 Without rye-grass ..	5,147	100.0
" "	4 With rye-grass ..	1,812	35.2

It will be seen that plot 3 (sown in June) had the highest aggregate yield in 1925 hay, contributing nearly three times as much clover as plot 4, and about 200 times as much as plots 1 and 2 (sown in April).

The April-sown plots had flowered freely in 1924, setting some seed which had germinated, but the majority of the young seedlings were unable to withstand the winter, self-seeding being too late to ensure the production of strong plants that could withstand the severe weather. Meanwhile the old plants derived from the April sowing had died down. The 1925 hay on plots 1 and 2 thus contained only produce from the few self-sown clover plants that had overwintered successfully. These plants were, however, not vigorous enough to flower in profusion until well on in 1925, the seed being again set too late for production of strong seedlings for successful overwintering. This resulted in a still lesser amount of subterranean clover in the 1926 hay, and, judging from present appearances, there will be no plants on these plots in 1927.

The June-sown plots, on the other hand, produced plants that were capable of overwintering, giving very material keep at mid-winter and in spring. Seeding was too late for flowering to take place in 1924; thus the plants acted as winter annuals, growing vegetatively throughout the winter and flowering freely in June of the first harvest year. Seed was set which germinated in early July, again producing plants sufficiently strong to withstand the winter. The cycle was repeated in 1925-26, the buried seed germinating abundantly after the heavy rains of mid-July, 1926. In West Wales, therefore, a June sowing of subterranean clover is capable of producing plants that can act as typical winter annuals, whereas an earlier sowing has the tendency to form plants all or most of which attempt to flower and set seed during the seeding year. Sowings made about June or early July will thus produce abundant winter pasturage, and at the same time the plants may act in a way as perennials in

that they form permanent elements in the sward by means of a succession of re-seedings.

TABLE II.—Percentage yield of subterranean clover in hay.

Cut July 9, 1926 (2nd harvest year)			
Average of plots 1 and 2, April sown, 1.4 per cent.			
„	„	3 „	4, June „ 30.5 „

Counts made of the number of seedlings found on the various plots in September, 1926, when most of the 1926 seed had germinated reveal that the number of plants from the original June sowings had substantially increased.

TABLE III.—Average number of plants of subterranean clover per 10 readings (= 2½ sq. ft.) analyzed September 14, 1926 (2nd harvest year)

Plot	Number of plants				
1	..	..	..	..	2
2	..	..	..	..	2
3	..	..	..	..	475
4	..	..	..	..	958

On plot 4 an average of 958 seedlings per 2½ square feet* were counted, and this is equivalent to a seeding of upwards of 220 lb. per acre. Plot 3 had an average count of 475 plants for a similar area, equivalent to a seeding of over 109 lb. per acre, whereas plots 1 and 2 only carried an average of about two plants per 2½ square feet, representing a seeding of less than ½ lb. per acre.†

It is difficult to assign the reason for the lesser number of plants on plot 3 as compared with plot 4; in 1925 the position was the reverse (see Table I), subterranean clover being an altogether denser stand on plot 3, although this was no doubt in great part due to the larger individual plants on this plot, a fact which can be explained as being due to the competitive effect of Italian rye-grass. It is possible, too, that on plot 4 the clover was better able to establish itself from self-seeding because of bare spaces left by the dying back of many rye-grass plants.

Calculations of the percentage ground covered by leafage of subterranean clover were made prior to the 1926 hay cut, and the figures obtained are given in Table IV. These data again show the very distinct difference between the two series of plots, the clover on the plots sown in June covering on an average over 40 per cent. of the ground space, whereas

* Three quadrats were taken per plot; 10 readings by the 6 inch × 6 inch mesh being made on each quadrat.

† In these calculations the real value of the seed is assumed to be 100 per cent., the weight per 1,000 seeds (= grain weight) is taken to be 6.00 grammes, and it is assumed that every seed produces a plant (i.e., per cent. establishment=100).

only occasional plants occurred on plots sown in April, these covering no more than 2 per cent. of the ground.

TABLE IV.—Percentage ground covered by leafage of subterranean clover previous to cutting hay. Three quadrats per plot, with 10 readings (6 in. × 6 in.) per quadrat. Analyzed July 2, 1926. (2nd harvest year.)

Plots 1 and 2, April sown, 2 per cent.			
„	3 „	4, June „	41 „

To recapitulate: it has been shown that to enable subterranean clover to act as a winter annual and to enable it to re-seed itself year after year it is best sown in Wales about June. Observations made on this species, growing wild on old grassland in the Aberystwyth district, show that this also flowers and re-seeds itself during June and July, and is able to act as a permanent element of the pasture. The results relative to subterranean clover would seem to indicate that there may be an optimum date of sowing in the case of other of our winter annuals. For example, suckling clover (*T. minus*) is difficult to establish from seeding as a permanent element in grassland, and yet it almost invariably makes an unsown indigenous appearance even in the early years of the ley. It may be that in this case, too, we have still to find the right date of sowing to ensure annual re-seeding.

The use of subterranean clover as an autumn catch-crop to provide autumn keep on short-duration grassland is at the present cost of seed not an economic proposition in Britain. Moreover, such species as crimson clover (*T. incarnatum*) provide abundant stubble grazing under favourable conditions, whereas Italian rye-grass can provide valuable winter and spring fodder at a far lower outlay.

As an element of more permanent swards, however, subterranean clover may have greater possibilities under carefully adjusted conditions. Sown at the right time of year the plants will each season overwinter as strong seedlings, flowering the following year. It is essential that abundant re-seeding be assured, and therefore the swards would have temporarily to be rested for purposes of flowering and seed setting. A light hay crop could be taken off in early July and, possibly, sheep turned in afterwards to trample down any seed pods not sufficiently buried. This would seem to be especially applicable to the older swards where the herbage is densely matted, successful seed burial being more difficult under these conditions than on a more open type of pasture.

If subterranean clover can be successfully established on pastures it will very materially increase the stock-carrying

capacity of our grassland, by increasing the relative amount of winter keep as compared with that of summer. A greater head of stock per acre could therefore be kept all the year round without resort to either the "foggaging" of pastures which never seem well grazed or to increasing unduly the amount of stall feeding.

By a careful adjustment of the sowing date, the clover can produce abundant winter keep which is highly palatable to stock, comparing favourably in this respect with Italian rye-grass. Its success is, however, very largely dependent upon management and, as Australian experience would suggest, upon a liberal supply of phosphates. It may be, too, that the ecological conditions under which the Aberystwyth trials were conducted have been especially favourable to the success of the clover. The soil conditions were poor and the soil itself shallow, and it is true that the plant is found growing wild mainly on the thinner soils of the district. There seems no evident reason, however, why the clover should not succeed on more varied soil types, so long as the grazing management is correctly adjusted.

Summary and Conclusions.—Much Imperial and foreign literature dealing with the culture of subterranean clover has been under review, and the main points of interest emerging have been summarized. Observations made on the clover in the course of trials recently conducted at Aberystwyth have been discussed together with the conclusions arrived at.

A number of observations which have a practical bearing and should be of interest to British agriculturists may be summed up as follows:—

(i) Subterranean clover is said to have been originally imported into Australia as an impurity in agricultural seeds. During the last decade it has been widely grown as a valuable fodder plant, increasing the carrying capacity of much second-rate land in Australia. It does not, however, appear to be recommended for first-class lands, where it is said to check the growth of such species as white and alsike clover. Mixtures of subterranean clover with perennial rye-grass and with *Paspalum* grass (*Paspalum spp.*) have been recommended by Australian writers.

(ii) It is said that the clover will not thrive where the rainfall is below 20 inches annually. In Australia it responds very well to dressings of superphosphate; indeed, liberal dressings of this manure seem to be essential to its success in

many areas. Where conditions are suitable it seems to be an aggressive species in pastures. On the Station plots, however, it was not so aggressive as Italian rye-grass in the first year, and in hay its yield was materially lowered by the inclusion of that grass.

(iii) The date of sowing of subterranean clover is in Wales of the utmost importance and varies according to the requirements to be fulfilled. If permanent establishment in grassland is required the best time of sowing is late June, whereas for the production of abundant late summer and autumn keep an early sowing in March or April is best. High prices ruling for seed of this clover at present, however, prohibit its use merely as a catch-crop. In Australia an autumn sowing is said to be the best; the plants vegetate during the mild winter months and flower in spring. The buried seed lies dormant in the surface soil through the hot summer, germinating at the first rain of the following autumn.

(iv) Three distinct types of subterranean clover are said to be distinguishable according to (a) time of flowering; (b) ratio leaf to stem; and (c) degree of leaf markings.

(v) Only occasional damage seems to be done to the clover by either insect or fungus pests. Lucerne flea (*Smynturus viridis*) and pea mite (*Motophullus bicolor*) sometimes occasion damage in the seed-production paddocks in Australia, whereas two root diseases are reported from Florida (U.S.A.).

Thanks are due to Mr. Ll. I. Jones, B.Sc., and Mr. I. G. Lewis for assistance given in making counts of plants and in botanical separations of the hay.

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* * * * *

AUGUST ON THE FARM

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Agricultural Organizer for Derbyshire.

Seasonal Notes.—At the time of writing—mid-July—it is difficult to visualize the husbandry of August when that normally appertaining to June has not yet been completed. Of one fact we may be certain, namely, that there will still be considerable areas of hay out when August comes in. For three weeks the mowing machines have stood waiting for the promise of a few fine days in which to make and gather a few acres; and now, with a less pessimistic tone in the forecasts and a fairly steady barometer, farmers seem to be hopeful that the requisite spell of fine weather is approaching and have re-started the machines.

The delay, should it prove to have been only delay, of about three weeks in the date of cutting has not been all disadvantage. Owing to the dry and chilly weather of May and the first half of June, the old land hay crops in many districts were light and benty at the time when, had weather permitted, cutting would have begun. The subsequent growth, being mainly leaf, should according to modern views be of a more nutritious character although it has not been secured in June, and certainly the weight of crop has increased. Leafy grass, however, requires more fielding than the normal mixture of leaf and stem; and in some cases it may be better to leave one or two fields unmown for winter pulling than to run the risks of overheating by trying to get on too fast. In some fields where there was a good growth in June, the bottom herbage is now brown and decayed. This not only makes cutting and curing more difficult but ruins the prospect of making the crop into good sweet hay.

In the earlier districts there has been heavy loss of clover and lea mixtures cut about the middle of June. Apart from that, the area of spoilt hay is as yet less than I have observed under similar weather conditions in past years. Farmers have exercised more restraint in the matter of mowing. The weather report, "further outlook unsettled generally," has been read or heard with exasperation, but it has prevented the resumption of mowing crops which otherwise might have been cut and afterwards ruined in the swath.

Corn Crops.—It would appear that, no matter how hot and dry the next spell of weather may be, corn harvest will be rather late this year. This may be advantageous, having regard to the delay with the hay crop; but with so much green growth in the bottom of the straw, farmers will be tempted to begin reaping as soon as conditions will permit. As regards grain yields, the heads of wheat are not so large as the bulk of straw might lead one to expect, and the proportion of empty spikelets at the base of the ears is rather larger than usual. Smut of the "blow away" type, *i.e.*, loose smut, is rather prevalent this year, especially in spring-sown wheat. It is not generally understood that dressing the seed with bluestone or formalin does not prevent an attack of loose smut in wheat or barley if the seed is infected with this disease. The grain from an infected crop should not be reserved for seed.*

The bulk of straw, which at one time seemed likely to be small, has increased considerably, but as yet comparatively little lodging has occurred. Whether the additional straw is quite welcome in some of the arable districts is doubtful. Some arable farmers have much of last year's straw on their hands, having been reluctant to feed so many bullocks as would have been required to convert all the available straw into manure. Seeing so many apparently surplus straw stacks in one of the Eastern counties, it was difficult to suppress two ideas that conflict with the generally accepted rules of good husbandry. The first was as to the possibility of transporting some of this straw to grassland dairying districts where in winter the supply of bedding is short. Selling straw is permissible, provided that other measures are adopted for keeping up the humus supply of the soil, and the case for handling the cash value of produce at the first opportunity is a strong one. The other idea was as to whether it is essential to convert straw into manure—by means of bullocks or otherwise—before returning it to the soil: is there no point in the rotation where

* See the Ministry's Leaflet, No. 92, *Bunt and Smut in Wheat*.

straw can be incorporated in the soil so as to secure the full benefit of its organic matter as a source of humus and without the denitrifying effects of fresh straw injuring the succeeding crop? It would appear that the time and place satisfying these conditions is in autumn, after corn and before roots and potatoes. At any rate, if bullock feeding continues to be a source of loss to the arable farmer it is desirable to experiment on these lines.

August Sowings.—August is a month in which seeds will germinate well, and the list of plants suitable for sowing at this time of the year is long. In the ordinary four- and five-course rotations, however, there is little land available for sowing in this month. Cabbages may be sown in seed beds for later planting out in the field; but the sowing of stubble turnips, trifolium and similar catch crops is practised only in specially favourable districts and after an early harvest.

Where early and second early potatoes are grown, good use can be made of Italian rye-grass. If sown immediately the potato crop is lifted, a good bite of lamb feed may be obtained in less than two months' time, after which the grass may either be left for further grazing in the following winter and spring or ploughed under. The value of Italian rye-grass for early spring feed, however, is not sufficiently appreciated either by flock masters or by dairy farmers. The milk producer need not regard April as a winter month if he can provide a field of Italian rye-grass sown not later than mid-September and suitably fertilized, not omitting the top dressing with nitrogenous manures in March.

Quality of Milk.—From time to time I receive visits from farmers who have been informed that their morning's milk is poor or below the 3 per cent. "standard." Recently, and due possibly to the peculiarity of the weather conditions, cases of difficulty in this matter have been rather more numerous than usual. As a rule the farmer brings in samples for testing and almost invariably he is surprised at the low fat content of the samples tested. Sometimes considerable differences will be found between milks taken from different churns which cannot be accounted for by insufficient mixing before taking the samples. Nearly always there is wide divergence between the results of the evening and the morning milks.

Without entering into the questions of whether the properly mixed milk of a herd may fall below the 3 per cent. "standard,"

it can be said that farmers would receive fewer warnings and complaints if they were aware of the possibility of wide variations in quality and endeavoured to prevent these variations. Samples may be submitted to the local agricultural college or county agricultural education department for testing at merely nominal charges.

One of the chief causes of low fat content in morning's milk is a long interval between the afternoon and the morning milkings. There are, in most herds, periods when the morning samples tend to be unusually low in fat. At these times arrangements must be made to milk at more nearly equal intervals. Generally it is the cows that are in or are just past full yield and have lost flesh that give the poorest milk: these should be milked first in the morning and last in the evening. This procedure must not be adopted, however, without taking the further precaution of thoroughly mixing the milk of these cows with that yielded by the remainder of the herd. Grouping the cows according to yield and stage of pregnancy may be a convenience in feeding and general management, but I have known it lead to quality troubles where the milk of all the groups has not been properly mixed before dispatch. The simplest method is to arrange for the milk as it leaves the cooler to run into two or more cans at the same time.

Recent legislation provides for an "appeal to the cow" in certain cases where the producer desires it. If, for example, a London local authority finds a churn or can of milk in course of delivery to be deficient in fat or non-fatty solids, the producer is notified accordingly. He has the right within 60 hours to apply to the Food and Drugs Inspector of the same local authority to take a sample of the milk from a corresponding milking of his cows. The Inspector in taking the sample will take special care to ensure that the sample he takes shall be thoroughly representative of the mixed milk of the whole herd, thoroughly milked and stripped. In most cases the results of the analysis of such a sample would be better than that of the sample complained of, which might be from one of three churns, two of which were well above the standard. Appeal to the cows is therefore unlikely to aid the defence unless the farmer had himself taken all possible precautions in the production and dispatch of the milk from which the deficient sample or samples were taken.

Telegony.—The question of whether telegony is based on supposition or fact has been raised by two readers. Only one of the queries need be discussed and it is not an uncommon type

of case. A Shorthorn bull broke bounds and impregnated some pedigree British Friesian cows and heifers. The resulting calves will, of course, be cross-breds, but the question at issue is whether the subsequent calves of these cows and heifers, if bred to pure British Friesian bulls, will show Shorthorn characteristics. In other words has the Shorthorn bull tainted the blood of the Friesian females?

Not many years ago teachers of the theory of breeding included telegony in their lecture material as established fact. The present-day student of the subject is very sceptical of the

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ending July 13					Cost per unit at London
	Bristol	Hull	L'pool	London		
	£ s.	£ s.	£ s.	£ s.	s. d.	
Nitrate of Soda (N. 15½%) ..	14 15	..	14 0	14 12	18 10	
Sulphate of ammonia —						
Neutral (N. 20·6%) ..	12 6*	12 6*	12 6*	12 6*	11 11	
Calcium cyanamide (N. 19%) ..	9 16*	9 16*	9 16*	9 16*	10 4	
Kainit (Pot. 14%) ..	3 2	2 17	2 17	2 16	4 0	
Potash salts (Pot. 30%) ..	4 17	..	..	4 12	3 1	
(Pot. 20%) ..	3 12	..	3 9	3 4	3 2	
Muriate of potash (Pot. 50·53½%) ..	9 10	8 5	8 13	9 5	3 5	
Sulphate " (Pot. 48·51½%) ..	11 10	10 5	10 16	11 2	4 4	
Basic Slag (T.P. 32%) ..	3 4§	..	2 19§	..	..	
(T.P. 30%) ..	3 2§	..	2 17§	2 15e	..	
(T.P. 28%) ..	..	..	2 10§	..	..	
(T.P. 26%) ..	..	..	2 5§	..	..	
(T.P. 24%) ..	2 10§	..	2 2§	..	..	
Ground rock phosphate (T.P. 58%)						
Very fine grade||	2 15	..	..	2 10d	0 10	
Fine grade||	2 10	..	..	2 7d	0 10	
Superphosphate (S.P. 35%) ..	..	..	3 12	3 0	1 9	
(S.P. 33%) ..	..	..	3 9	..	..	
(S.P. 30%) ..	..	2 15	3 5	2 15	1 10	
Bone meal (N. 3½%, T.P. 45%) ..	8 15	8 10	8 10	8 0	..	
Steamed bone flour (N. 4½%, T.P. 60·65%)	6 0†	6 2†	6 5	5 17	..	

Abbreviations: N.—Nitrogen; S.P.—Soluble Phosphate; T.P.—Total Phosphate; Pot.—Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Prices for 4-ton lots delivered to purchaser's nearest railway station in neighbourhood of towns mentioned above.

§ Fineness 80% through standard screen of 14,400 holes to the square inch (120 mesh sieve).

|| Fineness 80% through standard screen of 10,000 holes to the square inch (100 mesh sieve).

d Prices for 4-ton lots f.o.r. at Northern London Stations. At G.W.R. and S.R. London Stations the cost to purchasers is 2s. 6d. per ton extra.

e F.O.R. Northern rails; 3s. 6d. per ton extra on Southern rails.

possibility of telegonic influence. Several experiments have been carried out in which conditions were made as favourable as possible for such influence to be demonstrated, but all the results have been negative.

Apart from the above considerations, it is always a matter for regret when a bull breaks bounds. Many farmers have not a suitable paddock in which to allow the bull liberty without fear of his escape. Accordingly the bull is very commonly shut up in a loose box, where he gradually develops a fierce disposition and often becomes of little breeding value as a result of lack of exercise. The best solution in such cases appears to be that of tethering the bull in the field to a strong wire securely held down at both ends.

* * * * *

NOTES ON FEEDING STUFFS FOR AUGUST

H. E. WOODMAN, PH.D., D.Sc.,

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The Energy in the Ration.—The farmer hears the term "net energy" so frequently nowadays, in connexion with feeding stuffs and rationing, that it may not be out of place to attempt, in this month's Notes, to give some idea of what this conception signifies. All living things on earth, both plant and animal, are in truth but simple creatures of the sun, and batten, directly or indirectly, on the energy which, from time's beginning, has streamed out continuously from the great central luminary towards this planet in the form of light waves. The energy of the sun, though not necessarily the initiator of life, would seem to be in the strictest sense its indispensable support.

How comes this to be? To answer this question, we must recognize that the existence of animals without plant life is not conceivable. The plant is the great elaborator of the food of animals. It alone (if we except the synthetic art of the chemist) is able to bridge the gulf between the worlds of inorganic and organic matter. The mysterious activities in the minute plant cell laboratories, whereby this is rendered possible, are, however, dependent on the supply of solar energy. The plant absorbs carbon dioxide, a gas which is a waste product of animal life. Under the influence of light absorbed by the chlorophyll of the plant, this is converted, by subtle and only vaguely understood changes, into complex organic compounds like carbohydrates and oils, and in these substances are locked up, in the chemical or potential form,

the vast stores of energy which have been derived from the sun.

The work accomplished by the sun in this process is enormous. Every gramme of carbohydrate thus elaborated in the plant involves a storage of solar energy to the extent of 4,100 calories; in other words, an amount of energy which, if liberated as heat, would raise the temperature of nearly a gallon of water through one degree centigrade. This locked-up energy becomes manifest as heat and light when the carbohydrate is burnt in an atmosphere of oxygen, which is the great liberator of imprisoned energy. In this process the carbon dioxide is set free once more and forms again the starting point of the eternal cycle of change. Oil is even a richer storehouse of energy than carbohydrate, and yields, when burnt in oxygen, two and a half times the amount of heat which is obtained from an equal weight of carbohydrate. Protein under these conditions gives out about one and a half times the amount.

A feeding stuff is, therefore, to be regarded as a mixture of complex organic compounds in which varying amounts of solar energy have been locked up. This energy is available, in part at any rate, to the animal, which is merely, in the scientific sense, a mechanism for the transforming of energy from one form to another. The principle of the conservation of energy holds as rigidly for the animal as for the clock or the engine. Part of the energy of the food is transformed into heat for keeping up body temperature. Another part is utilized for maintaining the blood circulation and the heart beat, or for the performance of muscular work. Still another portion may become locked up in the various organic compounds which are built up in the animal, such as reserve fat, the glycogen of the liver, the proteins of flesh or the constituents of milk. Thus it is apparent that life is fundamentally a phenomenon of energy exchange, the plant in the first place collecting and storing the energy of the sun and then passing it on to the animal.

Gross Energy.—The total locked-up energy of a feeding stuff may be determined very simply by burning a known weight of the material in an atmosphere of oxygen and measuring the heat which is evolved. This is usually referred to as the gross energy of the feeding stuff. Unfortunately, however, this maximum amount of energy never becomes available for productive purposes in the animal organism, for the following reasons:—

(1) A portion of the chemical energy of the food fails to be transformed at all. It leaves the body in the undigested food residues of the faeces, such parts of the food thus evading oxidation in the animal.

(2) The paunch of the ruminant is the seat of intensive bacterial activity. The micro-organisms concerned derive the energy for their own vital processes by breaking down a portion of the carbohydrate and fibre of the food. This implies, therefore, a reduction in the amount of energy which will be available to the animal. The bacteria themselves, however, seem incapable of utilizing the whole of the energy in the carbohydrate and cellulose, since marsh gas and hydrogen, substances rich in energy, are formed as waste products of their activity. The excretion of these energy-rich gases from the animal involves therefore an appreciable loss of food energy.

(3) The full energy of the protein constituent of the food is not liberated in the animal organism, since breakdown of protein does not proceed to the limiting stage of carbon dioxide, but stops short at urea. Thus, the urea which is excreted into the urine carries out of the body some of the energy which was originally locked up in the protein of the food.

(4) Shortly after consumption of food, there is always a distinct rise in the rate of heat evolution from the body. This effect is known as specific dynamic action, and implies that a proportion of the total energy of the food is inevitably converted into heat, a form of energy which cannot be re-transformed into chemical energy in the form of fat, flesh or milk. As the heat necessary for body warmth is derived from the maintenance portion of the ration, it follows that heat coming from the production part of the ration is wasted from the animal's standpoint. In other words, it is given off from the body, being useless for productive purposes. We may refer to this fraction of the energy of a feeding stuff as the thermic energy.

Net Energy.—It is clear from what has been written that, in order to arrive at the amount of productive energy in a feeding stuff, we must add together the thermic energy and the energy losses in the liquid, solid and gaseous excreta, and subtract the total from the gross energy of the food. The difference is an accurate measure of productive value. It is known as the net energy value, and is usually stated in therms (1 therm = 1 million small calories) per 100 lb. of feeding stuff.

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When we refer to the productive value of a feeding stuff in terms of starch equivalent per 100 lb., we merely state the same thing in another way. Since 1 lb. of starch contains 1.07 therms of net energy, it follows that if we multiply the starch equivalent by this factor, then we convert the productive value into terms of net energy. In other words,

$$\text{Starch equivalent per 100 lb.} \times 1.07 \\ = \text{Net energy value per 100 lb.}$$

The system of starch equivalents has only been commonly adopted because of the convenience of the unit and the concrete picture of feeding value which it affords. Obviously, however, starch has no value to the animal as such, but only by virtue of the energy which it contains, energy which only becomes dynamic and useful during the process of destruction of the starch in the metabolic processes of the animal organism.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follow:—

	Starch equivalent Per cent.	Protein equivalent Per cent.	Per ton £ s.
Barley (Imported)	71	6.2	11 4
Maize	81	6.8	7 14
Decorticated ground nut cake	73	41.0	11 5
" cotton cake	71	34.0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2.52 shillings, and per unit protein equivalent, 1.08 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent Per cent.	Protein equivalent Per cent.	Food value per ton, on farm £ s.
Wheat	72	9.6	9 12
Oats	60	7.6	7 19
Barley	71	6.2	9 7
Potatoes	18	0.6	2 6
Swedes	7	0.7	0 18
Mangolds	7	0.4	0 18
Beans	66	20.0	9 8
Good meadow hay	31	4.6	4 3
Good oat straw	17	0.9	2 4
Good clover hay	32	7.0	4 8
Vetch and oat silage	13	1.6	1 14
Barley straw	19	0.7	2 9
Wheat straw	11	0.1	1 8
Bean straw	19	1.7	2 10

DESCRIPTION	Price per qr. s. d. lb.	Price per ton £ s.	Manu- rial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Pro- tein equiv. %
Wheat, British	—	—	12 17	0 15	12 2	72	3 4	1.78
Barley, British feeding	—	—	11 10	0 12	10 18	71	3 1	1.65
" Canadian No. 3 Western	45 0	400	12 12	0 12	12 0	71	3 4	1.78
" " No. 4	39 0	—	10 18	0 12	10 6	71	2 11	1.56
" Persian	36 0	—	10 2	0 12	9 10	71	2 8	1.43
Oats, English, white	—	—	10 13	0 13	10 0	60	3 4	1.78
" " black and grey	—	—	10 0	0 13	9 7	60	3 1	1.65
" Scotch white	—	—	11 10	0 13	10 17	60	3 7	1.92
" Canadian No. 2 Western	32 3	320	11 5	0 13	10 12	60	3 6	1.87
" " feed	29 0	—	10 3	0 13	9 10	60	3 2	1.70
" American	24 9	—	8 13	0 13	8 0	60	2 8	1.43
" Argentine	27 6	—	9 12	0 13	8 19	60	2 11	1.56
" Chilian	28 0	—	9 16	0 13	9 3	60	3 1	1.65
Maize, Argentine	33 0	480	7 14	0 12	7 2	81	1 9	0.94
Beans, English winter	—	—	11 0	1 10	9 10	66	3 0	1.61
Peas, Japanese	—	—	20 15	1 6	19 9	69	5 8	3.04
Dari, Egyptian	—	—	10 10	0 14	9 16	74	2 8	1.43
" Syrian	—	—	12 0	0 14	11 6	74	3 2	1.70
Millers' offals—								
Bran, British	—	—	7 2	1 6	5 16	42	2 9	1.47
" broad	—	—	8 2	1 6	6 16	42	3 3	1.74
Middlings, fine, imported	—	—	9 15	1 1	8 14	69	2 6	1.34
" coarse, British	—	—	8 17	1 1	7 16	58	2 7	1.38
Pollards, imported	—	—	7 12	1 6	6 6	60	2 1	1.12
Meal, barley	—	—	11 17	0 12	11 5	71	3 0	1.61
" maize	—	—	9 7	0 12	8 15	81	2 2	1.16
" " germ	—	—	9 0	0 18	8 2	85	1 11	1.03
" " gluten feed	—	—	8 15	1 5	7 10	76	2 0	1.07
" locust bean	—	—	8 10	0 11	7 19	71	2 3	1.20
" bean	—	—	12 0	1 10	10 10	66	3 2	1.70
" fish	—	—	20 0	4 1	15 19	53	6 0	3.21
Maize, cooked flaked	—	—	10 5	0 12	9 13	85	2 3	1.20
Oilcakes—								
Linseed—								
" cake, English 12% oil	—	—	18 2	1 9	16 13	119	2 10	1.52
" " " 10% "	—	—	12 0	1 16	10 4	74	2 9	1.47
" " " 9% "	—	—	11 12	1 16	9 16	74	2 8	1.43
" " " 8% "	—	—	11 7	1 16	9 11	74	2 7	1.38
Soya bean, " 6% "	—	—	11 7	2 11	8 16	69	2 7	1.38
Cottonseed cake, " 5 1/2% "	—	—	6 15	1 13	5 2	42	2 5	1.29
" " Egyptian, 5 1/2% "	—	—	6 12	1 13	4 19	42	2 4	1.25
Decorticated cottonseed meal, 7% oil	—	—	10 12	2 11	8 1	74	2 2	1.16
Coconut cake, 6% oil	—	—	9 7	1 9	7 18	79	2 0	1.07
Ground-nut cake, 7% oil	—	—	9 12	1 14	7 18	57	2 10	1.52
Decorticated ground-nut cake, 7% oil	—	—	11 5	2 12	8 13	73	2 4	1.25
Palm kernel cake, 6% oil	—	—	8 15	1 2	7 13	75	2 0	1.07
" " meal, 6% "	—	—	9 0	1 2	7 18	75	2 1	1.12
" " " 2% "	—	—	7 17	1 3	6 14	71	1 11	1.03
Feeding treacle	—	—	6 5	0 9	5 16	51	2 3	1.20
Brewers' grains, Dried ale	—	—	6 17	1 2	5 15	49	2 4	1.25
" " " porter	—	—	6 7	1 2	5 5	49	2 2	1.16
" " Wet ale	—	—	0 16	0 8	0 8	15	0 6	0.27
" " " porter	—	—	0 12	0 8	0 4	15	0 3	0.14
Malt culms	—	—	7 10	1 12	5 18	43	2 9	1.47

Prices at London except where otherwise stated.

* At Hull.

† At Bristol.

‡ At Liverpool

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 12s. 0d.; P₂O₅, 3s. 10d.; K₂O, 3s. 0d.

MISCELLANEOUS NOTES

THE second International Conference for Plant Protection has been fixed to take place early in November, 1928, so as to coincide with the work of the Ninth General Assembly of the Institute. The first Conference was held at the Institute's offices in Rome from February 24 to March 4, 1914, when a draft Convention was drawn up for submission to the adhering countries, providing for common action against the introduction and spread of plant disease. Owing to the outbreak of war a few months afterwards, the matter remained in abeyance, and, when the subject was reconsidered, it was felt that the time which had elapsed and the generally altered circumstances would necessitate amendment of the original draft Convention. The subject was further examined by an International Commission of Experts in Phytopathology which met a few days before the opening of the General Assembly in April of last year, and a revised draft Convention was agreed upon, and approved by the General Assembly. This revised scheme will be considered at next year's International Conference.

The Institute is to be officially represented at the following meetings: World Poultry Congress, to be held at Ottawa on July 27; Soil Science Congress (Washington, July 13); and the International Country Life Conference (East Lansing, Michigan, August 1). The International Cold Storage Congress will be held on September 19 at the Institute's offices in Rome.

* * * * *

THE Midland Agricultural and Dairy College, Sutton Bonington, Loughborough, will hold its fourth Annual Poultry Conference on Tuesday, September 13,

Midland College 1927, and all persons interested are cordially invited to attend. These conferences, which last a day, are arranged to give residents in the locality and others

who are unable to attend the National Poultry Conference an opportunity of hearing short papers by experts upon various aspects and problems of poultry keeping, and of joining in the discussions that follow. At the forthcoming Conference, the subjects for discussion will be of a practical character. At the morning session, Mr. F. W. Parton, Poultry Instructor, Department of Agriculture, Leeds University, will consider "Chicken Rearing," and Mr. R. Scott-Miller, F.Z.S., "The Selection of



FIG. 1.—View of part of Fruit Marketing Demonstration, Three Countries Show, showing Grading and Sizing Machine in foreground.

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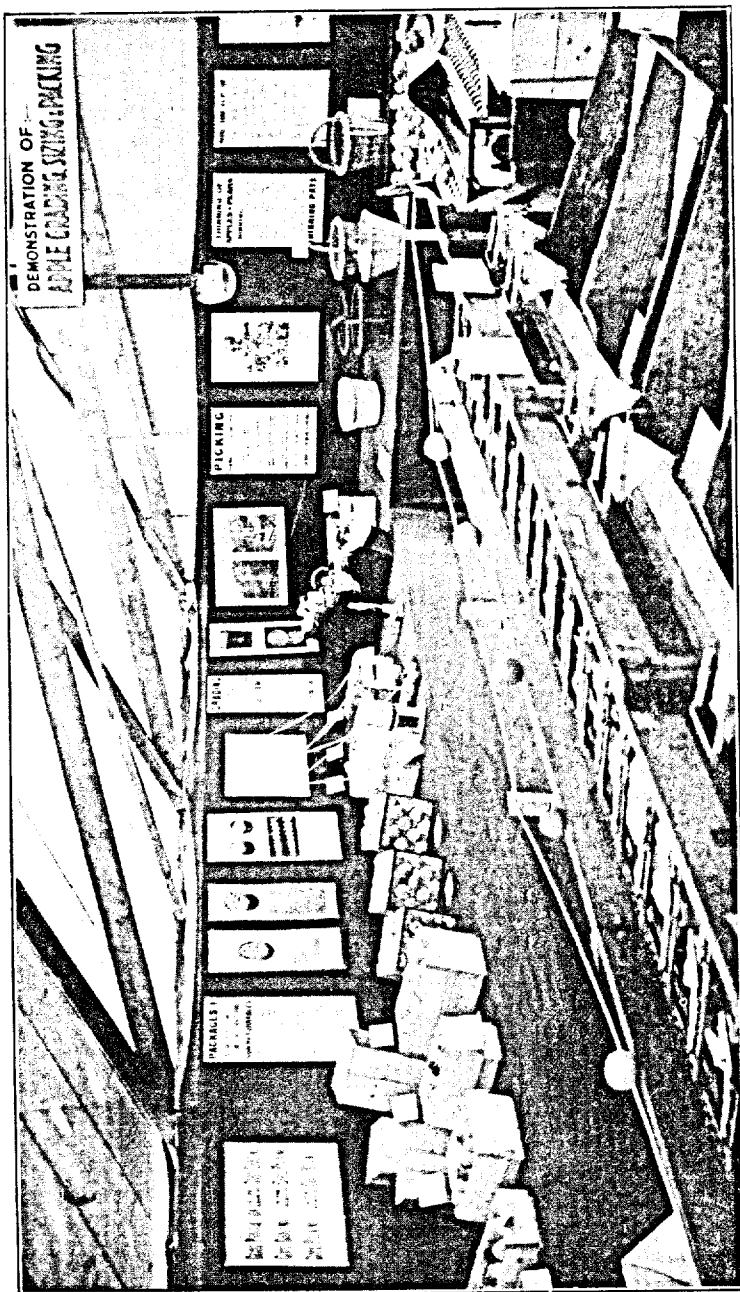
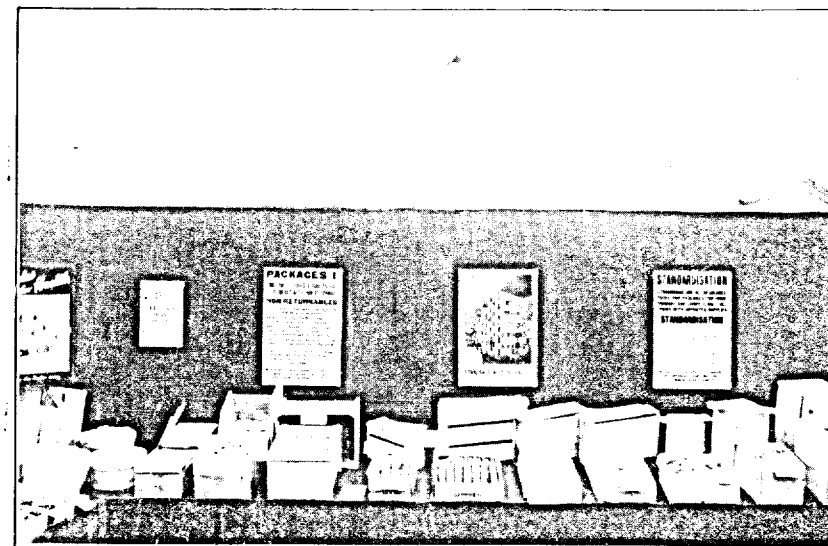
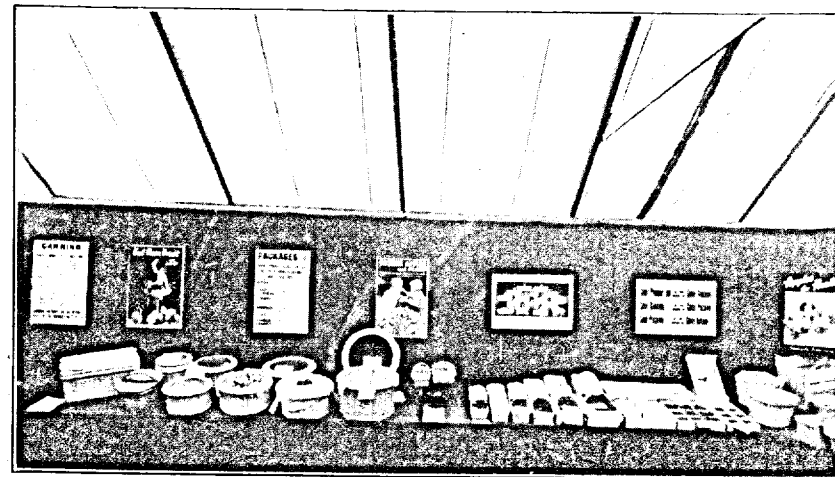


FIG. 2.—View of part of Fruit Marketing Demonstration, Three Counties Show.



FIGS. 3 & 4.—Views of the Fruit Marketing Demonstration. Bath and West and Southern Counties Show.

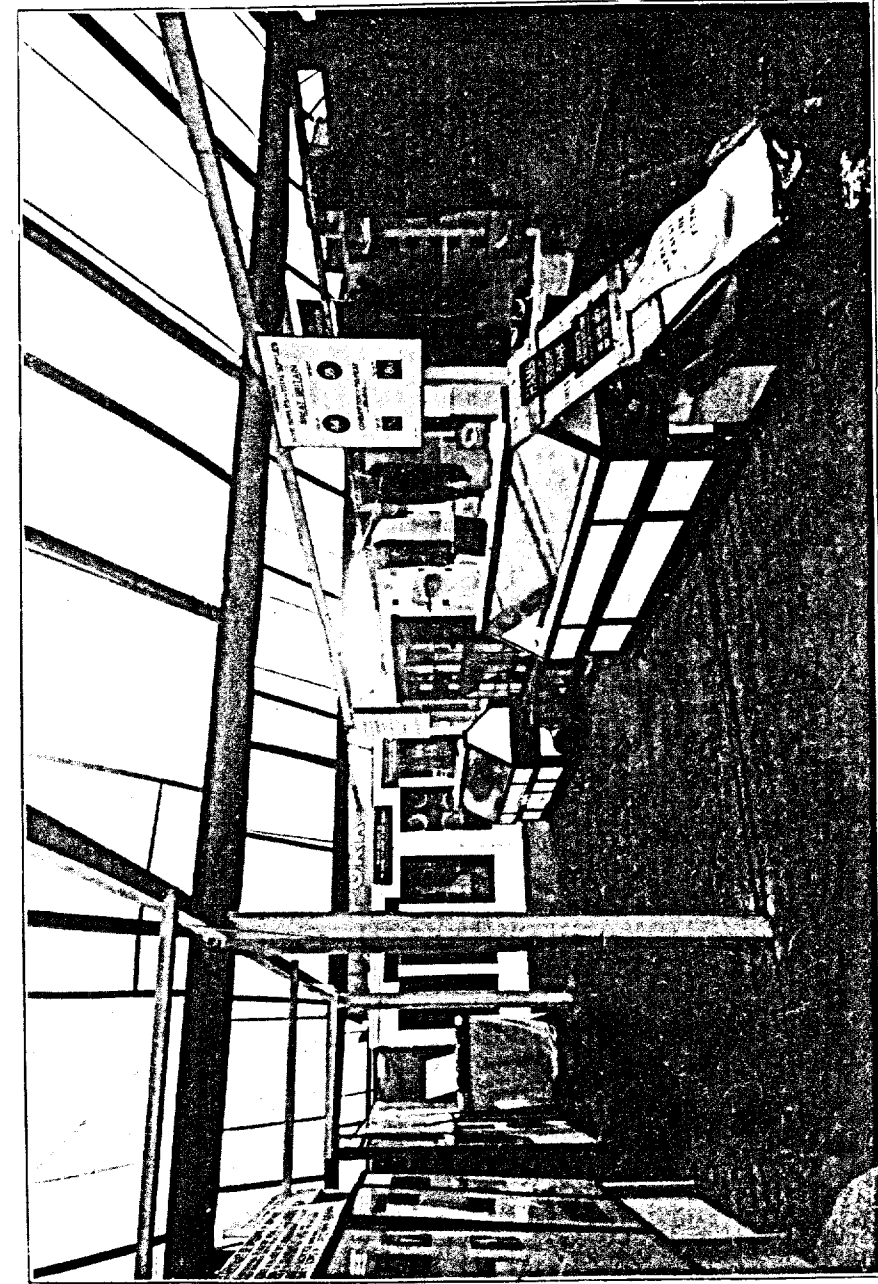


FIG. 5.—Pig Marketing Demonstration : General view of the pig-products section.

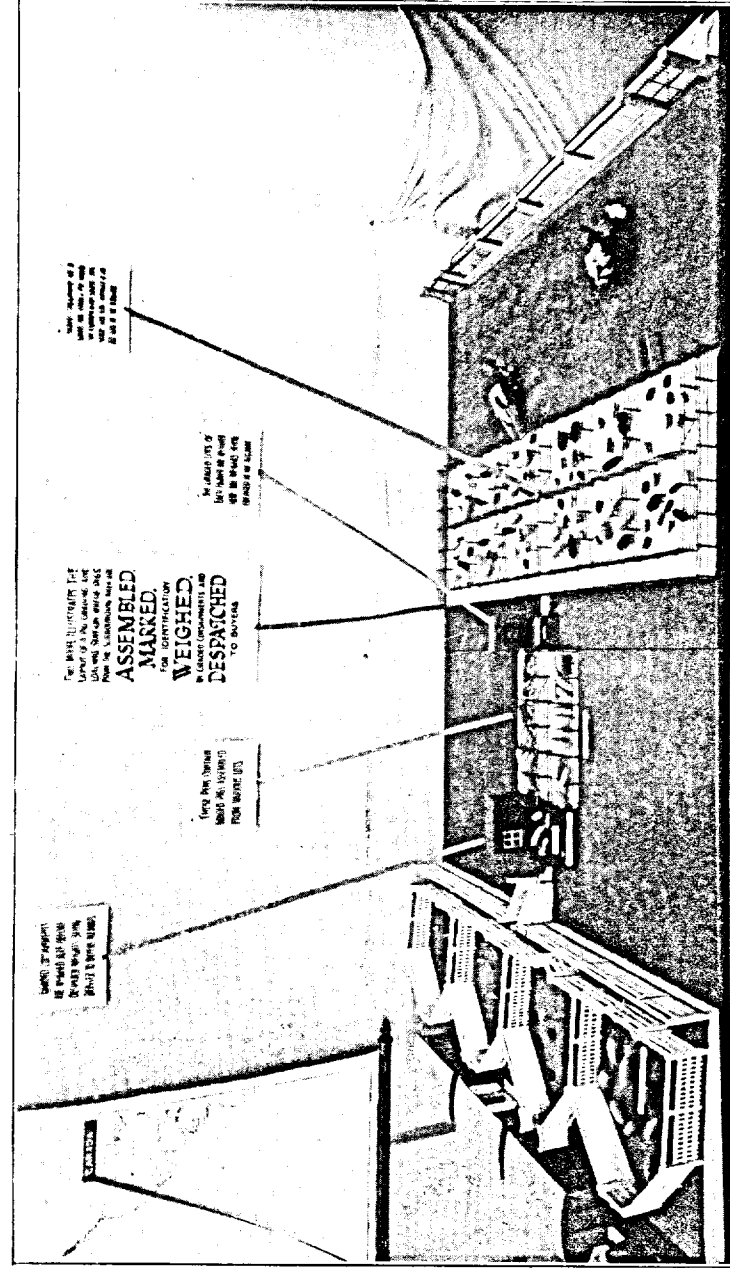


FIG. 6.—Pig Marketing Demonstration : Model of a pig-grading and loading station for the assembling, marking, grading and weighing of pigs from the surrounding areas, and their dispatch in graded consignments to district buyers. (See page 481.)

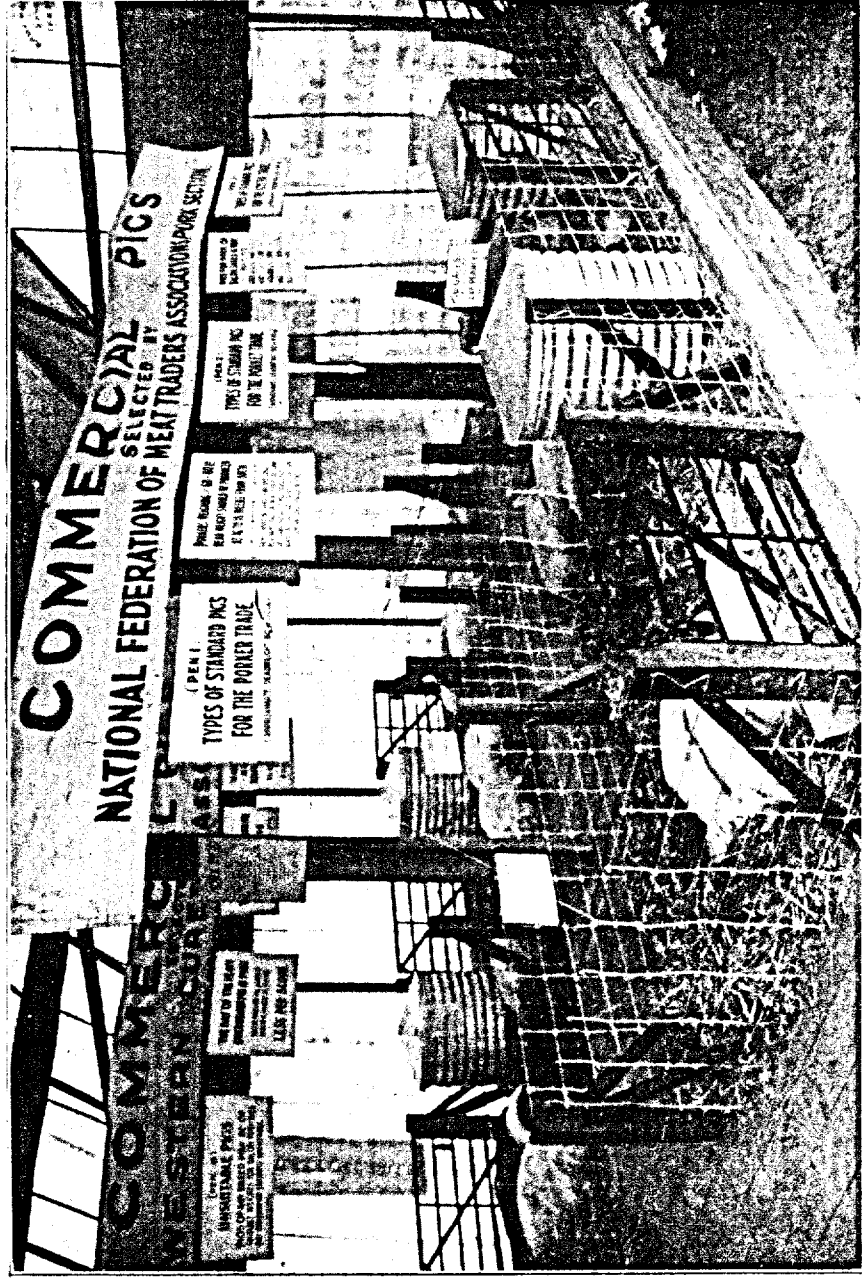


Fig. 7.—Pig Marketing Demonstration. View of the Commercial-Pig Exhibit. The pigs here shown were selected by the National Federation of Meat Traders' Associations and the Western Curers' Association as being of the types best suited to trade requirements.

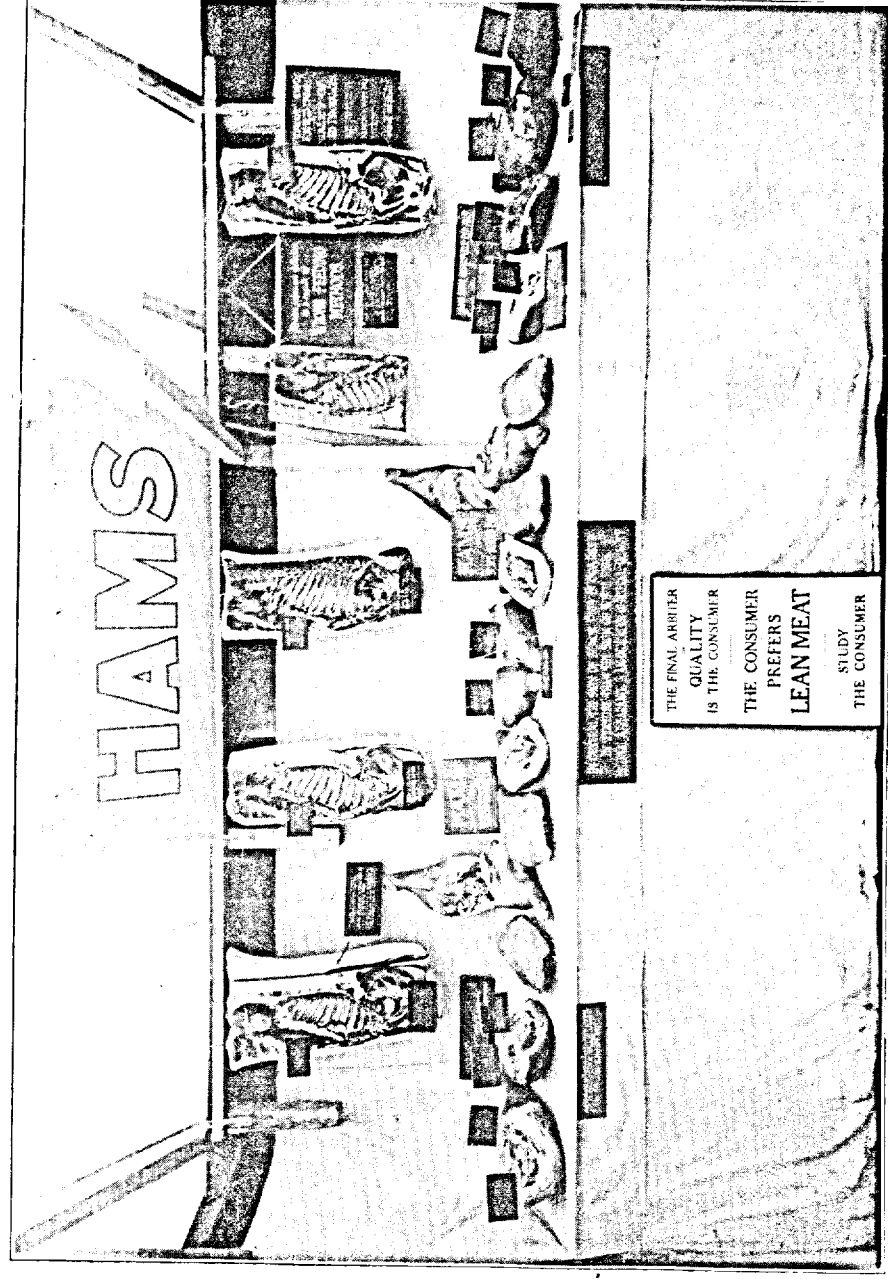


Fig. 8.—Pig Marketing Demonstration. Sections relating to the Midland Trade and to Hams.

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Birds for Laying Trials." In the afternoon, Mr. C. H. Dobbin, Poultry Instructor, Lancashire County Council, will deal with the "Artificial Lighting of Poultry Houses," and Mrs. R. Crawford will speak on "Farm Poultry Keeping." Time will be allowed for the inspection of the College buildings and poultry runs, and also the Notts and Leicester Laying Trials, which are being held at the College. Particulars of the arrangements, accommodation for visitors, meals, etc., can be obtained on application to the principal, Dr. T. Milburn.

* * * * *

THE object of this Scheme, it will be remembered, is to provide facilities for mating specially selected sires with the milch goats belonging to small-holders,

The Stud Goat cottagers, and similar persons. The
Scheme, 1926-27 improved stock already to be seen up and down the country testifies to the success

which has attended the Scheme since its inauguration three years ago. Figures for the past season are now available, and, as appears from the following table, they compare favourably with those of the previous year:—

	Centres	Goats entered	Goats registered	Services given	Services allowed for premium	Premiums	Administrative and travelling expenses
1925-26	83	103	89	1,115	1,077	£229	£121
1926-27	100	115	104	1,603	1,496	£303	£117

It will be observed that while the total cost to the Ministry increased by only 16.7 per cent., the number of services allowed for premium shows an increase of 34.1 per cent. This is all the more gratifying when it is remembered that the Scheme was necessarily affected to some extent by the restrictions imposed under the Foot-and-Mouth Disease Regulations. The average cost per service allowed decreased from 2s. 2d. to 1s. 7d. Thirty-five new centres were opened, some in counties which had not been previously represented. The animals accepted included 7 Saanens, 8 Toggenburgs, 8 Anglo-Nubians and 81 Anglo-Nubian-Swiss or other definitions. Six of these goats were imported in 1922, 7 were sired by imported goats, 35 were "Dagger"* males, 21 owned "Dagger" males as sires, while 16 were from Star or Q Star dams.

As in preceding years, the inspection was undertaken by an officer appointed by the British Goat Society. Twenty-four

* *i.e.*, males whose dams, and (on the sire's side) granddams, have secured the Star or Q Star, indicative of descent from good milking stock.

days were occupied in this work, and a total distance of 2,870 miles was covered. Ninety-nine goats qualified for premiums, of which 28 (at 27 centres) earned the full premium of £5, 1 each in Berkshire, Cambridgeshire, Cheshire, Suffolk and Yorkshire, 2 each in Cumberland, Dorset (3 goats at two centres), Kent, Norfolk and Surrey, 4 in Essex, and 8 in Durham. These 28 goats gave 852 services, of which 813 were allowed. For the total number of services, Durham easily leads the way, 2 of the goats in that county having made 68 and 69 services, Cumberland coming next with 52, and then Essex with 46. Of the services allowed under the Scheme, 349 were given gratis, while fees varying from 6d. to 5s. were charged for the remainder.

At several shows last year, special classes were provided for female kids sired by goats under the Scheme, while, at other shows, special prizes were offered for such kids. These special prizes are to be increased for the current season. Evidence of increased appreciation of the value of first-class stock is afforded by the inquiries which are received from time to time for goats eligible under the Scheme. There can be no doubt as to the efficient and economical manner in which the Scheme has been administered, and as to the beneficial results which have already been achieved.

* * * * *

THE practical demonstrations of improved methods of marketing, which are being carried out by the Ministry at selected Agricultural Shows during the present summer, were staged, in July, at the Royal Show at Newport and at the Great Yorkshire Show at Darlington. The

Marketing Demonstrations

demonstrations at Newport were concerned with pigs, pig products, eggs, poultry and fruit. Some illustrations of the demonstration in fruit marketing at the Bath and West and Southern Counties Show and at the Three Counties Show are given here. (Figs. 1 to 4.) At Darlington, fruit was omitted from the programme, which was otherwise the same. At both shows the demonstrations attracted crowds of visitors who showed considerable interest. The South African farmers at present visiting this country, and representatives of Young Farmers' Clubs from the United States, were among overseas visitors to the Ministry's Pavilion at the Royal Show. There was always a keen demand for publications, about 1,500 copies of the marketing reports in the Ministry's Economic Series being sold at the two shows.

A new feature which aroused interest and discussion was a model of a co-operative pig-grading and loading station (Fig. 6). At such a station, pigs from the surrounding areas could be assembled, marked for identification, graded, weighed in graded lots—each sender's lots being weighed separately, re-weighed in graded consignments of mixed lots of similar grade, and dispatched to buyers. Organizations of this kind are common in the domestic trade of the United States and Canada, and there are interesting examples in Germany. There is, however, only one important example in England and Wales of a farmers' organization which is engaged in the business of assembling and grading live pigs for dispatch to distant buyers. This is the live stock department of the Eastern Counties Farmers' Co-operative Association at Ipswich, which operates five assembling centres and, in recent years, has handled about 60,000 pigs per annum. It is claimed by the Association that its system of bulking pigs for dispatch in graded consignments enables it to effect savings in transport charges, and to allocate uniform lots of pigs in large quantities to the bacon and pork markets according to exact requirements.

* * * * *

WITHIN the past few years, a new mildew of the hop—the so-called "Downy Mildew"—has made its appearance in various European countries, and has also

Downy Mildew of the Hop : Warning as to Spraying been found in some hop gardens in England. This Downy Mildew is quite different from the well-known Powdery

Mildew or "Mould" of hops which is of such frequent occurrence and is controlled by the application of sulphur. Fully illustrated and detailed accounts of the Downy Mildew of the Hop have been published in this JOURNAL (March, 1925, p. 1144; April, 1925, p. 30; May, 1926, p. 149; and March, 1927, p. 1108) and should be consulted by those interested. It is also briefly referred to in Miscellaneous Publications, No. 42, *Cultivation, Diseases and Insect Pests of the Hop Crop*, obtainable from the Ministry, 10 Whitehall Place, S.W. 1., price 2s. 6d. net, post free.

The Downy Mildew fungus is a near relative of that which causes the well-known Potato Blight, and it might, therefore, readily be assumed that spraying hops with Bordeaux or Burgundy mixtures would be a suitable means of controlling it. In one instance, indeed, on the Continent, such a procedure has been recommended. In this country, however, this

is not desirable; for, although such mixtures might, and probably would, suppress the mildew, yet, if they reached the hop cones, the copper contained in them would render the cones entirely unsuitable for brewing purposes. *Growers are, therefore, warned that hop cones should not be sprayed with the mixtures mentioned.* For the present, indeed, it is deemed wise not to spray hops at all with these mixtures, but to adopt the control measures suggested by Professor Salmon and Mr. W. M. Ware in the issue of this JOURNAL for March, 1927, p. 1118 *et. seq.*

Farm Workers' Minimum Wages.—A meeting of the Agricultural Wages Board was held on July 19, at 7 Whitehall Place, S.W. 1, Mr. W. B. Yates, C.B.E., presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions.

Cambridgeshire and Isle of Ely.—An Order fixing special minimum rates of wages for the employment of male and female workers during the corn harvest, 1927. The rate in the case of male workers of 21 years of age and over is £11 for a period of four weeks of 64 hours per week, with payment for all employment on Sundays and in excess of 64 hours per week at 11d. per hour. In the case of female workers of 18 years of age and over, the special minimum rate for all employment on harvest work is 8d. per hour.

Essex.—An Order fixing special minimum rates of wages for employment of male and female workers on the corn harvest of 1927. The rate in the case of male workers of 21 years of age and over employed on the harvest throughout the harvest period on farms of more than 60 acres of corn is £5 5s. 0d. for the period in addition to the ordinary weekly minimum rate applicable to such workers. In the case of male workers, who are employed on harvest work for a part only of the harvest period, a proportion of the sum mentioned above is payable, whilst, in the case of male workers of the same age who are employed on farms of 60 acres of corn and under, the special rate is 10½d. per hour for all employment on harvest work. In the case of female workers of 21 years of age and over, all employment on harvest work is to be paid for at not less than 7½d. per hour.

Hertfordshire.—An Order fixing special minimum rates of wages for employment of male and female workers on the corn harvest in 1927. The rate in the case of male workers of 21 years of age and over is 10½d. per hour, and in the case of female workers of the same age, 7½d. per hour for all employment on harvest work.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

Special Minimum Rates of Wages for the Corn Harvest.—In addition to the eight Agricultural Wages Committees mentioned in the July issue as having fixed special minimum rates for the corn harvest (Derbyshire, Devonshire, Dorset, Hampshire and Isle of Wight, Norfolk, Somerset, Wiltshire, and the East Riding of Yorkshire), Orders have since been made in respect of such rates for Cambridgeshire and Isle of Ely, Essex, and Hertfordshire, and particulars of these Orders will be found above.

A notice of proposal has also been issued by the Suffolk Agricultural Wages Committee to fix bonuses to be paid in addition to the ordinary minimum wage to male workers employed throughout the harvest period on harvest work on farms of at least 60 acres of corn, the bonus in the case of workers of 21 years of age and over being £5. In the case of other male workers special hourly rates are proposed for all employment on harvest work, the rate in the case of adult male workers being 10d. per hour.

Enforcement of Minimum Rates of Wages.—During the month ending July 15 legal proceedings were instituted against five employers for failure to pay minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases are as follows:—

County	Court		Fines			Costs			Arrears of wages			Workers concerned
			£	s.	d.	£	s.	d.	£	s.	d.	
Yorks,N.R.	Thirsk	..	1	12	0	0	2	6	To be agreed			1
Lanes.	Chorley	..	2	0	0	4	3	0	1	8	6	1
Durham	W. Hartlepool	10	0	0	0	10	0	15	9	3	2	
Glam.	Neath	..	—			5	5	0	11	14	6	1
Hants.	Whitehill	..	30	0	0	—			101	5	0	6
			£43	12	0	£10	0	6	£129	17	3	11

Appointments at the International Institute of Agriculture.—The permanent Committee of the International Institute of Agriculture at Rome invites applications for several appointments as "Redacteur." The minimum initial emoluments are 22,750 liras per annum. The travelling expenses (second-class) of successful candidates will be paid 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 a three years of their travelling expenses to their native countries. Candidates should possess a knowledge of foreign languages, good general academic qualifications and/or special knowledge of one of the following subjects, namely: Agricultural Economics, Tropical agriculture, Dairy Science and Plant Diseases.

Applications should be addressed to the Bureau du Personnel, Institut International d'Agriculture, Villa Borghese, Rome, and must be received not later than August 31, 1927.

Foot-and-Mouth Disease.—The existence of foot-and-mouth disease as confirmed on July 7 at Wigginton, near Tamworth, Staffs. This was the first case to occur in Great Britain after a period of three months' complete freedom from the disease. A further case was confirmed in the same parish on July 10. A fresh centre of disease was discovered at Hunton, near Maidstone, Kent, on July 19. Twenty-six outbreaks in all have been confirmed since January 1st, involving nine counties and the slaughter of 1,152 cattle, 831 sheep, and 353 pigs.

NOTICES OF BOOKS

The British Goat Society's Year Book for 1927. (London: Compiled and issued by the Honorary Secretary, Thomas W. Palmer, 10 Lloyd's Avenue, E.C. 3. 180 pp. Price 1s. 6d. net.)

The seventh issue of this useful annual, which contains numerous illustrated articles, dealing with practically every aspect of modern goat-keeping, should appeal to all interested in goats.

There can be little doubt that the milk yield of goats is improving. In 1919, two goats are recorded as having given 10 lb. or over in 24 hours; last year the number had increased to 44. These yields were obtained under the adverse conditions inseparable from shows, and it may be safely assumed that the normal average of the animals concerned was considerably higher. A good example of the possibilities of the milch goat is furnished by Didgemere Dream Q**. Her yields of 18 lb. 7 oz. in 24 hours at the Royal Norfolk Show, and of 4,236 lb. 4 oz. for the year ending October 1, 1926, constitute records. In her present lactation, she has yielded 4,703 lb. 2 oz. in 345 days.

Dr. Hare, of the Department of Pathology in the University of Liverpool, supplies some practical notes concerning the proper treatment of sick goats. Mr. F. C. Bobby writes on "The Goat and Her Economic Uses to the Poultry Farmer"; while Mr. J. A. Caseby indicates five ways of making "Indirect Profits from Goats." The steps which are being taken towards "Improving the Stock" are outlined by Mr. S. Leigh Hunt. There are articles on goat-keeping in the Isle of Eigg (Scotland), in Ireland, Ceylon, South Africa, Kenya, and other parts of the Empire.

The scientific aspect is not neglected. Dr. Asdell, of the Animal Nutrition Institute at Cambridge, details the results of recent research in regard to the inheritance of colour, beard, and tassels; Mr. F. E. Corrie writes on "The Feeding of Goats," a subject which received some notice in the March number of this JOURNAL; and Dr. M. C. Clutterbuck a chapter on "Milk from a Chemist's Point of View."

English Farming, Past and Present. By Lord Ernle. (London: Longmans, Green & Co., Ltd., 1927. Fourth edition. xvi pp. + 506. Price 12s. 6d. net.)

To this new edition of the classical history of English farming, Lord Ernle has added a chapter on "Peace-time Farming, 1919-1927," and has, as far as possible, brought the appendices and statistical tables up to date. Doubtless conditions of printing and publishing made it impossible to make use of this opportunity for reconsidering other sections of the book: but before long it is to be hoped that the first three chapters in particular will be revised. As mediæval sources are explored and more intensively studied, our conception of the course of events is becoming radically changed. To take one instance. Lord Ernle accepts the view (pp. 64-5) that from 1349 to 1485 the yield of the soil had declined; but the most complete figures yet published, those taken from the Winchester manors by Sir William Beveridge,* certainly do not bear this out, and the point is really fundamental in any discussion of mediæval agriculture.

The last chapter, the new contribution which this edition provides for the student, is by the hand of one who has taken a large part in making modern agricultural history. It is hardly written *sine ira et studio*, nor perhaps could we expect an attitude of complete detachment. For its facts the reader will be grateful: of its underlying economic and political assumptions he would do well to beware. Many people

* "The Yield and Price of Corn in the Middle Ages," in *Economic Journal*: Economic History Series, No. 2.

would dispute Lord Ernle's assumptions violently and not perhaps altogether unreasonably. But to discuss them would be to introduce questions of political controversy which are foreign to this JOURNAL and in which the historian is handicapped.

Every serious student of agricultural history will welcome a new edition of a book which stands alone among all those that attempt to tell the story of English farming. To praise it would be superfluous.

* * * * *

ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Ernle, Lord.—English Farming Past and Present. (Fourth Edition.) (506 pp.) London: Longmans, Green, 1927, 12s. 6d. [63 (09).]

Haldane, Sir W.—Farming Experiences: Some things they have taught. An address given to the Edinburgh University Agricultural Society. (28 pp.) Edinburgh and London: Oliver & Boyd, 1927, 6d. [63 (41).]

Fitzrandolph, Helen E., and Hay, M. Doriel.—The Rural Industries of England and Wales. III. Decorative Crafts and Rural Potteries. (168 pp.) Oxford: Clarendon Press, 1927, 5s. [63.193.]

Gardiner, R. Strachan.—The Agricultural Landowner's Handbook on Taxes, Tithe Rentcharge and the Death Duties (England and Wales). (Second Edition.) (178 pp.) London: Central Landowners' Association, 1927, 5s. [336.22; 348.]

Irish Land Trust.—First Report of Irish Sailors' and Soldiers' Land Trust, January 1, 1924, to March 31, 1926. (106 pp.) London: H.M. Stationery Office, 1927, 5s. [325 (415); 333.32; 69.]

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NOTES FOR THE MONTH

THE report of the work of the Intelligence Department for the two years 1924-26, just issued,* gives an account of the progress achieved in that period in the Ministry's schemes of research and advisory work, agricultural education, horticulture and live stock improvement. In presenting the report, Sir Daniel Hall expresses the hope that it shows that the resources which have been placed at the Ministry's disposal for such purposes have been economically used in the execution of a sound policy.

**Report of the
Intelligence
Department,
1924-26**

The period on the whole was one of consolidation, and the progress rendered possible by the provision of the Corn Repeal Fund in 1921 has been secured.

Research Institutes.—In this period the Institutes of Agricultural Engineering, at Oxford and of Animal Pathology at Cambridge were firmly established and have entered on what it is hoped will be long and distinguished careers. The Research Institutes may now be said to have reached a position of stability: the original scheme has been completed, and the research staffs, which expanded rapidly after the war, are in process of settling down. The crying need now is the provision of endowment funds. With the creation of the Empire Marketing Board and the convening of an Imperial Agricultural Research Conference for next October, prospects of organized influence and helpfulness throughout the Empire are opening before the Research Institutes, the primary concern of which, however, must always be the interests of the British farmer.

The maintenance grants paid to Research Institutes were £149,910 in 1926-27 compared with £147,450 in 1925-26 and

* Ministry of Agriculture and Fisheries Report on the Work of the Intelligence Department of the Ministry for the Two Years 1924-26, H.M. Stationery Office, Adastral House, Kingsway, W.C.2. Price 2s. 6d. net.

£134,710 in 1924-25. The capital grants in the two years totalled £10,700—a small sum compared with previous periods, the accommodation and equipment of the institutes now being reasonably complete.

Advisory Service.—In advisory work, the service of economic advisers in agriculture has been completed and now covers the whole country, and the number of assistants for dairy bacteriology—a staff designed for the improvement of the milk supply—has been largely augmented. The services of chemists, entomologists, and mycologists have been maintained at their full strength, and there are also a few advisory officers in veterinary science. A total of £57,820 was paid in grants to advisory centres in 1926-27 compared with £52,110 in 1925-26 and £41,670 in 1924-25.

Special Schemes of Research.—These schemes can be no more than mentioned in this short review. They relate to soil surveys, agricultural meteorology, crop variety testing, fruit variety testing, pig husbandry, new systems of farm management, electro-culture, basic slag, agricultural machinery testing, foot-and-mouth disease research, flax research, and field trials of Jerusalem artichokes.

Research Scholarships and Fellowships.—The scheme for selecting promising graduates (usually with first class honours in pure science) and training them in agricultural research in this country and abroad, to fit them for research and advisory posts, was continued, there being still a large demand for men. A similar scheme for securing recruits for the service of agricultural education was also continued. A number of travelling fellowships was again, in the period under review, awarded to agricultural research and advisory workers, to enable them to visit workers abroad and keep abreast of the progress of research in their own and allied subjects.

Agricultural Education.—The new buildings at Leeds and Bangor were practically completed during the period, and Liverpool University have been promised a grant towards an extension of their Veterinary Department on a £ for £ basis. The National Institute of Poultry Husbandry at the Harper Adams College of Agriculture was practically finished, and now constitutes the best experimental and instructional plant in this country. Two new farm institutes were opened (in East Sussex and Carmarthen), making a total of 16.

Maintenance grants totalling £49,100 in 1925-26 and £48,500 in 1924-25 were paid to universities and agricultural colleges; and annual grants totalling £210,000 (approximately) in

1925-26 and £177,000 in 1924-25 were paid to county authorities. The number of regular “higher agricultural education” students appears to have settled down at about 2,000. In the two years 1925 to 1927, the total number of whole-time instructors and instructresses employed by County Councils rose from 293 to 339.

An important change in administrative policy regarding agricultural education provided for younger students was introduced towards the end of the period under review. Previously, the Ministry's grants were limited to agricultural education intended for students above the age of 16, and the Board of Education were responsible for aiding such agricultural education as was provided for students below that age. During 1925, a revised arrangement was come to between the two Departments, under which instruction in agriculture for students between the ages of 14 and 16, outside that provided in elementary and secondary schools, will in future be aided by the Ministry.

Among special educational schemes supervised directly by the Ministry, mention should be made of the Young Farmers' Club Movement. An Inspector was appointed early in 1925 to take charge of this scheme, and through his efforts a considerable development has taken place. The Young Farmers' Club Movement attracts boys and girls at an age which is often a turning point in their lives; hence, the Ministry regards it as a valuable means of stimulating the young to an interest in a rural career.

Dairying and Small Live Stock.—One of the most noteworthy features in dairying education is the increased attention that is being given to the question of clean milk production. The number of clean milk competitions held increased from 7 in 1923-24 to 34 in 1925-26, and the number of competitors from 181 to 843.

The rationing of dairy cows provides one of the surest means of reducing the cost of milk production to the farmer. The conclusion of a Committee, set up by the Ministry, on the subject was that the general administration of a scheme of advice on rationing, uniform in its main principles, was both practicable and desirable, and a standard scheme was outlined which provided for the utilization of milk recording societies as extensively as possible.

It is the Ministry's policy to assist the development of the poultry industry mainly by facilitating the provision of instruction and advice by Local Education Authorities, and,

with the aid of grants from the Ministry, 53 County Authorities now employ expert Instructors for this purpose. Under the Egg-Distribution Scheme, operating in forty counties, there were, in 1926, 324 station-holders, and the total distribution of eggs was 132,169, and of chicks 68,252.

Scholarships.—The scheme of scholarships for the sons and daughters of agricultural workers has been successful. The experimental five-year period has just concluded and the Government has decided to continue the scheme in slightly amended form.

Horticulture.—Much work has been done in horticulture in the period under review, particularly in the direction of improving the marketing of fruit and vegetables by instruction and demonstrations in packing and grading.

As the result of action by the Ministry, the National Food Canning Council, comprising a number of tin-plate manufacturers, can makers, canners, and growers, was formed to promote the organization of food canning in co-operation with producers and distributors, so as to increase the quantity and consumption of home-grown produce. The Council proposes to endeavour to develop the home industry in every possible direction, so that it may the better compete with the products of the highly organized industries abroad.

The scheme for testing new varieties of fruit trees is progressing favourably, and many varieties of bush fruits have passed the initial tests at the Central Station at Wisley, and have been distributed to Sub-Stations for further trial.

Under the Destructive Insects and Pests Acts, Orders were made in 1924 and 1925 prohibiting the entry of potatoes from the United States and Canada on account of the prevalence of the Colorado Beetle in those countries. An order was also made in 1926 prohibiting the landing in England and Wales of raw cherries grown in France, unless accompanied by an official certificate that the Cherry Fruit Fly is not known to exist in the Department in which the fruit was grown.

The report on the administration of the Wart Disease of Potatoes Order of 1923 shows that the rate of spread of the disease has been materially checked.

Live Stock Improvement.—There was a very satisfactory measure of advance in the operations of the Live Stock Scheme during the period under review. Apart from the increase in the number of sires provided and the number of cows recorded under the Scheme, there has been a growing

interest in questions closely allied to breeding. The services and advice of the Ministry's Live Stock Officers and of the County Organizers are being increasingly sought in connexion with rationing, butter-fat testing, etc.*

The decline in the breeding of horses continued. Appreciable recovery was made, however, in regard to the operations of the Ministry's Heavy Horse Scheme which was revived in the season of 1924. Notwithstanding the somewhat serious position of the horse-breeding industry, it is satisfactory to note that the main object of the Horse Breeding Act, 1918, viz., the elimination of the unsound travelling stallion, is being achieved in a very large measure. During the years under review, only five unlicensed stallions were reported on the road, and, in all cases, proceedings were instituted by the police.

Steady progress was maintained by the Milk-Recording Scheme, indicated not only by the steady increase in the number of members, but also by the improvement which has undoubtedly taken place in the manner in which records are being kept, and by the interest which members are taking in such matters as butter-fat tests and rationing. Another feature which is worthy of notice is the increasing stability of the societies operating under the scheme. In 1925-26, the number of samples taken for butter-fat tests was 108,000 compared with 72,000 two years previously.

In conclusion, in the volume recently published by the Ministry, *The Agricultural Output for England and Wales for 1925*, the total output of the land is estimated at 225 million pounds for that year. The State expenditure on agricultural education, research and allied activities may be taken in round figures at £700,000 per annum, i.e., less than one-third of 1 per cent. of the agricultural output.

* * * * *

THE last beet sugar manufacturing campaign was the most successful since the introduction of the subsidy. The acreage under beet was more than double that of the previous year and five additional factories were available to handle the crop. Increased experience in cultivation and the happy circumstance of a favourable growing season were reflected in a much larger production of sugar per acre of land under sugar beet.

* The Annual Report on the Live Stock Improvement Scheme for the year 1925-26, will be found on page 418 of August issue of the JOURNAL.

The general results of the campaign, compared with those of the previous one, may be summarized as follows :—

	1926-27	1925-26
Acreage under sugar beet.. ..	129,463	56,243
Average yield per acre (tons)	8.63	7.67
Number of factories	14	9
Average No. of days worked*	114	87
No. of workers employed in factories ..	7,194	4,613
Tonnage of beets delivered to factories ..	1,117,072	431,185
Average sugar content of beets (per cent.)	17.31	16.36
Average price paid per ton of beet ..	59s. 5½d.	55s. 6d.
Total production of sugar (cwt.) ..	3,069,739	1,035,672
Average extraction of sugar expressed as percentage of beets delivered to factories	13.83	12.01
Average farm output of sucrose per acre of beet grown (lb.)	3,346	2,809
Average factory output of commercial sugar per acre of beet grown (lb.) ..	2,656	2,063
Production of By-products :—		
Molasses (cwt.)	715,886	270,910
Pulp (tons) { Dry	62,800	21,795
Wet	26,138	31,481
Subsidy paid :—		
Sugar	£2,990,973	£1,009,019
Molasses	317,892	112,562
Total	£3,308,865	£1,121,581

* England and Wales only. To July 31, 1927.

N.B.—It should be remembered that the factories have to pay Excise Duty on the sugar they produce at the rate of 7s. 4½d. per cwt. (ex. 98 deg. polarization).

It will be noted that the production of dried beet pulp increased from 21,795 tons in 1925-26 to 62,800 tons in 1926-27, whilst the quantity of wet pulp fell from 31,481 tons to 26,138 tons. It may be added that the quantity of dried pulp exported rose from 4,657 tons in 1925-26 to 36,760 tons in 1926-27, being 21.4 per cent. and 58.6 per cent. respectively of the total output. Most of the pulp exported went to the U.S.A., where there would seem to be a ready market for this useful feeding stuff. In view of the heavy importations of feeding stuffs it is unfortunate that farmers in Great Britain have not made more use of this very valuable by-product rather than let it go out of the country. An account of the composition, nutritive value and uses of dried sugar beet pulp was given in this JOURNAL for May, 1927, p. 175.

ARISING out of a resolution passed at a meeting called by the Scottish Agricultural Organization Society on June 22, 1926, a special Committee was set up in Scotland, with Major Mark Sprot of Riddell as convener, to formulate a policy for the guidance of Scottish pig breeders and feeders.

Report of the Scottish Pig Industry Committee

It is of interest that the findings of the Committee, as set out in a Report issued on July 6, agree generally with the suggestions contained in the Ministry's Report on Pig Marketing.* The Scottish Committee, in their recommendations regarding breeding, are, however, even more restrictive than the trade associations in England and Wales, and for both the bacon and pork trades, recommend either (a) pure Large Whites of a suitable type, or (b) a first cross between a Large White boar and a Middle White sow. The Committee add, that a first cross between a Large White boar and a Large Black sow is also acceptable to a number of curers. It is significant that the Committee definitely recommend the Board of Agriculture for Scotland to restrict its premiums to boars of the Large White breed. It is also of interest to note that an experimental station for the testing of pigs, as part of a scheme of "advanced registry" on Swedish lines, is nearing completion at Liberton, Edinburgh.

Attention is drawn in the Report to the unsatisfactory position regarding price-recording of live pigs, and it is recommended that an effort should be made to secure a standard classification on the basis of that suggested in the Ministry's Report on Pig Marketing.

The Committee draw attention to the fact that curers complain of the miscellaneous character of "dealer-collected" consignments, and recommend the establishment of live-pig marketing societies on the lines of that operated by the Eastern Counties Farmers' Co-operative Association at Ipswich.

Finally, the Committee recommend that a standing body should be appointed to co-ordinate the development of the industry generally. This accords with the suggestion, made in the Ministry's report referred to above, that a Pig Industry Council should be set up in England and Wales.

* Economic Series, No. 12. H.M. Stationery Office. Price 6d., post free 8½d.

IN the April issue of this JOURNAL was given a list of the centres at which marketing demonstrations were to be given by the Ministry this year. The summer programme, up to and including the Royal Welsh Show at Swansea (July 29-August 2), has now been completed. The nature and scope of the demonstrations have been fully described in the JOURNAL, and it is sufficient to say that they have aroused considerable interest and elicited many expressions of appreciation. It is significant that nearly 3,500 copies of the Economic Series of reports were sold at the demonstrations.

The revised programme for the autumn is as follows:—

Show or District	Place	Date	Subjects to be demonstrated
Shropshire ..	Shrewsbury ..	Sept. 27-28 ..	Eggs & poultry
Herefordshire ..	Hereford ..	Sept. 28-29 ..	Fruit
Worcestershire ..	Pershore ..	Oct. 4-5 ..	Fruit
Gloucestershire ..	Grange Court Market	Oct. 11-12 ..	Fruit
London Dairy Show	Agricultural Hall	Oct. 18-21 ..	Eggs & poultry; pigs
*Lincolnshire Potato Show	Spalding ..	Oct. 27.. ..	Potatoes
Imperial Fruit Show	Manchester ..	Oct. 28-Nov. 5	Fruit
*York Potato Show	Doncaster ..	Nov. 8	Potatoes
*Durham Potato Show	Durham ..	Nov. 2	Potatoes
Birmingham Fat Stock Show	Birmingham ..	Nov. 26-Dec. 1	Pigs
Smithfield Show	Agricultural Hall	Dec. 5-9	Pigs; potatoes
West of England Show	Plymouth ..	Dec. 14-15 ..	Pigs

* Provisional.

STRAWBERRY INVESTIGATIONS AT LONG ASHTON. 1.

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Introduction.—In recent years the yield of fruit obtained per acre by strawberry growers has in many cases been most unsatisfactory when compared with that obtained a number of years ago. It is frequently stated that where 2 to 4 tons to the acre used to be obtained the yield is now only 15 cwt. to 30 cwt. There were certain recognized diseases affecting the strawberry, e.g., leaf spot, mildew, red plant and cauliflower. These, however, by no means entirely accounted for the serious reduction in yield. The other causes of failure were obscure.

Some suggestions have been made to account for this decrease in crop, e.g., that in some cases the land was becoming "strawberry sick" owing to being continuously cropped with strawberries. Another suggestion was that the varieties at present in commercial cultivation were old, i.e., had been propagated vegetatively for a large number of years and had deteriorated. A third possibility was that strawberries had become contaminated by some virus disease such as affects potatoes or tomatoes. Another very credible suggestion brought forward was as follows: During the Great War the acreage of strawberries had been considerably reduced; when hostilities ceased there was a rapid expansion of the area under strawberries and consequently the demand for runners was greater than the supply of really good material. The result of this was that a great deal of inferior material was used, and diseased and weakened stocks were greatly multiplied.

The need was apparent for a detailed knowledge of the life history of the strawberry plant and also for an investigation of the causes underlying the differences between one strain* and another. The former was required as a basis for any investigation of the pathology of the strawberry. Subsequent observations revealed the importance of the strawberry aphid

* In this article the word "strain" is used in its widest sense, no definite genetical variations being implied.

as a factor affecting the strawberry crop. It had been observed for some years, but no serious importance had been attached to its presence as a pest affecting the strawberry crop.

These considerations made it clear that any analysis of the various problems of strawberry growing must be preceded by a thorough investigation of the development of a normal healthy plant. This having been obtained, the influence of certain other factors such as methods of cultivation, strain and disease, can be assessed in their true relationships. For these reasons the following plan of investigations has been carried out at Long Ashton:—

- I. The investigation of the life history of the normal strawberry plant.
- II. The various effects of the following external factors on the development of the strawberry plant:—
 - (1) Time of planting.
 - (2) Methods of planting.
 - (3) Methods and time of cultivation.
 - (4) Mechanical damage to crowns and roots.
 - (5) Deblossoming.
 - (6) Climate and locality.
- III. "Strain" investigations.
- IV. "Red plant."
- V. The strawberry aphid (*Capitophorus fragariae*).
- VI. Investigation of other types of abnormal strawberry plants.

In this paper, an account is given of the work which has been carried out on these subjects during the past three years, emphasis being laid on the practical importance of the results which have been obtained. References are given to articles in the *Journal of Pomology* and elsewhere in which detailed accounts of the investigations can be found.

The Life History of the Normal Strawberry Plant.—Field observations in the spring and summer of 1924 showed clearly the necessity of a more adequate knowledge of the normal development of a healthy strawberry plant from the date of planting through two or three consecutive seasons, and experiments were commenced by the writers in September, 1924. Some 1,200 plants of the variety "Royal Sovereign," obtained from a reliable source, were planted at Long Ashton on September 2, 1924. These plants have been carefully lifted, in batches of ten, at intervals of from three to six weeks, for the past two years. Detailed observations, both qualitative and quantitative, have been made which have been fully described and discussed in previous publications (4, 5, 9, 14).*

* The numbers in brackets refer to the bibliography at the end of the article.

It is proposed to present here a brief résumé of these results.

From the date of planting onwards, until the middle of December, there is a very marked growth of the root system in a normal healthy runner. Numerous new white roots arise from the crowns, and strong lateral roots develop on the main roots of the original runner root system (Fig. 1). During this period, little growth of the crowns occurs, and there is a gradual dying back of the foliage. In this condition, the dormant season is passed (Fig. 2).

During February internal changes, revealed by the quantitative results obtained, mark the recommencement of active growth. By the middle of March close examination of the root system shows that numerous fine lateral roots are beginning to appear. These roots have their origin on the strong autumn-formed roots and also on the original runner roots. Little change in shoot growth is observable at this date.

Towards the end of April, it is observed that very prolific production of new fibrous roots has taken place. These finer roots we have described as feeding "roots" and they form the most important absorbing organs of the plant. Few main roots are produced at this period, the chief activity of the root system as a whole being directed towards the establishment of an efficient absorbing surface by means of the development of numerous lateral roots on the main "scaffold" roots formed in the previous autumn. Shoot growth has advanced considerably by this date, and a normal plant shows three or four new leaves on each crown with, generally, a partially expanded flower truss.

During May and early June, there is very little change in the bulk of the root system, but a very pronounced colour change occurs. The older roots turn brown and finally black. This is not a death symptom but marks a definite phase in the normal development of the strawberry root. At the commencement of the growing season, a specialized circle of rapidly dividing cells arises just inside the central conducting cylinders of the main roots. This layer (the so-called phellogen or cork-cambium) divides rapidly, giving rise to a mixed secondary tissue within the white outer tissues (cortex) of the root. Certain definite circles of cells in this tissue are cork cells. As a consequence, the outer tissues of such roots, being cut off from water and food supplies by the secondary cork layer, commence to disintegrate. The progress of this disintegration is revealed by the colour changes from yellow

to brown and finally black. At the final blackened stage, the dead outer tissues may be readily removed, revealing the healthy central core of the root system protected by the secondary cork tissue. Meanwhile, growth of the "tops" has proceeded rapidly, and, by the first week in June, fully developed foliage and half-ripened fruits are present (Fig. 3).

Little further change in the root system is observable through the cropping season and before the middle of July. By this time it is generally possible to observe the commencement of a new phase in the development of the root system. To the right and left of the leaf bases of the earliest formed leaves new roots commence to make their appearance (Fig. 4). This marks the beginning of what we have termed the post-cropping stage of root growth, and it is of the utmost importance that everything possible be done to ensure this phase being vigorous. With reference to shoot growth, new foliage is produced and daughter crowns commence to develop, usually one on either side of the bases of the dying fruit stalks.

During August, a rapid advance in the development of the new roots observed in July occurs, and new roots are also produced at the bases of the daughter crowns. Shoot development has also advanced considerably (Fig. 5).

This vigorous development of the root system continues after shoot growth has ceased, and it is very probable that the chief factor arresting this vigorous development is that of decreasing soil temperature. Thus, when the second dormant season is reached in December (Fig. 6), a normal strawberry plant exhibits the following features:—

Root System.—(1) The original runner roots are much thickened and black, owing to the large development of secondary tissue. These roots are often much twisted and are furnished with strong lateral roots.

(2) Long, much-branched roots, formed in the period immediately after planting, are also much thickened and dark in colour.

(3) A few less vigorous, primary roots formed in the spring, are usually less thickened and yellow-brown in colour.

(4) Numerous long, white, primary roots of the post-cropping period arise from the main crown and daughter crowns and approximately one inch above the root system of the cropping period. This portion of the root system forms about one-half of the total bulk in a normal plant: a smaller proportion denotes impaired vigour.

Shoot System.—By this date, the foliage is for the most part dead or dying, and each crown possesses two or three small, deep green leaves.

In a general way, the sequence of root and shoot development in the second, and part of the third seasons, from the date of planting, is essentially the same as that described

above. Results obtained from subsequent observations on the same batch of plants confirm in all essentials those previously recorded, but certain features require special reference.

It was particularly observed during the course of the first year's observations that very little death of the roots occurred at any period during the season. Apart from decay of one or two runner roots damaged in planting, death of the roots was almost entirely confined to the very fine feeding roots produced during the spring, and this only occurred towards the end of the cropping season, when the development of the post-cropping, new roots had already commenced. At the same time, it was observed that the older roots, including the original runner roots, increased markedly in thickness. Similarly, in the second and third seasons, observations definitely established the fact that death of the main roots of a normal strawberry plant is exceptional. Thus, the root system of a normal three-year-old plant in the dormant season presents the following features: First, the very much thickened and twisted runner roots, with strong thickened branch roots, can be observed at the base of the old rhizome or crown. Next, above these, the strong main roots formed in the first season immediately after planting are succeeded by a similar mass of thickened brown roots formed in the post-cropping period of the second season.

Microscopic examination of the internal structure of the older roots shows that the specialized secondary tissue previously described is very strongly developed (15). Not only does this tissue form a protective layer by virtue of the numerous circles of cork cells produced, but it also contains many cells packed with starch grains. Calculations made from numerous sections have shown that, approximately one-third of the volume of the older roots is composed of this specialized storage tissue. With the recommencement of root activity and growth, there is a rapid depletion of the reserves of starch contained in this storage tissue of the older roots.

The older roots of this type are, in turn, followed by a third series of vigorous new white primary roots arising from the bases of the numerous daughter crowns, and developed in the late summer and autumn following the second crop.

This detailed study of the life history of normal plants extending over the greater part of three consecutive seasons has revealed the following important features:—

(1) A very vigorous production of new roots occurs immediately after the planting of the runner.

(2) These roots form the framework on which is built up an efficient absorbing system of fine "feeding" roots which support the plant during the spring and early summer period when the crop is borne.

(3) The development of new main roots commences soon after cropping and continues until the dormant season is reached. Thus, the period of greatest root growth generally follows the period of most vigorous shoot growth.

(4) A similar cycle is followed in both the second and third seasons after planting.

The Distribution in the Soil of the Roots of a Normal Strawberry Plant.—The observations recorded in the foregoing section were made on plants carefully lifted and washed free of soil. Though valuable information was thus obtained on the features of root development and the amount of root growth, little could be learned of the actual position in the soil of the various types of roots. Accordingly, during the dormant season, plants were carefully lifted in boxes sufficiently large to accommodate the plants with the entire mass of soil penetrated by the roots and great care was taken to avoid disturbing this mass of soil in the course of removal to the laboratory. Successive sections of the soil mass from a depth of 16 in. up to the surface layers were carefully washed through a fine sieve so that all roots were thus recovered. The roots obtained from each region were separately measured and weighed. From the measurements taken, a diagram was constructed to show the distribution of these roots beneath the crown (Fig. 15). The relative proportions of the root system in successive layers of the soil from the surface to a depth of 16 in. were calculated from the weights of roots obtained. The relative quantities of roots from the successive layers is illustrated in Fig. 16.

Distribution of the Roots of a Normal Strawberry Plant in successive regions of the soil from the surface to a depth of 16 in.

Region	Percentage of Total Roots in successive layers
Surface to 1 in. .. 25%	73% in first 3 in. of soil
1 in. " 2 " .. 22%	
2 " " 3 " .. 26%	
3 " " 6 " .. 17%	
6 " " 9 " .. 2.5%	10% below the 6 in. level
9 " " 13 " .. 4.5%	
13 " " 16 " .. 3%	

The figure constructed and the quantities quoted above show very strikingly the essentially surface-rooting habit of the strawberry plant. The writers fully realize that such factors as soil character and soil moisture may modify the distribution of roots considerably. The plants which yielded these results were grown at Long Ashton in a medium loam sufficiently

well drained, a type of soil commonly encountered in strawberry growing districts in this country. Observations on plants grown in soils of considerably lighter texture have shown that, though rooting is less restricted, the distribution of the roots is not essentially different from that described above.

In the diagram, roots developed in the post-cropping period are represented in lighter colour. It is observed that the bulk of these roots lie in the uppermost three inches of the soil. It should be almost unnecessary, therefore, to point out the prime importance of *disturbing the soil in the proximity of the plants as little as possible* after a thorough cultivation, carried out as soon as practicable after cropping. The earlier this cultivation is completed, the better will be the opportunity for vigorous rooting, with a consequently more vigorous and more productive plant in the following June.

The Various Effects of Some External Factors on the Development of the Strawberry Plant.—(1) *Time of Planting* (10).—Following the general planting of runners on September 2, 1924, a second small batch of runners was planted in October, and a further number was set out in the spring of 1925. Plants from these two groups, treated similarly with regard to general cultivation, were examined concurrently with those from the normal series. The runners planted in spring were deblossomed. In this preliminary experiment, the results showed clearly that delayed planting very seriously impaired the vigour of the resulting plants. When examined in May, the plants from the October series were no more vigorous than those set out in the spring and the plants of both series were much inferior to those from the normal September-planted series.

A more comprehensive experiment was designed for the season 1925-1926, as follows: Batches of normal, healthy runners, of a vigorous strain of the variety "Royal Sovereign," each batch consisting of 200 plants, were set out on the following dates:—

August series	Planted August 8, 1925.
September "	" September 8, 1925.
October "	" October 8, 1925.
December "	" December 18, 1925.
Spring "	" March 18, 1926.

These plants were lifted at intervals and examined concurrently in the manner previously described for the normal series. Both qualitative and quantitative results were obtained which have been reported in full elsewhere (10, 14), and the main features of these results are summarized here.

The findings of the preliminary experiment, namely, that delayed planting resulted in reduced vigour, were amply confirmed. That early planting resulted in greatly increased vigour was very conclusively demonstrated by comparing plants of the August group with those of the September series. The normal sequence of vigorous root production in the period between planting and dormancy was followed in the first three series. Plants set out in December failed to develop new roots until the spring, when they appeared almost identical with plants from the spring series. This result serves to emphasize once more the great importance of the late summer and autumn phase of root production. There is no doubt that the performance of plants during the cropping season is determined to a very great extent by the vigour or otherwise of this root development. Plants set out in August reap a second important advantage. Previous work had shown that growth of the strawberry crowns continues until the end of September. If, therefore, runners are set out in early August not only is extra time gained for root establishment, but further development of crowns may also occur. In our experiments this was indeed the case, and, by the time the dormant season was reached, a typical plant of the August series possessed four strong crowns each with a considerable number of strong white primary roots. The plants of the later series were for the most part single crowned. At the commencement of the cropping season, the advantage of this early crown development became apparent, for each August plant produced from eight to ten strong flower trusses, as compared with two or three in the case of the September, and one in later planted runners (Figs. 9-12). In a general way, the August plants resembled average two-year-old plants rather than typical "maidens," and the fact that the *crop from these plants was almost four times that produced by the September series*, and proportionately greater than that from the October series, gives special significance to the resemblance.

The practical importance of these results may be summarized in a very few words, by stating that it is decidedly advantageous to plant out strawberry runners at the earliest possible date compatible with local conditions.

(2) *Methods of Planting* (11).—It has frequently been observed in the field that many weak plants often show very poor contact between the crowns and the soil, with consequently ill-developed root systems. Often on the crowns of



FIG. 1.—Photographed Oct. 13, 1924, six weeks from date of planting. The arrow indicates the position of the new primary roots developed since Sept. 2 of that year.

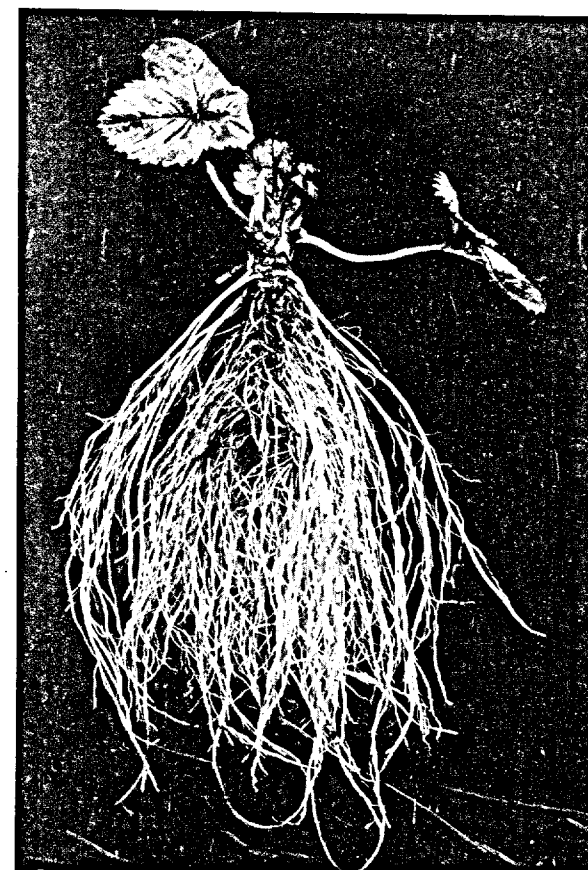


FIG. 2.—Showing the condition of the plant in the dormant season.

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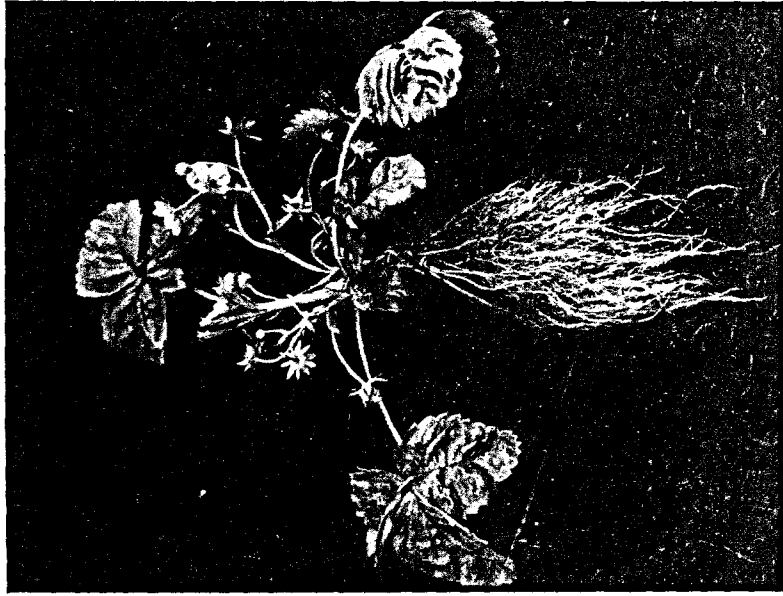


FIG. 3.—Condition of the plant in the flowering season.

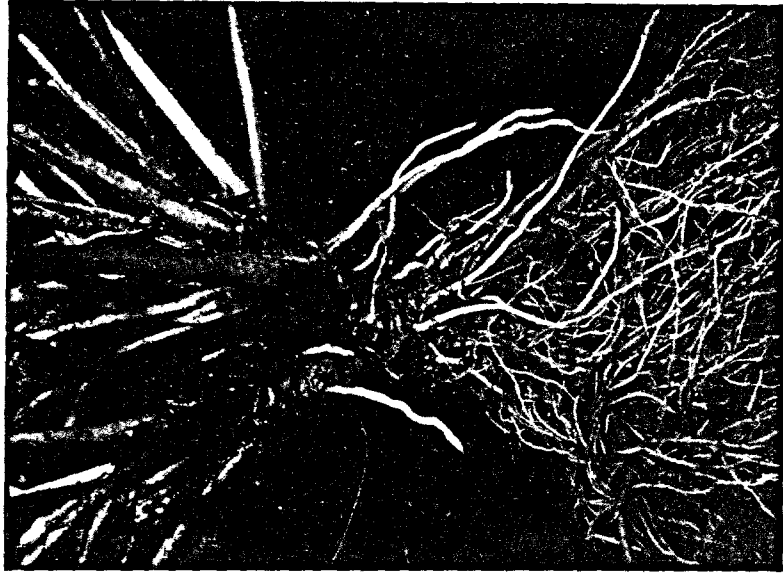


FIG. 4.—This photograph (July 20) shows the points of origin of the new roots which develop after the cropping season.

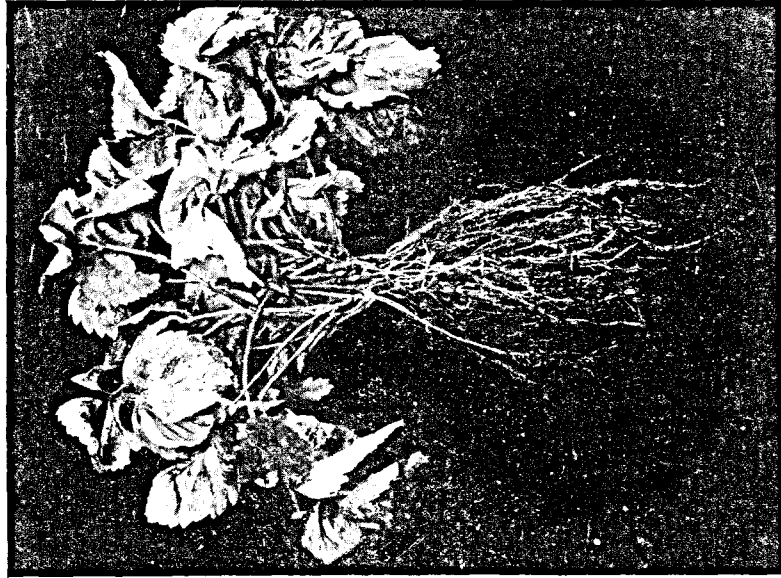


FIG. 5.—Condition of the plant twelve months after planting.

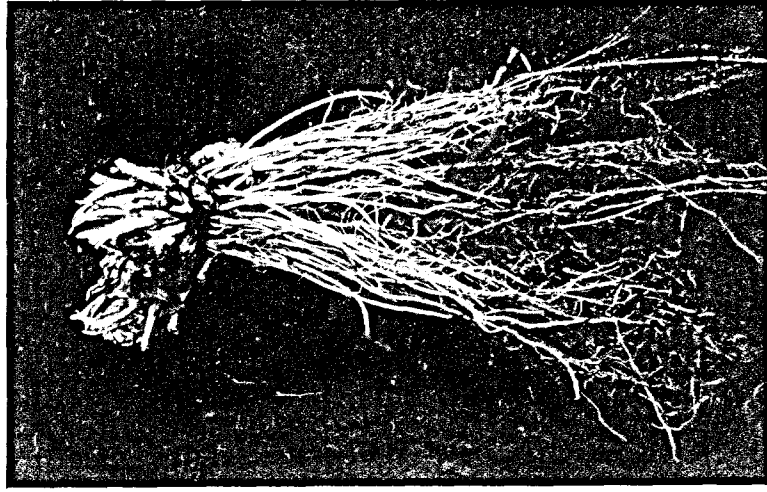


FIG. 6.—Crowns and roots of a plant at the commencement of the dormant season of its second year. (December 1.)

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(FIG. 7.—March 16, 1926, growth re-commenced. (Note the vigorous production of fine lateral roots.)

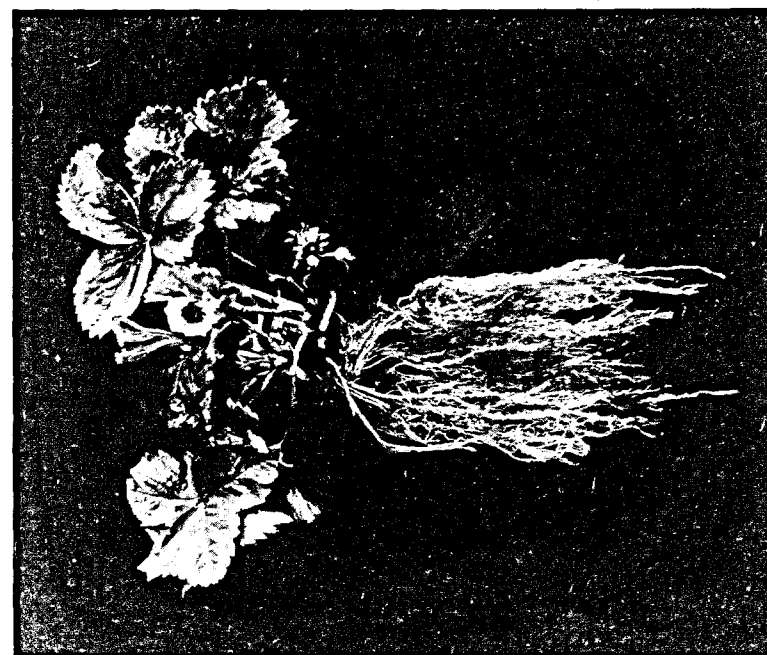
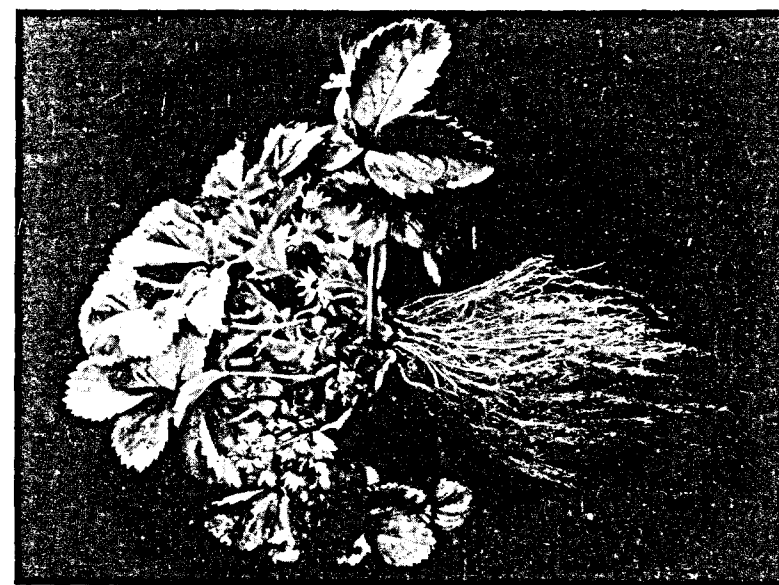
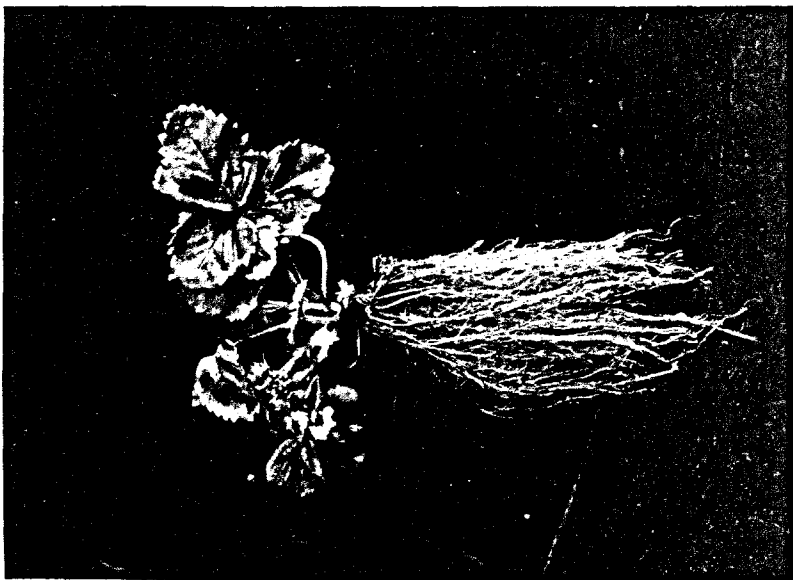


FIG. 8.—This photograph (taken Feb. 17, 1926) shows the quantities of new roots produced by runners planted in August, September, October and December, respectively, of the previous year.



FIGS. 9 and 10.—Time of planting experiment. Condition at blossoming period (April 27, 1926) of typical plants planted in August and September, respectively, of previous year. (See also Figs. 11 and 12.)



Figs. 11 and 12.—Time of planting experiment. Condition at blossoming period (April 27, 1926) of typical plants planted in December, 1925, and in the Spring of 1926, respectively. (See also Figs. 9 and 10.)

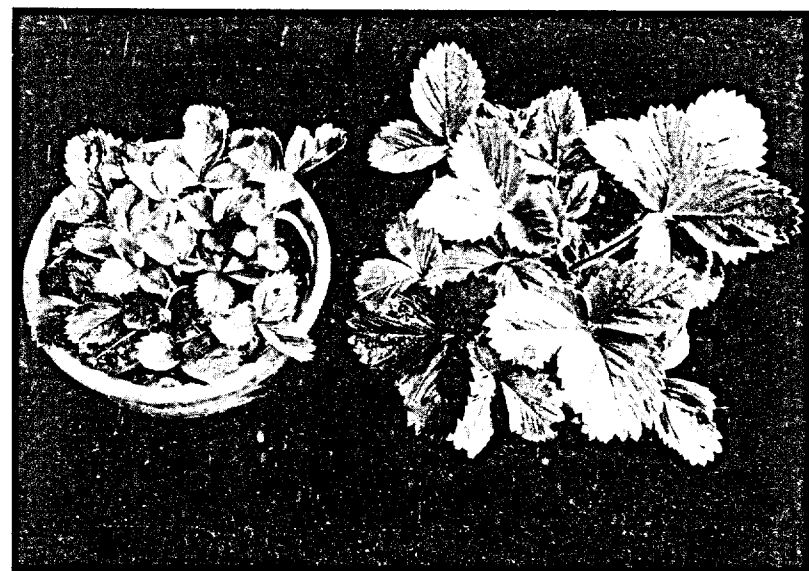


FIG. 14.—“Small-leaf” (Type 2) produced by water-logging. The plant on the right is a control plant which has not been subjected to the water logging treatment. Variety: Stirling Castle.



FIG. 13.—“Miffy” plants (Type 1) produced by crown damage.

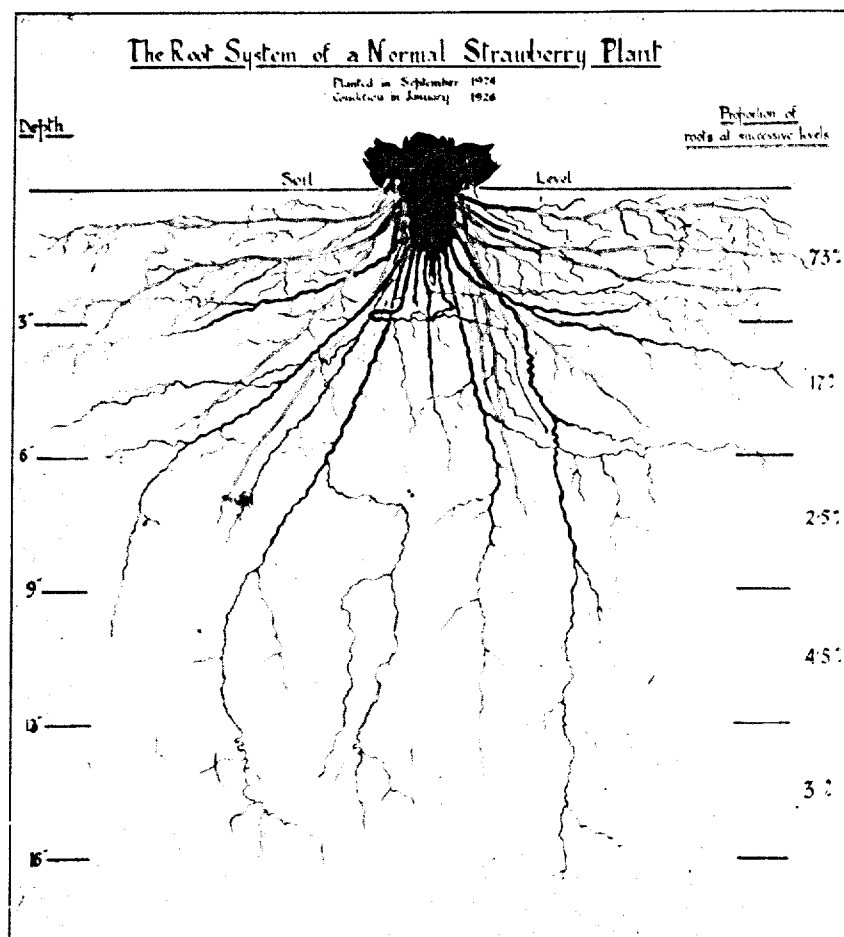


FIG. 15.—Root Distribution. Shows the distribution of the roots of a normal two-year-old strawberry plant in the soil.

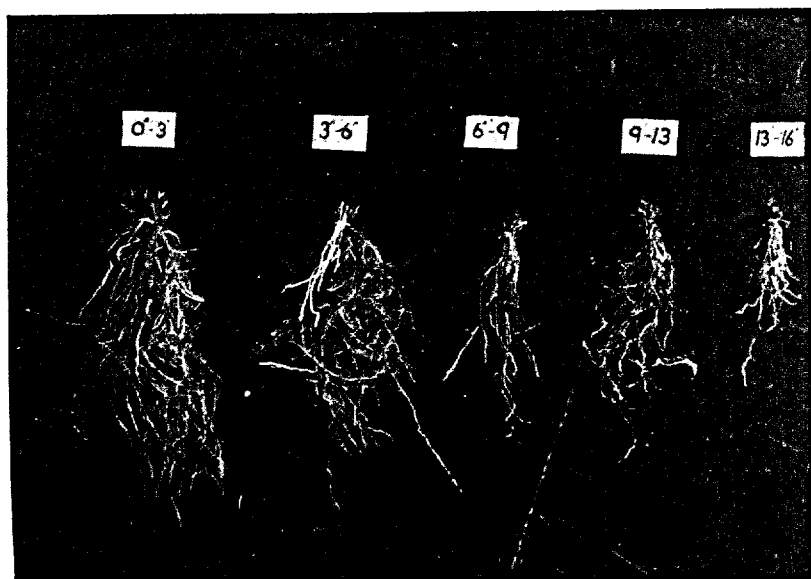


FIG. 16.—Illustrates the relative quantities of roots present in

such plants are found numerous stunted roots which have failed to reach soil level before the tips were killed by drying out. Experiments were commenced in order to discover whether planting methods had any influence on this condition. Batches of healthy runners were planted in September, 1924, and also in September, 1925, as follows:—

- (a) Planted at normal depth with the soil level up to the leaf bases.
- (b) Shallow planted with only the runner roots, to the base of the crown, below soil level.
- (c) Deep planted, with the whole of the crown below soil level.
- (d) Roots trimmed before planting. Approximately half the runner roots were cut off from the base and the plants set out at normal depth.

The above experiment has been twice repeated, and the following results have been obtained.

The effect of shallow planting was generally shown in a marked reduction in vigour. Root formation was decidedly poorer in this series than in any other. New roots, formed higher up on the crowns, failed to reach the soil and remained in a stunted, useless condition. The foliage produced by these plants was small and pale green, and there seems no doubt that such a condition is the direct result of inferior root development.

Deep planting caused abnormal lengthening of the crowns, but produced no serious ill-effects. There is, however, a tendency to cause damage to the main crowns by rotting when runners are planted so deep that the crowns are smothered with soil.

The root-trimming experiment was carried out to test under our conditions the advantage or otherwise of the current Canadian practice. As a result of cutting the main runner roots, vigorous strong lateral roots were produced near the cut ends within six weeks of planting. These roots grew out almost horizontally from the runner roots, forming an efficient anchoring root system. Such a development may be of considerable advantage, especially in lighter soils where there is a tendency for plants to "lift" as a result of frost. When plants of this series were examined along with normal plants one year after planting, they appeared to be neither better nor worse for the treatment.

To summarize, shallow planting is bad, since it leads to the production of weak plants with poorly developed root systems and frequently leads to a type of weak "small-leaf" plant later in the season. It is better to err on the side of deep planting, though losses may occur from smothering the crowns

with soil. Best results are obtained when the bases of the lower leaves mark the position of the soil level at planting.

(3) *Methods and Time of Cultivation.*—The ill-effects of shallow planting described above have shown the importance of maintaining good contact between the crowns and the soil. Frequently, in the course of cultivation, hoeing is necessary close to the plants. In this way, soil is removed from the neighbourhood of the crowns and, frequently, roots are disturbed and damaged. The longer cultivation is delayed, the greater is the resulting damage. From the knowledge of the normal distribution of the strawberry roots, it is obvious that disturbance of the soil in the proximity of the plants is bad practice. Further, as soil is scraped away, the chances of new root establishment are diminished and the net result is the production of a small-leaved weak plant. This result has been conclusively confirmed by experiment.

Conversely, experiments were carried out to discover whether any advantage was to be gained by "earthing-up" the plants slightly at various times during the season. It was found that slight earthing-up, the best time being in late July, had a markedly beneficial effect on the general vigour of the plants in the following season.

(4) *The Effects of Poor Drainage and Consequent Water-logging.*—In certain cases it was observed that plants growing in badly drained portions of a field showed a marked tendency to produce numerous weak crowns and small leaves. In such cases, the contact between soil and crowns was good, and it was therefore necessary to seek some other cause of the abnormality. Examination of the root systems showed that considerable death of the roots had occurred, especially of the finer lateral roots with their masses of fine feeding roots.

Root killing in these instances could not be attributed to any definite parasitic fungus, and it was decided to examine experimentally the effects of water-logging. Vigorous plants in large pots were grown in troughs containing water to within three inches of the soil surface. The experiment was commenced in April and within three weeks the ill-effects of water-logging were apparent. After flowering and fruiting the control plants were quite vigorous and healthy, but the water-logged plants showed abnormally small pale foliage and numerous weak crowns (Fig. 14). Examination of the roots showed that much death had occurred up to the level reached by the water, and subsequent root development had been very poor.

(5) *Mechanical Damage to Crowns and Roots.*—(a) *Damage to the Crowns.*—In the course of field observations in the spring, young plants were commonly observed to possess four or five very weak crowns instead of the normal strong single crown. Usually, these weak crowns produced imperfectly developed leaves, the stalks of which were often bright red in colour. Such plants may be confused at first sight with runners affected by the disease known as "red-plant" or "red-leg" (1, 3, 12). Subsequent observations on a large number of individual plants showed that, with increased growth, the weak crowns became normal, produced normal foliage and, in the following season, normal flowers. The whole plant, however, exhibited a bushy appearance unlike that of a perfectly normal specimen.

When plants of this type were examined at an early stage it was invariably found that the main crown had been damaged, or, for some other reason, had ceased to develop. Often the damage could be attributed to an accidental stroke with the hoe. As a result of this stoppage of the main growing point, four or five weak lateral buds in the axils of leaves, just below the point of damage, had started to grow rapidly, often before the embryo leaves in the buds had reached their normal stage of development. Thus, the first leaves were often forced into growth when only partially formed, but later in the season, true leaf form was attained. Damage of this nature frequently occurs to runners, and the multiple-crowned plant observed as a result in the spring is termed a "Miffy" plant by many strawberry growers (Fig. 13). Such plants may recover and make good two-year-olds, but bear no fruit in the first season. Many so-called "blind" plants are produced in this way.

The above observations have been fully confirmed by experiment. The main crowns of runner plants and also of plants in their second and third seasons have been cut off at different times during the year and subsequent development has been closely observed. By this means, the special features and the various stages of recovery outlined above have been exactly reproduced both with pot plants and in the field.

(b) *Damage to the Roots.*—Following experiments on the effects of shallow planting, hoeing the soil away from the plants and water-logging, it was decided to test the effect of mechanical damage to the roots. For this purpose, strong runners were planted in September, 1925, and batches of 25 plants were treated as follows. Using a knife with a long stiff blade, a complete circle approximately four

inches in diameter was described around each plant. The knife was plunged sufficiently deep into the soil to sever roots outside this region. Four batches of 25 plants were treated in this manner (a) in October, (b) in the dormant season, (c) in late spring, and (d) immediately after cropping. The plants treated in the dormant season and in the spring showed the greatest ill-effects from the treatment. These plants were much inferior in general vigour to the control series. The root system was much smaller, the crowns weaker, and the leaves markedly reduced in size. Plants damaged in October showed similar reduction in size and vigour, though to a less marked degree. Those plants treated after cropping showed no marked ill-effects from the damage.

The experiments show that damage to the roots, after the period of autumn root growth and before the cropping season, has a definite weakening effect and leads to the production of a type of inferior, small-leaved plant. The fact that little damage accrued from the treatment immediately after cropping would indicate that this is the most suitable time for the most thorough cultivation of the strawberry beds.

(6) *Deblossoming* (5).—It is a current practice in certain strawberry-growing centres of Great Britain* to plant runners extensively in the spring. Such plants are deblossomed during the first season and carry their first crop some fifteen months after planting. Underlying this practice is the belief that a runner set out in spring is not sufficiently well established to support a crop during the following summer. A study of the normal sequence of root and shoot development has fully confirmed this view, and further experiments have proved that the general vigour of plants is considerably increased when deblossoming is carried out. Plants set out at various dates from September to the spring have been treated in this way with the constant result of improvement of vigour from deblossoming.

For this reason, the practice is advisable in the case of weak plants. The same treatment may often be recommended in the case of the runner bed where the object is to produce first-class runner material. In this instance, since the large

* It is frequently the case that winter conditions are too adverse for runners set out in the autumn and losses are too heavy to render practicable such planting. It is suggested, however, if planting were possible at an early date in August that by the time winter conditions were reached, the strong, well-developed August-planted runner would be sufficiently well established to withstand the rigours of winter.

food reserves are not drawn upon to nourish a developing crop, more energy is available for the production of vigorous vegetative shoots, including runners.

(7) *Climate and Locality* (10).—Work on this subject has not yet advanced very far, but some information has been obtained. In September, 1925, runners of the variety "Royal Sovereign" were planted at Hoveton, Norfolk, and it has been possible to examine batches of these plants concurrently with batches of plants of the same age and variety planted at Long Ashton in September, 1925.* The Hoveton soil is a much lighter alluvial soil than that at Long Ashton. The average yearly rainfall at the two centres is respectively 26.48 in. and 34.88 in.

The comparative observations so far made show that plants at both centres exhibited precisely similar phases of normal root and shoot growth, following closely the sequence of normal development previously described. The Hoveton plants showed a more rapid and abundant production of roots in the autumn, a feature connected with the lighter texture of the soil, which is known to allow of free root development. In all other respects, differences were of a very minor order.

Plants were set out at Hoveton as the conditions in Norfolk offered a considerable contrast to those at Long Ashton. It therefore appears unlikely that local conditions can modify to any serious extent the normal sequence of root and crown development carefully worked out at this Station.

(To be concluded.)

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* The writers desire to express their thanks to Mr. A. C. Drake, Fruit Foreman, Hoveton Fruit Farm, Wroxham, Norfolk, who personally superintended the cultivation of these plants, and forwarded samples when they were required.

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HERBAGE SEED PRODUCTION IN NEW ZEALAND :

IV—PERENNIAL RYE-GRASS AND CRESTED DOGSTAIL

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Perennial Rye-grass.—An altogether larger acreage is devoted to the production of the seed of perennial rye-grass than of any other herbage species in New Zealand. Before 1914, the acreage annually cut was about 50,000, the total crop frequently exceeding 8,000 tons. During the period 1916-18, the area increased to over 70,000 acres and then decreased, but in 1924-25 it had risen to over 66,000 acres, with a total yield exceeding 13,000 tons of seed. By far the largest amount of the crop is used for home consumption; in 1924-25, the total export was only 1,152 tons, 906 tons of which went to Australia. The amount of New Zealand perennial rye-grass reaching the European market is negligible and, consequently, the interest to the British farmer is only in connexion with the general practices adopted with reference to seed production and the relation of those practices to the quality of the seed and to the character of the strains which the seed represents.

Seed Production in Relation to Farm Practice and Habitat.—Perennial rye-grass is, to a far greater extent than red clover, definitely relied upon as a seed-producing crop in many

districts of New Zealand. That is to say, the harvesting of a seed crop will not depend upon a variety of contingencies, but rye-grass seed, equally with wheat, is regarded as a crop to be produced and turned to cash account every year. Thus, on most Canterbury farms, the main lines of production are fat lambs, perennial rye-grass seed, and wheat. The leys are therefore sown, as much with a view to seed production, as to the herbaceous keep that they will provide for farm stock. The harvesting of a seed crop from leys is chiefly practised in the Canterbury Plains, in Southland, and, to some extent, in Otago, in the South Island; also in the Sandon district of the North Island. Perennial rye-grass is also harvested in limited amount from quite old swards in the North Island, particularly in the Poverty Bay and Hawke Bay districts.

Harvesting Practices : Canterbury Plains.—The rye-grass is frequently sown in leys with red clover, when the seed crop is usually taken in the second harvest year. It is, however, often the practice to sow rye-grass in the autumn and to take a seed crop the following summer (= first harvest year). The paddocks are shut up for seed in the middle of September. It is a fairly common practice, when rye-grass is growing with red clover, to turn a comparatively large head of sheep for a restricted grazing period into the seed-producing paddock, about two-three weeks before cutting the crop, as the sheep will eat down the clovers (which, as explained in a previous article, are usually abundant in the second and even the third year) without harming the rye-grass. The crop is cut with a self-binder when dead ripe, despite the risk of shedding, is stooked in the field for about 10-14 days, and is invariably thrashed from the stook, and it is the feasibility of doing this that is largely responsible for the profitable production of rye-grass seed. The straw after thrashing has a fair feeding value and is altogether more relished by stock than that of Italian rye-grass. Hair-grass (*Festuca bromioides*) is a plentiful and troublesome weed.

Seed crops are not infrequently taken from leys that have been down to grass from three-four years; the seed is then taken with a stripper, when it is essential that the crop should be dead ripe.

Southland.—The Southland farming resembles that of the Canterbury Plains, except that oats take the place of wheat in the rotation. The rye-grass may be sown in a mixture of the general type, 20-40 lb. perennial rye-grass, 5 lb. cocksfoot,

1 lb. crested dogstail, and 1 lb. white clover, seed crops being taken in the second and third harvest years. Rye-grass is, however, not infrequently sown in the autumn (April) and a seed crop taken the following (= first harvest) year.

In the seed-producing districts of the South Island, oats and rye-grass are sometimes sown together in the autumn (April), the two species being harvested together for seed the following December—that is to say, a seed crop is taken within about eight months of sowing.

Sandon.—The rye-grass leys are almost invariably spring-sown in this district, and are then fed off during the autumn and winter, a seed crop being taken in the first and, sometimes, again in the second harvest year. The crop is cut with a self-binder and, as elsewhere in New Zealand, thrashed from the stook—normally only standing about 14 days, but in adverse seasons the stooks have been known to stand on the paddocks for nearly two months. The rye-grass straw after thrashing is often sold to local dairymen for £4 per ton.

Yellow suckling clover is generally abundant on the rye-grass leys, over 40 lb. of suckling clover seed sometimes being cleaned from an acre of rye-grass. New Zealand suckling clover, thus cleaned from the perennial rye-grass, finds its way to an appreciable extent on to the European market.

Yield.—The average yield of seed from New Zealand, as a whole, runs to about 400-600 lb. per acre, but yields of well over 800 lb. are frequently recorded. The bushel weight of dressed seed is usually high, ranging from 26 to 36 lb.

Strain in Relation to Methods of Seed Production.—It will have been noted that the methods of seed production allow from as short a period as eight months in sward to two or three years, and, in extreme cases, to upwards of twenty years. It used to be claimed for Poverty Bay seed that it was always harvested from old swards and, in the past, much of the Sandon rye-grass came originally from Poverty Bay old swards. At the present time it would seem probable that much of the seed harvested from the Hawke Bay and Poverty Bay districts is not necessarily taken from old swards, while the Sandon growers are perhaps not going to these districts as much as formerly for a change of seed. It yet remains true that there are certain broad distinctions between "Poverty Bay," "Sandon," and "Southern" rye-grass. It is a well-recognized fact that "Southern" rye-grass tends to contain a much higher percentage of Italian rye-grass than does

either Sandon or Poverty Bay. It is also a fact that Southern rye-grass gives a fine "bold" sample of high viability. The considerable practice of autumn sowing, followed by taking a seed crop in the first harvest year, inevitably tends to constitute a selection not only in favour of Italian rye-grass but also of the quicker growing and more short-lived strains of perennial rye-grass; particularly so, if this practice is followed year after year without change of seed. Comparative trials at the Welsh Plant Breeding Station have shown that these "Southern" rye-grasses do, in fact, contain an excess of strains of a stemmy and early type which, in comparison with British indigenous strains, and with ordinary Irish and Ayrshire commercial strains, do not render "New Zealand" rye-grass an attractive commodity.

Lots under test, received as "Poverty Bay," have, in no case, compared favourably, in respect of the characteristics of the plants produced, with plants derived from seed representing the cleanings of wild white clover from old British swards—but the different lots have varied very considerably. Many of the "Poverty Bay" samples have given rise to a certain proportion of plants having the characteristics of density and leafiness which betoken the harvesting of seed from swards that have been down to grass for a period of years rather than months.

It is significant in New Zealand that both "Sandon" and "Poverty Bay" seed command a higher price than "Southern," but it is equally significant, having regard to the varied practices of seed production adopted in that country as a whole, that samples of "New Zealand" rye-grass tested at Aberystwyth have, in general, shown a greater mixing and a greater variety of strains per lot than is usual in the case of seed obtained from other and ordinary commercial channels.

As both the seed merchant and the farmer now look, very rightly and properly, for long-lived strains of herbage plants, and also consider germination and purity in relation to strain, and further, in view of the fact that New Zealand cocksfoot does definitely constitute a long-lived strain, and that much of the New Zealand white clover is also satisfactory in this respect, it is appropriate to voice a word of warning in respect of New Zealand perennial rye-grass.

It is more than probable, indeed practically certain, that in New Zealand there are excellent long-lived strains that could be harvested and marketed as such if the necessary

precautions were taken. It remains a fact, however, that no single lot of ordinary commercial New Zealand seed that has been tested at Aberystwyth (whether designated "Poverty Bay" or "Sandon") has approximated in average leafiness and desirability to the lots of British "ex-wild white" under contemporaneous test.

It is to be hoped, therefore, that "Poverty Bay" rye-grass will not begin to find its way on to the British market as a cheaper substitute for our own "ex-wild white"—or at all events will not do so until complete tests in this country, with properly authenticated lots of seed, have fully justified such a procedure.

Crested Dogtail.—Before 1914, it was only occasionally that New Zealand produced more crested dogtail seed than was required for home consumption, namely, about 150 tons per annum. In more recent years, the area devoted to seed production has increased, and, in 1921-22, was as much as 6,713 acres, with an output of over 600 tons. The area has subsequently decreased and would seem now to stand normally at about 2,000 acres, but frequently over 100 tons of seed are available for export, this surplus mostly coming to the United Kingdom, though much of it may be re-exported. It will be seen, therefore, that New Zealand is not infrequently an appreciable source of supply for crested dogtail retailed to the British farmer.

Seed-Producing Districts.—Crested Dogtail has been grown for seed for many years in the Sandon district of the North Island, but more recently this has been taken up extensively in the neighbourhood of Gore, in Southland, where far more seed is now harvested than in the North Island.

Gore.—Here the usual practice is to broadcast 16-20 lb. of crested dogtail seed with the turnips sown in the spring. A seed crop is sometimes taken in the first harvest year, but perhaps more usually in the second harvest year. The crop is cut with the self-binder, the average height of the stand being about 18 inches, and, under favourable conditions, remains about three weeks in stook and is thrashed from the stook. Stacking is not practised unless unavoidable.

A number of farmers in this district will annually harvest about 80 acres. The yields of dressed seed are frequently decidedly high, and may exceed 500 lb., but the average would be about 250 lb. Seed is also taken from older leys, when the fields are only shut up for about a month or six weeks; this seed is taken with a stripper and includes a

fair amount of perennial rye-grass. The yields run to about 100 lb. to 140 lb.

The chief weed seeds taken with crested dogtail are the Canada (= creeping) thistle, sheep's sorrel, and Yorkshire fog. The crested dogtail leys have the reputation of making excellent and very healthy sheep-grazing, and lambs are reported to fatten excellently upon them.

Sandon.—Temporary grass farming, with the production of both perennial rye-grass and crested dogtail for seed, is the feature of this district. On a 600-acre farm, it would be expected to work round the whole area in about seven years, the chief crops being grass, turnips, and rape. It is usual to sow about 20 lb. of crested dogtail alone or with oats in April; after harvesting the oats, a perfect stand of dogtail will be attained. The following year, the field will be shut up in October or November and harvested in January. It is the usual practice to leave in stook up to three weeks and to thrash from the stook; yields of from 350-400 lb. are expected.

The seed is also stripped from older leys. The strippings are put into bags, which are half filled; two bags are tied together and left open hung over a fence for the purpose of drying the seeds. *Linum marginale* is a common impurity in the seed of dogtail from this district; it may be present to the extent of 1 to 3 per cent., but is easily removed and is said to have a value for use in the manufacture of proprietary feeding stuffs.

As in the Gore district, the leys are held in high esteem for fattening lambs. Crested dogtail leys will not maintain a clean, pure herbage for more than about two years, if a seed crop is taken in the first harvest year, but they will become over-run with weeds and sweet vernal grass. Largely on this account the production of seed is not as popular as formerly, since it necessitates maintaining special short duration leys. The whole tendency in New Zealand to-day—a natural outcome of the excellent results obtained by the use of phosphatic manures (chiefly superphosphate)—is to depend less on the plough and more on top dressing and, consequently, much to extend the duration of the leys.

Quality of Seed in Relation to District.—Crested dogtail is one of those species which tend to drop in germination during ocean transit or if retained long in store. This appears to be intimately connected with the degree of maturity of the seed when harvested. A bright yellow sample of seed is always

esteemed; this association of brightness with presumed excellence is, indeed, a striking example of one of those seed characteristics which have come to have a trade value for no good reason and without the backing of any reliable tests or evidence for its justification.

The bright yellow colour in crested dogstail is an outcome of too early cutting and of premature ripening off in stook, a state of affairs much aggravated by particularly dry conditions at harvesting time. This practice is common in the Gore district, the seed of that district having a considerable reputation for its brightness.

The Sandon seed is usually not cut so early, is far better matured and, consequently, takes on a richer brown colour, which, in fact, betokens excellence and high viability, and implies an ability better to withstand prolonged storage or prolonged transit.

This matter of colour is important in relation to the import trade, for, if a rich dark brown were to become the criterion of excellence, demanded alike by farmers and seed merchants in this country, it would immediately react on the harvesting methods adopted in the South Island of New Zealand and, therefore, upon the viability of the seed reaching our shores from the Dominion. There is little doubt that the different species of herbage plants require very different conditions in which to mature and ripen their seed, in order to attain to maximum viability and in order to maintain vitality for the greatest possible length of time under other than the most favourable conditions. Mr. Nelson Foy, of the Department of Agriculture at Wellington, gave his opinion to the writer that dogstail, and to some extent cocksfoot also, both require a "damp" harvest, while rye-grass, to reach high excellence as seed *qua* seed, must have dry, hot conditions. The whole question is one of the first importance, and one that needs to be subjected to critical examination.

It is useless to investigate loss of germination in transit or during storage unless the whole cycle of maturing and harvesting has also been under study. This is now thoroughly recognized in New Zealand, and investigations in progress may be expected to throw considerable light on a number of difficult problems connected with the harvesting and handling of herbage seeds.

Strain.—Investigations conducted at Aberystwyth with seed from Ireland and New Zealand, and with that collected from old pastures in England and Wales, although showing

interesting strain-differences in respect of dogstail, have not revealed such striking and important economic differences as in the cases of perennial rye-grass, cocksfoot, timothy, and red and white clover. It is probable, therefore, that, in point of strain, it makes relatively little difference what nationality of crested dogstail seed is sown. This is the more probable in view of the fact that crested dogstail, undoubtedly, very largely maintains itself on our grasslands by means of repeated and abundant self-seeding and self-establishment.

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NOTES ON TWO FUNGICIDES: SULPHUR AND BORDEAUX MIXTURE

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"Wettable Sulphur."—As is well known through practice, sulphur kills those fungi known as "powdery mildews." Used dry in powder form, it has proved a cheap and reliable remedy against "mould" in hops, the mildews of the strawberry, rose, etc., and is in common use for this purpose. It not infrequently happens that crops which are affected with mildew suffer at the same time from damage caused by insects, and require, therefore, spraying with some insecticide, in which event a simultaneous application of sulphur and the insecticide is called for. In some cases, the need is met by using a dissolved compound of sulphur, such as "lime-sulphur" (calcium polysulphides) or "liver of sulphur" (potassium polysulphides), which can be mixed with the insecticide. In other cases, however, it is still advisable to use the sulphur in powder form, to avoid any injury being caused by the polysulphide solutions to the delicate parts of the plant sprayed. The question then arises of how to obtain an intimate mixture of sulphur powder with a wet spray.

It is common knowledge that it is impossible to mix sulphur powder with water, as it remains, even after the most vigorous stirring, on the surface. The use of soap as a medium for wetting sulphur appears to have been first proposed in 1910, by Vermorel and Dantony. They recommend* that sublimed sulphur be mixed with 1 per cent. soap solution and 1 per cent. sodium carbonate. As soap cannot be used satisfactorily when such spray-fluids as Bordeaux mixture, lime-sulphur, lead-arsenate, etc., are used, it was later recommended by the

* *Comptes Rendus*, Vol. 151, p. 1146 (1910).

same authors* that the sulphur should be moistened with an alcoholic solution of oleic acid, for sulphur so treated could at once be wetted with water. Alcohol alone suffices to make sulphur "wetttable," but, when the alcohol evaporates, the sulphur again becomes unwettable. If, however, a small amount of oleic acid is incorporated with the sulphur, the latter retains the property of being easily wetted by water or spray-fluids. W. O. Gloyer,† in 1915, reported, from the results of experiments in the control of a stem-rot and leaf-spot of Clematis, caused by the fungus *Ascochyta clematidina*, that "a mixture of 1 lb. laundry soap and 6 lb. of sulphur to 15 gall. water" proved successful. It was also used with success in the control of leaf-blotch, *Diplocarpon rosae*, on roses grown in the forcing houses.

In order to obtain information as to the best, easiest and cheapest way of rendering sulphur wetttable, a number of trials were carried out in the laboratory, in which the following substances were used: soft soap at various strengths, alcohol with and without oleic acid, oleic acid alone, casein in various forms, and glue. The practical points to which attention was directed were (a) ease of wetting; (b) the manner in which the sulphur remained in suspension; (c) the extent to which dilution could be carried out. It is not necessary to enter into details concerning the results which were obtained in the above trials, for it was found that a 1 per cent. solution of soft soap (10 lb. to 100 gal. of ordinary tap water of a hardness of 18°) proved most satisfactory in rendering the sulphur wetttable, and that, with the water in question, dilution to $\frac{1}{4}$ per cent. of soap was possible without any separation of the sulphur.

Various brands of sublimed sulphur and ground sulphur were tested; all of them settled to the bottom of the vessel rather rapidly and could only be kept in suspension by constant agitation. Fine dusting sulphur, about 90 per cent. of which passed a 200-mesh sieve, was the most satisfactory sample tested, but the best commercial brands of sublimed sulphur and ground sulphur also gave satisfactory results. Tests, in which the various brands of sulphur were compared, showed that the sulphur remained in suspension in the case of the diluted soap solution as satisfactorily as in any other case except lime-casein (calcium caseinate), but, as the latter is much more troublesome in mixing, it is not recommended.

* *I.c.*: Vol. 153, p. 194 (1911).

† *New York Agric. Exper. Station Bull.* 44 (1915).

The addition of nicotine, at the rate of 6 oz. per 100 gal. to the sulphur, wetted with soap solution and with the other preparations—oleic acid and calcium caseinate—gave no indication of any change, and, consequently, the use of nicotine with wetted sulphur can be recommended for trial.

Biological Experiments.—During June, 1926, experiments* were carried out, in an unheated greenhouse, with hop plants infested with "mould" (*Sphaerotheca Humuli*). Marked leaves bearing a number of patches of the mildew, densely powdery with the accumulation of spores (*conidia*), were sprayed with a thick suspension of sulphur, previously treated with oleic acid, in a 1 per cent. solution of soft soap.†

The mixture was sprayed on in a very fine mist, using an atomizer. The container of the atomizer was well shaken each time before the application of the spray. No difficulty was found in getting the suspension to pass the extremely fine aperture of the nozzle. Unsprayed leaves at the same node, bearing similar patches of mildew, served as "controls." By the next day after spraying, all or most of the upright branches (*conidiophores*) of the mildew, as well as the chains of spores which they bear, were seen to be collapsed; no further growth of the mildew took place, the patches remaining sterile until the end of the experiment (11 to 14 days). The same satisfactory results were obtained when a mixture of the same amount of sulphur (with no oleic acid) and $\frac{1}{2}$ per cent. of soft soap was used. The rapid collapse of the mildew was in striking contrast with the effect observable when sulphur in powder form (sublimed or finely ground sulphur) is dusted on a patch of mildew. Dry sulphur causes no immediate collapse of the upright spore-bearing branches, which are only slowly affected at the relatively few places where the particles of sulphur touch the fungus—a fact on which further observations will be found below. The explanation of the difference of action is probably due to the fact that, in the fluid wash,

* The full details of these experiments will be published elsewhere.

† The brands of sulphur used were those known on the market as Brandram's "flowers of sulphur" (sublimed sulphur), Fortress Brand of Hop Sulphur (ground sulphur), and Monro's Dry Dusting Sulphur. The suspension was made by wetting 100 grammes of sulphur moistened with 4 c.c. methylated spirit and 1 c.c. oleic acid, and of this treated sulphur, 5 grammes were taken and added to 100 c.c. of 1 per cent. soft soap solution. Attention is called to the fact that this amount of sulphur—equivalent to $\frac{1}{2}$ lb. sulphur to the gallon—is not sprayed on to the plant, as a considerable proportion remains behind as a deposit. The amount of deposit varies according to the thoroughness of the agitation.

particles of sulphur are carried to all the parts of the fungus that are wetted, whereas only the surfaces of mildew patches are touched by the dry sulphur. Some observations which were made on hop leaves in the open, which were sprayed with the wettable sulphur, made as described above, incline us to believe that the sulphur particles remaining on the surface of the leaf, after the wash has dried, are less liable to be washed off by rain or dew than when sulphur is applied dry.

The sulphur particles suspended in the wash settle rapidly, as already pointed out, and constant agitation is required to maintain the suspension at the nozzle. It remains to be seen whether the agitation provided in the ordinary knapsack sprayer and in the horse-drawn hop-washer will be sufficient. The simultaneous application of sulphur and of an aphid-killing wash (nicotine, with or without soft soap) will, it is believed, prove feasible, and it is intended to carry out field experiments on these lines in the coming season.

Since it is the practice of some of the most successful hop-growers to apply sulphur in powder form to the hop plants when they are in flower (or, as the growers say, in "burr"), it was important to ascertain whether the application of a wash, containing wetted sulphur, would affect injuriously the flowers or the production of the hop cones. On August 6, 1926, a number of opposite lateral branches, which were in full "burr," on plants in the Experimental Hop-garden at Wye College, were selected, and one branch was heavily sprayed, an atomizer being used, with the wetted sulphur and soft soap solution described above, while the other branch was left unsprayed and served as a control. No injury resulted from the spraying, and, by the end of the month, it was found that the development of the cones on the sprayed and unsprayed branches was the same.

"Flowers of Sulphur" (Sublimed Sulphur) and Ground Sulphur.—In a previous communication to this JOURNAL,* one of the writers, when pointing out that sulphur is effective in controlling hop "mould" (*Sphaerotheca Humuli*), recommended for the purpose pure sublimed sulphur ("flowers of sulphur")—the statement being made "that flowers of sulphur remains the one safe and reliable remedy." This statement now requires modification. Within recent years, the use of improved machinery and the adoption of special apparatus have resulted in the manufacture of ground roll

* E. S. Salmon. This JOURNAL, XXVIII, p.157 (1921).

or brimstone sulphur which, in the case of good samples, is not inferior, in fineness and purity, to the best "flowers of sulphur."

During 1926, some experiments were carried out to compare the efficacy of sublimed sulphur and ground sulphur as fungicides against hop "mould." The method of applying the sulphur was as follows: a test-tube, 5 in. long and $\frac{9}{16}$ in. bore, was half-filled with the sulphur and its mouth covered with fine muslin. Sufficient sulphur was shaken out in a fine cloud to cover completely the powdery patches of mildew on hop leaves attached to a growing plant.

The first experiment was made on March 18, when similar patches of mildew, on two young leaves at the same node on the stem of a young hop plant, were treated with sublimed sulphur and the finest ground sulphur respectively. On April 1, 14 days after the application, the two leaves were removed and examined under the microscope. The fungicidal action of the two kinds of sulphur was the same. Wherever any particle of sulphur had touched the chains of spores borne on the upright branches (*conidiophores*) the former were shrivelled and dead, although the conidiophore below the chain of spores was uninjured; where, however, as at the edge of the leaf, no sulphur had touched the mildew, the latter was still vigorous and producing chains of spores. The sulphur was then removed as far as possible by washing the leaves; in the hollows near the veins of the leaves, the mildew had been protected from contact with the sulphur and was unaffected; elsewhere, the sulphur had killed the tallest branches (*conidiophores*) and their chains of spores, while the shorter, sheltered ones, not having touched the sulphur, were unaffected. There were no signs that the mycelial hyphae had been affected.

The second experiment, using the same two kinds of sulphur, was made on March 25, on two leaves at the same node, each bearing several large powdery patches of mildew. On April 27, 33 days after the application, the effect of the two sulphurs was exactly similar; where the sulphur had touched them, the chains of spores had all shrivelled, although here and there a young conidiophore with a short chain of spores occurred which was unaffected. The hyphae of the mycelium on the surface of the leaf were white and apparently unaffected.

In the third experiment, the same brands of sulphur were used, air-dry and after having been passed through a 160-

mesh sieve. The powders were applied, in the same manner as before, on May 19. On June 11, 23 days after the application, the mildew patches were still completely covered by the two powders; when the surplus was shaken off from some of the patches, these still seemed, to the eye, well covered by the sulphur. Under the microscope, fine hyphae of the mycelium could be seen radiating from the edges of each patch. There was no evidence that any of the mycelium was dead. Although the chains of spores were shrivelled and dead where contact with the sulphur particles had occurred, fresh conidiophores were appearing in the intervening spaces between the particles. By June 16, 28 days after the application, the remaining patches, still completely covered by the sulphur, were alive and showed young living hyphae at the circumference; intermingled with dead and shrivelled chains of spores were young conidiophores pushing up, with, very occasionally, a mature spore at the tip. It was evident that if the sulphur were removed—such as might result from the action of heavy rains—the mildew patches would be able to renew their growth and produce spores. No difference in action between sublimed sulphur and ground sulphur was observable.

It would appear from the results of the above experiments that, while sulphur in powder form does effectively stop the dispersal of spores of the mildew and thereby checks the spread of the disease, it is very slow in fungicidal action, and there is always the risk that it may be removed by heavy rains. Even when sulphur remained undisturbed for a month on the mildew patches, the fungus, under the conditions of the experiment, was not killed. Since the fungicidal action appears to be identical in both cases, the hop-grower can be advised to use either sublimed sulphur or special ground sulphur of equal fineness and purity.

In view of the slowness of action of sulphur when applied as a dust, the fluid wash of wetted sulphur (described above), with its much quicker fungicidal action, merits a trial against hop "mould" and other "powdery mildews."

Home-made Bordeaux Mixture.—The fungicide known as Bordeaux mixture (made by mixing together copper sulphate solution ["bluestone"] and milk of lime) is second to none in preventing many of the plant diseases caused by fungi. In all countries, it has been in use, for many years past, by the progressive farmer who realizes the benefits which it brings. The best method of making Bordeaux mixture has been given

in articles in this JOURNAL, in 1908 and again in 1910.* These articles may be consulted for detailed information both as to the making of stock solutions of copper sulphate and of lime, and for the proper application of the mixture. In the agricultural literature of every country, the results of numerous experiments have been published which show that Bordeaux mixture may confidently be relied upon to prevent the attacks of most fungi on cultivated crops. To take one instance, Bordeaux mixture effectively controls the "scab" or "black spot" of the apple, as recent articles in this JOURNAL have shown.†

Satisfactory results, obtained by the use of home-made Bordeaux mixture against other fungus diseases, have also been recorded.‡

The difficulty which is often experienced in obtaining, at short notice, small quantities of good freshly burnt quicklime, suitable for making Bordeaux mixture, has undoubtedly been one reason why many growers have not used this spray or have chosen a manufactured article.§ Moreover, quicklime does not retain its properties under the usual conditions of storage, so that the grower has to obtain fresh supplies each time he wishes to spray. As is well known, quicklime becomes hydrated by absorption of moisture and then combines with the carbon dioxide of the air to form carbonate of lime, which is worthless for making Bordeaux mixture. When quicklime is slaked with water, the hydrate of lime is produced, and it is this substance that combines with the copper sulphate to produce the well-known gelatinous blue precipitate, characteristic of properly made Bordeaux mixture. It is true that, as pointed out in 1910,|| perfectly satisfactory stock solutions of lime can be made with little trouble, but the farmer who shows the necessary enterprise, to have at hand stock solutions

* E. S. Salmon: "Apple Scab" or "Black Spot" (this JOURNAL, XV, 191 (1908)); "The Making and Application of Bordeaux Mixture" (I.c., XVI, 793 (1910)).

† N. B. Bagenal, W. Goodwin, E. S. Salmon and W. M. Ware: "Spraying Experiments against Apple Scab" (I.c., XXII, 137 (1925); XXXIII, 38 (1926)).

‡ E. S. Salmon: "Cherry Leaf Scorch" (I.c., XIV, 334 (1907); *Idem*: "Potato Spraying for Farmers" (I.c., XXIV, 265 (1917); *Idem* and H. Wormald: "Potato Spraying Experiments" (I.c., XXVI, 71, 269 (1919)).

§ Experience both in this country and abroad has shown that home-made Bordeaux mixture is superior in fungicidal qualities to the ready-made preparation in paste or powder form.

|| This JOURNAL, XVI, 793 (1910).

of the ingredients to make Bordeaux mixture, remains, unfortunately, the rare exception.

The object of the present communication is to call attention to a variation in the method of making Bordeaux mixture, which consists in the use of slaked lime (calcium hydrate or hydrate of lime) in the place of quicklime (calcium oxide). Hydrate of lime is now prepared in a high degree of purity on a commercial scale, and, by its use, a simplification of the method of making Bordeaux mixture becomes possible. Comparative laboratory experiments made at Wye showed that the appearance and nature of the precipitate, as well as the rate of settling, were almost identical in the case of Bordeaux mixture made with quicklime and hydrate of lime, respectively, up to the end of 6½ hours; after longer periods the differences were only slight. On theoretical grounds, there seems to be no objection to the employment of hydrate of lime, for this is the product which is obtained in the milk of lime which, having been prepared by adding water to quicklime, is ordinarily used for the preparation of Bordeaux mixture. The advantages which can be obtained by using commercial hydrate of lime are (1) a high degree of purity; (2) a product which can be stored for comparatively long periods without becoming seriously changed; (3) a more rapid preparation of the spray fluid, as no time is lost in slaking the quicklime.

Hydrate of lime is obtainable on the English market in the form of a fine white, dry powder, and good commercial samples contain not less than 95 per cent. of hydrate; when packed fresh in closed paper-lined bags, it does not become carbonated at all rapidly. The proper packing is essential, for, unless this is done, the hydrate changes to carbonate, and there are no indications (as is the case with lumps of quicklime, which fall to a powder and so show that some change has taken place) to call attention to material which is no longer fresh and suitable for making Bordeaux mixture. As 1.32 parts by weight of hydrate of lime are equal to 1 part of oxide of lime, it is necessary to modify the proportions of copper sulphate and lime when the hydrate is used. A safe rule is to take 1½ pounds of the hydrate in place of 1 pound of quicklime, the usual formula for Bordeaux mixture, 8.8.100 thus becoming 8.12.100. The cost of the hydrate of lime will, of necessity, be somewhat higher than that of quicklime, especially if the latter can be obtained locally; but the advantages offered by the former are that it is a high-grade

product of uniform composition and, if kept closed in paper-lined bags, it does not change on storage. If the use of hydrate of lime becomes general, no doubt supplies will be obtainable in paper-lined bags of various sizes; at present, 56 lb. is the usual weight. The price of hydrate of lime, on rail at the works, is about £2 per ton, in four-ton lots, bags extra. It will be understood that hydrate of lime, even when packed in closed paper-lined bags, will not keep indefinitely, but from trials which were made last season it was found that it remained in a satisfactory condition from the time of the first spraying (April 17) to the last (June 19). The hydrate, when stored in closed metal containers, was fit for use after a lapse of nine months. It is recommended, however, that fresh supplies should be obtained for each season's spraying.

Reference to technical literature shows that in America hydrate of lime (slaked lime) has been in use for some time for making Bordeaux mixture. In a few cases, an adverse report has been given. Thus, Butler, in 1914, stated* that "hydrated lime does not produce as fine a milk of lime, all things equal, as quicklime, and the results [of experiments] show that this lack of fineness unmistakably increases the rate of settlement of the mixtures prepared with it. The use of hydrated lime, in lieu of quicklime, is not, therefore, to be recommended, except perhaps in the rare instances when the latter is not obtainable, or is of too poor quality to be advantageously used." In 1923, Martin carried out experiments in spraying potatoes against early blight (*Macrosporium Solani*), in which comparison was made of Bordeaux mixtures prepared from quicklime and from hydrated lime. This author states† that "it is apparent that the use of stone lime for making Bordeaux mixture is to be advised over that of hydrated lime. Where the former is difficult to secure, however, the hydrated lime may be substituted." In 1924, Newton, in reporting the results of spraying experiments against apple "scab," stated,‡ "The use of hydrated lime in Bordeaux mixture appeared to produce very much more severe russetting of the fruit than was caused by rock lime." Chupp, in his *Manual of Vegetable-Garden Diseases* (1925), states that "hydrated lime, if

* O. Butler: in New Hampshire Agric. Exper. Station *Circ.* No. 15 (May, 1914).

† W. H. Martin: "Ten Years of Potato Spraying in New Jersey," New Jersey Agric. Exper. Station *Bull.*, 383 (1923).

‡ Newton, F. W.: in *Trans. Illinois State Hort. Soc.*, LVII, 165 (1924).

fresh, may be employed if lump lime cannot be obtained, although Bordeaux mixture made of it does not stay in suspension quite as long as does that made from the burnt lime."

On the other hand, by far the greater number of experimenters report favourably on the use of hydrated lime in the preparation of Bordeaux mixture. Thus, Fields and Elliott, in 1920, stated* that "the hydrated lime Bordeaux mixture compared favourably with the mixture made from freshly slaked lime." In 1923, Winston, Bowman and Yothers reported† that "in general effectiveness Bordeaux mixture made with hydrated lime has proved throughout the experiments to be equal to that made with quicklime." Ballou and Lewis, in 1923, in Ohio, found‡ that a satisfactory control of apple "scab" was obtained by Bordeaux mixtures of various strengths, in which three pounds of high-grade hydrated lime were used for every pound of copper sulphate. Anderson, also, in 1924, in Illinois, in reporting on experiments in spraying apples against "scab," stated§ that Bordeaux mixture made with hydrated lime gave as good control and caused no more injury than Bordeaux mixture made from rock lime. In the *Spraying Programs for the Orchard and Fruit-Garden*, published by the Ohio Agricultural Experiment Station in 1920 and in 1922, the use of hydrate of lime is recommended.|| Further references to authors advocating the use of hydrated lime are given below.¶

* W. S. Fields and J. A. Elliott: in Univ. Arkansas Agric. Exper. Station Bull., 172 (1920).

† J. R. Winston, J. J. Bowman, and W. W. Yothers: United States Dept. Agric. Bull., 1178 (1923).

‡ F. H. Ballou and I. P. Lewis: in Ohio Agric. Exper. Station Monthly Bull., VIII, 3-4, p. 42 (1923).

§ H. W. Anderson: in Trans. Illinois State Hort. Soc., LVII, 165 (1923).

|| Monthly Bull., Ohio Agric. Exper. Station, V, No. 3, 70 (1920); VII, 1 and 2, 19 (1922).

¶ Green, Selby and Gossard, in Ohio Agric. Exper. Station Bull., 309 (1917); Halligan, Pettit and Coons, in *Sixty-First Annual Report*, State Board Agric., Michigan, 423 (1923); Robinson, in Oregon Agric. College Exper. Station Bull., 201 (1924); Coons and Kotila, in *Sixty-Third Annual Report*, State Board Agric., Michigan, 505 (1925); Dutton, Pettit, Bennett and Cardinell, in Michigan Agric. College Agric. Exper. Station Special Bull., 140 (1925); Dodge and Wilcox, in U.S. Dept. Agric. Farmers' Bull., 1488 (1926); Young, Houser and Ballou, in Ohio Agric. Exper. Station Bull., 393 (1926); and Manuel, in Australia, Agric. Gaz., N.S. Wales, XXXIII, 759 (1922).

Robinson has recommended,* in the making of Bordeaux mixture with hydrated lime, the addition of 0.01 casein. The proportionate amount to be taken of hydrated lime as compared with quicklime is given by the various authorities quoted above (usually) as $1\frac{1}{2}$ lb. to 1 lb., although the ratios $1\frac{1}{2}$ to 1 and $1\frac{3}{4}$ to 1 are also given.

A comparative trial of Bordeaux mixtures made with quicklime and with hydrated lime, respectively, was carried out at Wye during 1926. Eight pounds of copper sulphate to 100 gal of water were used, and 8 and 12 pounds, respectively, of quicklime and hydrated lime. The latter was gradually mixed to a thin cream with cold water, and then diluted fully with the requisite amount of water before the concentrated copper sulphate solution (at the rate of 1 lb. of copper sulphate to 1 gal. of water) was poured into it. The same method of mixing was followed in making the Bordeaux mixture with quicklime. The two mixtures were sprayed on to an equal number of apple trees, of the varieties Newton Wonder and Allington Pippin, in a plantation on Wye College Farm. Three applications, using a fine, "misty" spray, were given; the first (at the "pink-bud" stage) on April 17; the second and third on May 21 and June 19. It was found that the Bordeaux mixture made with the hydrate of lime adhered to the foliage as well as that made with quicklime. Owing to a failure of the crop on the trees, the results of the spraying on the control of "scab" on the fruit could not be ascertained. It was observed, however, that the two Bordeaux mixtures controlled to a marked and equal extent the attacks of the fungus on the leaves, while causing no appreciable "scorching" injury. As early as May 29, many of the leaves on the "control" (unsprayed) plots showed so severe an infestation that they were becoming "sooty" with the growth of the fungus, while the foliage of the sprayed trees was practically free from attack. This control of the "scab" on the leaves of both Newton Wonder and Allington Pippin was continued right through the season, while the disease continued to develop on the unsprayed plots.

If, as seems likely to be the case, Bordeaux mixture made with hydrate of lime proves equal in fungicidal powers to that made with quicklime, a demand will grow up for the two constituents of the mixture prepared in convenient form. If weighed amounts of copper sulphate and of hydrate of lime are sent out by the manufacturers, with suitable instructions

* R. H. Robinson: in *Indus. and Eng. Chem.*, XV, 941 (1923).

for mixing, the making of home-made Bordeaux mixture on farms in this country may yet become as common as it should be.

Summary.—(1) A method is described of making a fluid wash of "wetted" sulphur, with or without soft soap.

(2) Experiments, carried out in 1926, showed that a suspension of sulphur in a solution of soft soap kills the "powdery mildew" of the hop (*Sphaerotheca Humuli*). The fungicidal action of the sulphur in this wash was observed to be far more rapid and complete than when sulphur was applied in powder form.

(3) Finely ground sulphur was found to be equal in fungicidal power (against the hop "powdery mildew") to sublimed sulphur.

(4) A method is described of making Bordeaux mixture with hydrate of lime in the place of quicklime.

(5) Preliminary experiments, made in 1926, showed that Bordeaux mixtures made with hydrate of lime and quicklime, respectively, controlled to an equal extent the attacks of "scab" (*Venturia inaequalis*) on the foliage of apple trees (Newton Wonder and Allington Pippin), and did not cause any "scorching" injury.

* * * * *

BRITISH FINCHES: THEIR ECONOMIC STATUS

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THE Finches and Buntings form a well-defined family; some of them are among our commonest birds. None of them attains any great size—the Hawfinch is the largest member of the family—and, as they are all to a great extent seed eaters, they possess more powerful bills than their relatives, the warblers, which live mainly on insects and other soft food. There is, however, considerable variation in this respect even among the Finches, *e.g.*, between the powerful stone crushing bill of the Hawfinch and the comparatively weak pointed bill of the Chaffinch or Goldfinch,

but, generally speaking, a strong bill, with a tendency to a conical shape, is characteristic of the Finches. It is not proposed to deal here with the rarer species of the family, but only with those which are present in fair numbers and whose economic influence is appreciable.

(1) **The Hawfinch**, *Coccothraustes c. coccothraustes* (L.).—This is a large and striking-looking bird, and, to one who has only seen a stuffed specimen on the shelves of a museum, might be expected to be very conspicuous. It is local in its distribution, and there are large areas in England and Wales where it is hardly ever seen. If we except the almost negligible fraction of ornithologists and students of wild nature, the vast majority of country folk never see a Hawfinch from one year's end to another, except at too great a distance to be recognizable, even in those districts where the bird is comparatively common. There are, however, certain signs by which the presence of the bird in the summer months can readily be detected. Thus, if there is reason to suspect the presence of Hawfinches, it is well to keep an eye on any yew trees in the neighbourhood when the berries are ripe. Note may be made as to whether fresh droppings are lying on the ground, as if a gardener had trimmed off the outlying shoots some few inches long and left them lying there. If there is none it is unlikely that there are Hawfinches about, but, if there are, they should be examined to discover whether they have held berries. If this is the case and no gardener has trimmed the trees, it is safe to infer that the birds are in the habit of coming there to feed, cutting off the twigs with their powerful bills to get at the berries. If the tree is approached quietly when there is no one about, probably, before long, at perhaps the second or third attempt, one will be aware of a bird flying out with a hurried, bustling flight, but always on the far side of the tree, so that one only catches a glimpse of it.

Another test of the presence of Hawfinches is to watch the rows of green peas in the kitchen garden, and here the evidence of the gardener may prove useful. Jays, Hawfinches, Sparrows, and to some extent Tits, will all do damage to green peas. The Jay is a large and conspicuous species, and likes to have plantations and woods close at hand; the destructive work may be done in the early hours of the morning, but it should not take long to detect this culprit. Sparrows set about their work with plenty of chattering, and generally in company,

so they are very easily spotted; while the Great Tit has to go through a slow process of boring to get at the peas and does not play havoc with the row like the other thieves. If the damage is extensive and the pods are completely wrecked, with no evidence of Jays or Sparrows, one probably has to deal with the Hawfinch, and careful watching should soon enable one to surprise him engaged in his work. Cherry trees have an irresistible attraction for the Hawfinch, not so much on account of the fruit, but, what is just as bad for the grower, for the kernel of the stone. Single trees will be visited day after day, until every cherry has been cleared off, and a well-hidden watcher will hear the crack of the stones as they are cracked with the greatest ease by the birds. It might seem a hard task for a small bird to smash a cherry stone with its bill, but if the heavy conical bill of a dead Hawfinch be forced open, the ridged grasping surface seen within will leave no doubt. Still more convincing proof can be obtained by handling a winged bird incautiously, while even a nestling can draw blood at quite an early age.

As may be imagined from the above paragraphs, the Hawfinch is no favourite with the gardener, yet on the whole, except for the two crops mentioned, it does little damage. Unless cherries are grown, it becomes simply a matter of keeping it from the peas, though no doubt some of the smaller stone fruit trees, such as the damson or bullace, are visited at times. As far as the writer is aware no volumetric analysis of its food has yet been made, but there is little doubt that, though some birds are destructive to peas and are kept away with difficulty, the great majority come under the heading of indifferent, their food being almost entirely obtained from such trees as the hawthorn, yew, bird-cherry, and, to a lesser extent, beech, blackthorn, laurel, sycamore, and maple. Against their misdeeds in the garden and orchard, must be estimated a certain amount of positive good done by the destruction of injurious insects, such as the larva of the currant moth in the spring.

The shy and secretive habits of the bird also tend to prevent it from visiting small or exposed gardens, and it is only likely to be a nuisance in large, old-fashioned gardens, with big yew hedges and adjacent woodlands or old timber. On one occasion no fewer than four occupied nests of this species were found in a little patch of orchard, hardly more than a rood in extent, close to a garden of this character, all in lichen-covered fruit trees and from 8 to 15 feet from the ground.

If the birds are troublesome in an old garden, it generally pays to look round the fruit trees for nests, especially if the trees are much overgrown with lichens. A favourite site for the nest is on a more or less horizontal branch, at no great height from the ground, where it can be detected by the fringe of dead twigs which form the foundation of the nest and are visible on each side of the supporting branch. The eggs are easily recognized with their greenish blue ground and bold streaks and scrawls of black.

A curious characteristic of the species is the way in which, after being common in a district for years, it will, without any apparent reason, desert it altogether. Economically, it only becomes important in districts where stone fruits are largely grown, such as the Kent and Worcester orchards. Where the Flemish cherry is grown, nothing but shooting is effective in protecting the crop. Peas are more easily protected and are more readily watched, while the signs of damage can at once be detected. In other respects, it is practically harmless.

(2) **The Greenfinch, *Chloris c. chloris* (L.).**—This is a much more familiar species than the Hawfinch, and most country dwellers are familiar with the yellow-green plumage, while those who are acquainted with bird songs know only too well the monotonous drawling note of the male and the interminable twittering notes of the nestlings. It has none of the shyness or the secretive instinct of the Hawfinch and breeds freely in hedgerows and in shrubberies or gardens, so that it is easily recognized.

Though the bill of the Greenfinch is strong, it is not built on the massive lines of the Hawfinch, is almost entirely a seed eater, and does not interfere with fruit crops. It is said to destroy blossom occasionally, but not to any great extent, and in the orchard its presence may usually be ignored, although Theobald speaks of the damage done in this way as being serious. The only accusation of injury done to fruit is that of picking seeds from ripe strawberries in Kent (L. H. Page), but the habit does not appear to be general and no other instances of it have come to the writer's knowledge.

In arable country and gardens, however, the Greenfinch is a different proposition, and, owing to its numbers, it may at times become very troublesome. Freshly-sown garden seeds are a temptation to these birds, and, as several

birds are often to be seen together on the beds, they soon produce definite effects. In gardens where the surface to be protected is small, they can be kept off by thread entanglements and similar devices, but it is a more serious matter when a large flock descends upon a field of newly-sown turnips or corn. Hooper records a case when a field of milled sainfoin had to be ploughed up because most of the seed had been taken by Greenfinches. The amount of grain taken in corn-growing districts where the bird is abundant must be considerable, even though the quantity taken by individual birds is small, and it does not descend on ripe cornfields in such flocks as the Sparrows do. The staple food throughout the year of this species consists of the seeds of weeds of many kinds. From the examination of 42 adult birds W. E. Collinge records the seeds of seven species, viz., mouse-ear and common chickweed, charlock, common sorrel, curled dock, ribwort and corn marigold (*The Food of Some British Wild Birds*, p. 83), while C. F. Archibald, in addition to charlock, dock and corn marigold, also mentions dandelion, plantain, goose-grass, corn crow-foot, knot-grass and wild vetch.

Collinge has secured interesting results by sowing the faeces of these birds on sterilized soil. From 38 droppings thus treated 52 plants were raised belonging to seven species—charlock (4), curled dock (12), ribwort (3), dandelion (6), knotweed (9), goose-grass (5), and corn marigold (13). From this it is clear that the destruction of weed seeds is by no means complete or an unmixed benefit.

Florence's summary of 166 cases shows that 133 contained cereals and 76 seeds, while insects were only found in 9 cases and a spider in one. The very small proportion of animal matter is noteworthy: only a few beetles (including the turnip flea beetle (*Phyllotreta*) and various weevils), aphides, and winged ants have been recorded from adults. Even in the nestlings, Collinge only found remains of insects in 19 cases out of 28: these consisted chiefly of small caterpillars (19), and small flies (16), together with three spiders. Evidently the young are fed largely on masses of unripe or sprouting seeds. H. B. Knox has taken a mass of food of this kind from one bird's crop, which filled a large teaspoon, yet only one larva was contained in it. Lepidoptera (moths) are also said to be occasionally fed to the young, and the late M. C. H. Bird has known them fed with the seeds of the Scotch pine. C. H. Hooper states that, in the hop-growing districts, this bird is very destructive to the blossoms, which it pulls to

pieces in order to get at the seeds, so that, when the birds are present in numbers, the ground is littered with the flower bracts.

To summarize: on grasslands and in dairy-farming districts the Greenfinch is quite harmless except to the young seeds in the kitchen garden, and this can be guarded against. In arable and corn-producing areas, though far less destructive than the Sparrow, it must do considerable damage, and its numbers should be kept down, while it is a serious nuisance in the hopfield and to the market gardener. In the fruit-growing districts, the harm done is almost negligible.

(To be continued.)

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COUNTY EGG-LAYING TRIALS

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SINGLE bird, egg-laying tests, open to poultry-keepers in Cheshire, have been held at the Cheshire School of Agriculture during the past two years, each test commencing in the middle of October and extending over a period of 48 weeks.

Details of the Trials.—Two sections have been provided: (a) Heavy Breed Pullets; (b) Light Breed Pullets. The flocks have been housed under identical conditions in two, three-quarter-span-roof laying-houses of 50-bird capacity, each provided with a quarter-acre grass run. The eggs have been graded and scored under the new system advocated by the Ministry of Agriculture, viz.:—

Special Grade.—Eggs of normal shape and shell, weighing: 2 oz. and over during first four weeks; $2\frac{1}{8}$ oz. and over during second four weeks; $2\frac{1}{2}$ oz. and over during remainder of test.

First Grade.— $1\frac{7}{8}$ oz. and over, but under 2 oz., during first four weeks; $1\frac{1}{2}$ oz. and over, but under $2\frac{1}{8}$ oz., during second four weeks; 2 oz. and over, but under $2\frac{1}{2}$ oz., during remainder of test.

Second Grade.— $1\frac{5}{8}$ oz. and over, but under $1\frac{7}{8}$ oz., during first four weeks; $1\frac{1}{4}$ oz. and over, but under $1\frac{1}{2}$ oz., during second four weeks; $1\frac{3}{4}$ oz. and over, but under 2 oz., during remainder of test.

No limits were set to the number of second-grade eggs allowed to score: all double-yolked eggs were included in this grade. No points were given for eggs below second grade in weight, or eggs which, owing to abnormal shape, or imperfect

shell, were obviously unfit for incubation. Such eggs were, however, recorded separately and are included in the figures of total eggs laid.

Period	POINTS FOR EACH EGG			
	Special grade	First grade	Second grade	
First four weeks..	11	10	8	Oct.-Nov.
Second „	13	12	10	Nov.-Dec.
Third „	11	10	8	Dec.-Jan.
Fourth „	9	8	6	Jan.-Feb.
Fifth „	8	7	5	Feb.-Mar.
Sixth „	6	5	3	March
Seventh „	6	5	3	April
Eighth „	6	5	3	Apl.-May
Ninth „	6	5	3	May-June
Tenth „	7	6	4	June-July
Eleventh „	7	6	4	July-Aug.
Twelfth „	8	7	5	Aug.-Sep.

The entries received were as follows :—

	1924-25	1925-26
Heavy breeds ..	52 birds from 35 flocks	57 birds from 38 flocks
Light breeds ..	41 „ „ 28 „	37 „ „ 24 „

Prizes and Certificates.—Gold, silver, and bronze medals have been awarded for the three birds scoring highest points in each section; and Certificates of Merit for all birds laying 180 first and special grade eggs.

Quality of Birds.—On the whole, birds sent to the tests have been of good quality, though a number which had been in lay too long and a few immature pullets were received in both years. The numbers of birds which had not commenced to lay by given dates were as follows :—

	1924-25	1925-26
At end of first month ..	26 birds—28 per cent.	27—28·7 per cent.
„ „ second „ ..	19 „ —20·4 „	11—11·7 „
„ „ third „ ..	6 „ —6·5 „	4—4·3 „

Health and Mortality.—The general health of the stock throughout the tests was excellent. In 1924-25, a few slight colds appeared in the third month, but these quickly responded to treatment; no deaths occurred until the eighth month. Altogether six birds were lost, four of the deaths being due to troubles connected with the egg organs. In 1925-26, six deaths occurred, five of which were due to ovarian disorders.

Feeding.—In both tests, grain was fed twice daily, early in the morning and at noon, and wet mash every afternoon (except on Sundays, when an extra feed of grain was given).

The standard wet mash mixture was made up as follows

Bran ..	25-30 per cent.
Thirds ..	35-40 „
Sussex ground oats ..	10-15 „
Maize meal ..	10-15 „
Meat meal ..	10-15 „

The exact composition of the mixture was varied slightly from time to time in accordance with seasonal changes in the condition of the birds.

Dry mash hoppers were kept filled throughout the test and limestone grit was provided as required. During autumns, marrow-stem kale was given almost daily. The total food consumed was as follows :—

	1924-25	1925-26
Grain ..	3,830 lb.	4,257 lb.
Meal in wet mash ..	3,175 „	3,803½ „
Meal in dry mash ..	734 „	694¼ „
Total ..	7,739 „	8,754¼ „

The average consumption of meal and grain was therefore 4 ounces per bird per day in 1924-25, and 4·5 ounces in 1925-26. It is interesting to note the very decided preference for wet mash displayed.

Observations on the Results.—Tests of this descriptive furnish interesting evidence on a number of points in connexion with egg production. The records suffer, it is true, from the disadvantages attaching to relatively small numbers, but, on the other hand, the birds were kept under carefully controlled conditions; they were drawn from a large number of flocks and were probably not related one to another. Their performances were, therefore, much more likely to represent the average of good flocks than would the records of larger numbers on a single station. In an ordinary flock it is difficult to obtain many birds which are unrelated half a dozen or more generations back. There is little likelihood in tests such as these that any particular strain or colour will influence the average results to any appreciable extent. Moreover, the error attaching to the results can in most cases be measured by mathematical means.

Egg Yield, Food Consumption, and Value of Eggs.—Eggs produced during the tests were sold, ungraded, at wholesale rates current from week to week in the poultry market at Nantwich.

The following table gives for each year the average figures per bird for the two flocks, the general average per bird per month, and the average prices of eggs.

TABLE I

Month	Food consumed	Egg Yield		General average	Value of eggs (pence)	Av. price of eggs per doz.
		Heavy breeds	Light breeds			
1924-5	lb.					s. d.
Oct.-Nov. ...	6.2	8.9	11.9	10.2	31.5	3 2½
Nov.-Dec. ...	6.7	10.2	10.9	10.5	34.1	3 3
Dec.-Jan. ...	6.9	13.1	13.1	13.1	35.4	2 9½
Jan.-Feb. ...	6.9	12.5	13.0	12.8	32.5	2 6½
Feb.-Mar. ...	6.6	15.7	17.7	16.6	32.5	1 11½
March ...	6.6	16.4	21.4	18.6	25.6	1 4½
April ...	7.2	17.7	22.7	19.9	22.4	1 1½
May ...	7.4	16.0	21.5	18.4	22.6	1 2½
May-June ...	7.2	13.6	19.4	16.2	20.6	1 3½
June-July ...	6.9	11.4	17.1	14.0	24.8	1 8½
July-Aug. ...	7.4	11.0	15.3	12.9	25.1	1 11½
Aug.-Sep. ...	7.4	10.2	11.8	10.9	23.4	2 1½
Oct. 15- Sep. 15 ..	83.4	156.7	195.8	174.1	330.5	2 0½
1925-6						
Oct.-Nov. ...	6.7	9.8	12.9	11.1	41.1	3 8½
Nov.-Dec. ...	8.5	10.5	12.1	11.15	37.3	3 4½
Dec.-Jan. ...	8.7	11.9	12.2	12.0	32.25	2 8½
Jan.-Feb. ...	7.6	12.8	13.2	12.95	29.1	2 3
Feb.-Mar. ...	7.2	13.3	13.9	13.55	27.4	2 0½
March ...	8.3	18.4	19.0	18.7	24.3	1 3½
April ...	7.9	18.3	18.6	18.4	21.5	1 2
May ...	8.1	17.2	18.2	17.6	19.9	1 1½
May-June ...	8.2	14.4	16.8	15.5	17.1	1 1½
June-July ...	8.1	13.0	15.3	13.8	19.7	1 5½
July-Aug. ...	8.1	11.1	14.1	12.3	20.3	1 7½
Aug.-Sep. ...	7.3	9.3	10.2	9.7	20.1	2 1
Oct. 15- Sep. 15 ..	94.7	160.0	176.5	166.75	310.05	2 0

The quantity of food consumed shows slight variations from month to month—probably due to slight differences in the amount of meal left in the hoppers at the month-ends. In 1924-25, the average monetary return was £1 7s. 6½d. per bird, the cost of food (neglecting the kale and pasture) 9s. 7d. per bird; in 1925-26, the return was £1 5s. 10d. per bird, the cost of food 10s. per bird. The price figures show that the most remunerative period in each year was November to February, there being a marked drop in receipts in March, despite the increased number of eggs. The monthly yield and value figures have been averaged for the two years, the results being shown graphically in Fig. 1.

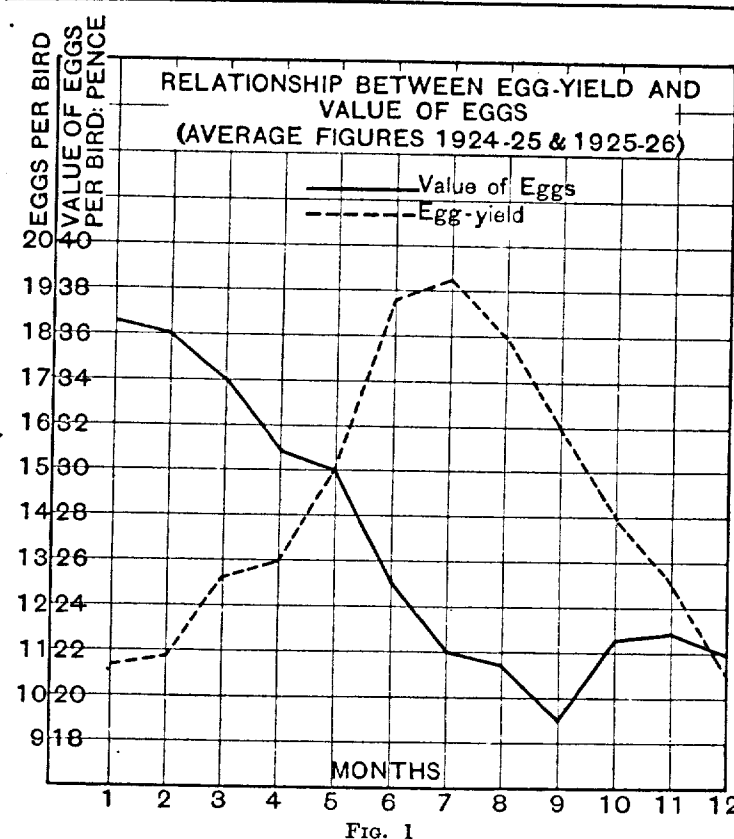


FIG. 1

Comparison of Light and Heavy Breeds.—The monthly flock averages in Table I show that the light breed flocks were considerably more profitable than the heavy flocks. Comparison of the average winter and summer totals for the two flocks yields the following figures:—

	Average yields per bird			
	Heavy breeds		Light breeds	
	1924-5	1925-6	1924-5	1925-6
Six winter months ..	77	76.7	86	83.3
Six summer months ..	83	83.3	107	93.2

The superiority of the light breeds during the summer months is in accordance with popular estimation, but the figures for the winter months are somewhat surprising. The difference between the light and heavy breeds for this period, though not very great, is probably a real one, i.e., it is not due to chance.* The average monthly yields of the two flocks for the two years are expressed graphically in Fig. 2.

* Frequency curves for the two flocks suggest that the superiority of the light breeds is significant.

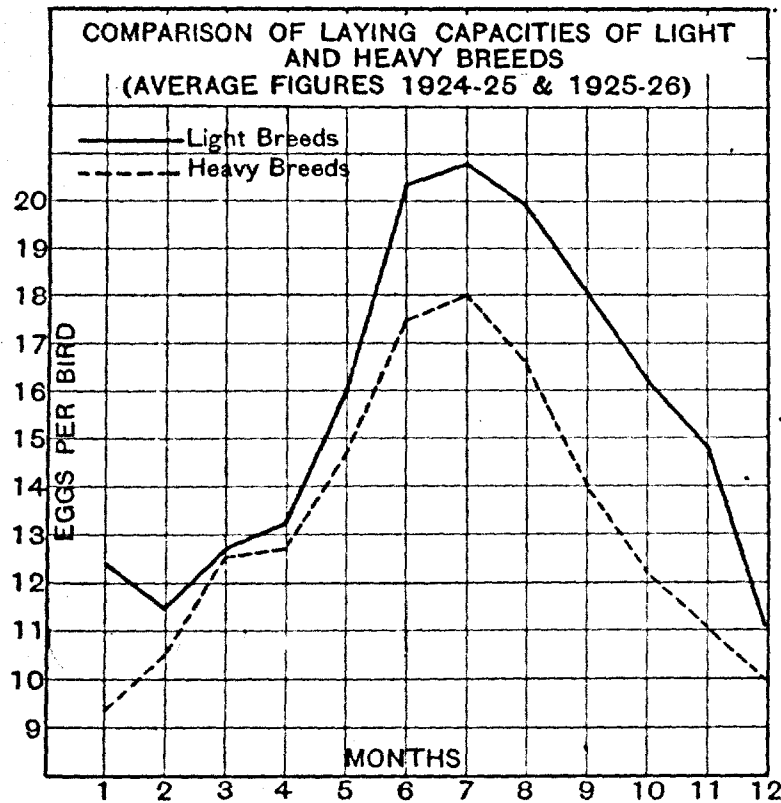


FIG. 2

Comparison of Breeds.—Fourteen breeds were represented in the 1924-25 competition, and 12 in 1925-26, but, in most cases, the numbers of birds were too small to make comparison possible. The following table gives particulars of the performances of the two chief breeds represented.

TABLE II.—BREED AVERAGES

	Year	No. of birds	No. of flocks	Special and first grade eggs	Total eggs
White Leghorn	1924-5	36	26	144-6	198-4
	1925-6	27	20	144-5	184-0
White Wyandotte	1924-5	22	18	104	154-4
	1925-6	23	19	120-7	173-1

White Leghorns were thus much more prolific than Wyandottes in 1924-25, but, in 1925-26, the difference was scarcely significant. Rhode Island Reds were represented by a total of 23 birds, averaging 175 eggs per bird. Light Sussex birds, of which there were 16, showed remarkable variability.

Relationship between Winter Yield and Year's Yield.—The relationship existing between a bird's yield in the autumn

or winter months and her yield in the complete year is a matter of considerable practical significance. If good and bad layers could, from their records, be picked out with any degree of certainty during the early months of their laying life, breeding stock could be selected at an early date; and trapnesting could thereafter be limited to those which in the first few months put up the best records. Similarly, "wasters" could be culled at an early period and, incidentally, laying tests could be limited to a short period instead of twelve months. Clearly, however, the value of any rule or formula which might be deduced to enable one to calculate the year's yield from the three-months' or six-months' yield depends upon its reliability. Exactitude can hardly be looked for, but, on the other hand, if the error involved in making the calculation is a large one, the formula is of academic interest only.

The relationship referred to can, to some extent, be gauged from a study of the monthly records in tests such as those under discussion. It is necessary, however, to premise that the figures in these tests relate only to the period October 15—September 15, and not to a complete calendar year, still less to a complete year for every bird from the date of the first egg.

The Value of Winter-Month Records.—In the following table (III), the birds have been gathered together into groups

TABLE III

	Three-month total	Average twelve-month total		Two years' aver- age	Six- month total	Average twelve-month total		Two years' aver- age
		1924-5	1925-6			1924-5	1925-6	
Light Breeds	0-10	153	137	145	31-50	125	130	128
	11-20	156	160	158	51-70	178	146	162
	21-30	176	182	179	71-90	185	183	184
	31-40	191	168	180	91-110	219	198	211
	41-50	213	202	207	Over 110	219	213	216
	51-60	230	181	206				
	Over 60	212	248	230				
Heavy Breeds	0-10	109	129	119	21-40	97	102	100
	11-20	132	136	134	41-60	123	129	126
	21-30	125	156	141	61-80	159	145	152
	31-40	176	148	162	81-100	167	182	175
	41-50	185	180	183	101-120	199	206	203
	51-60	180	194	187	Over 120	222	—	—
	Over 60	217	199	208				

according to the number of eggs laid in three or six months, and the twelve-month average yields for the same birds are stated alongside. Light and heavy breeds are dealt with separately, as the winter and summer yields of the two classes do not bear the same relationship to one another.

As may be seen, the correlation, between the short-period total and the twelve-month totals, is, *on the average*, fairly close. It may, indeed, be shown by approximate statistical methods that a fair degree of correlation exists between even two or one-month totals and the corresponding twelve-month totals.

The results with individual birds have been studied by the construction of a series of regression graphs, one of which is reproduced in Fig. 3. In this graph, six-month yields for birds of the heavy breeds are measured horizontally and the corresponding yields in twelve months vertically. If the correlation between the short-period and the long-period yields were perfect, all the points would be in a straight line, the approximate position of which is indicated in the graph; but the manner in which the points are scattered indicates that the relationship is variable; any formula which could be devised for calculating twelve-month yields from those obtained in six months would therefore be subject to a considerable margin of error. The graph is a fair sample of the results for heavy breeds, when the two years are treated together, and for the light breeds in 1924-25. It does not, however, fairly represent the great degree of variability in the results with light breeds for 1925-26, in which case a few exceptional birds render the deduction of a general law extremely difficult. Thus, although the majority of the birds which laid 80 eggs in the first six months exceeded 180 in twelve months, one bird which laid 86 in the first six months did not reach 100 in the year, and another which laid 110 in six months achieved a total of only 130 in twelve. We have therefore abandoned the attempt to calculate a general formula for the deduction of twelve-month records.

It is, however, not difficult from the regression graphs to pick out the minimum three-month yields which, in five cases out of six, give twelve-month totals above any standard which may be selected. Thus, as may be seen from the above graph, 22 birds laid 100 eggs or more in six months. Nineteen of these laid 180 in the year, while three failed to reach this standard. The chances of a bird with a six-month record

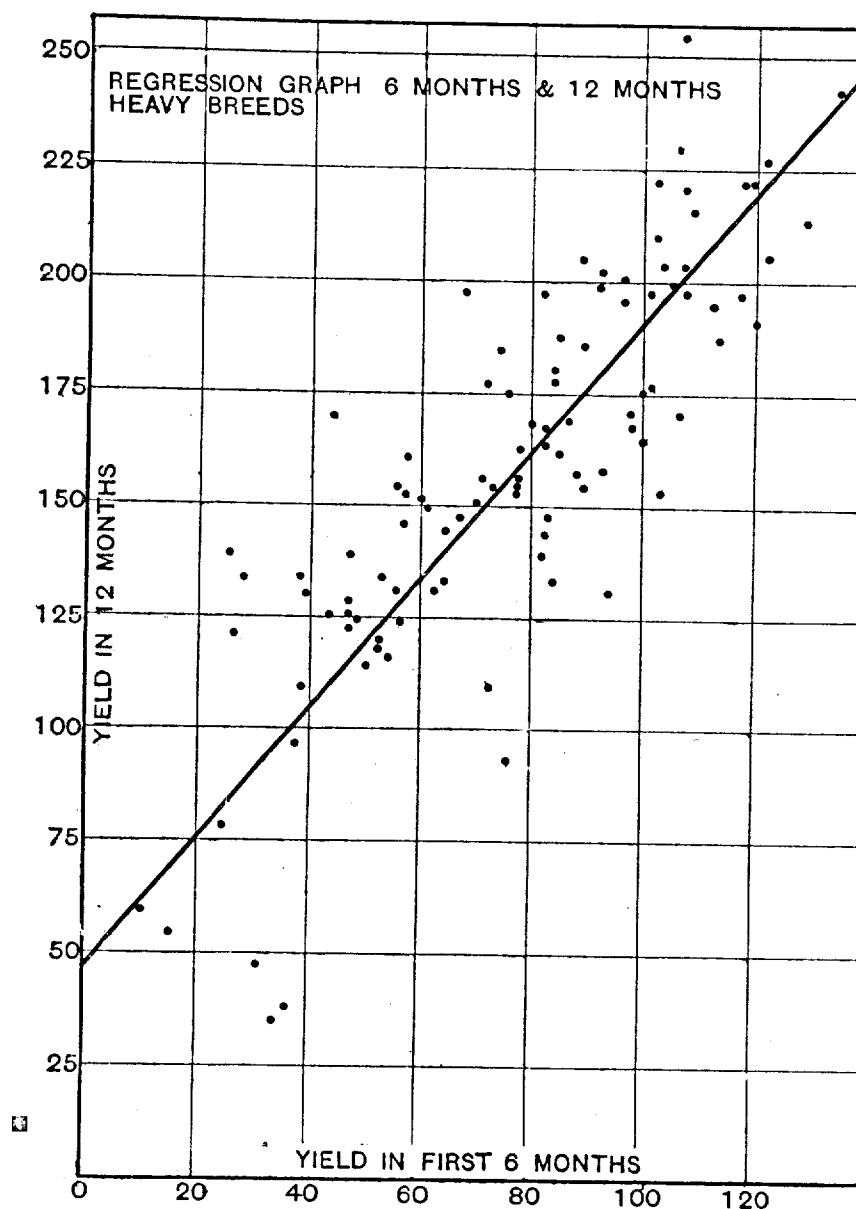


FIG. 3

of 100 or more giving 180 in the twelve months are therefore 19 to 3, or roughly 6 to 1.

At the other end of the scale, we find that the chances are 43 to 8, i.e., 5 to 1, against any bird which lays less than 80 eggs in three months giving 160 in the year; and 25 to 1

against such a bird laying 180 in the year. Proceeding in this way, the standards for short periods, which in five cases out of six could safely have been used, have been worked out. These standards are put together in Table IV.

TABLE IV.

Twelve-month standard aimed at	Corresponding two-month record	Corresponding three-month record	Corresponding six-month record
LIGHT BREEDS			
(a) For selecting 200 eggs and over	41	55 (?)	120
180 " "	27	43	112
(b) For culling			
Below 160	?	7	60
" 180	20 (?)	25	78
HEAVY BREEDS			
(a) For selecting 200 and over	45 (?)	62	117
180 " "	37	54	102
(b) For culling			
Below 160	16	32	81
" 180	25	45	96

As might be expected from the records obtained in these tests, the winter standards for the heavy breeds, corresponding with given standards for the twelve months, are higher than those for light breeds.

Summer and Winter Yields.—In Fig. 4, the birds of heavy breeds have been grouped according to their winter and summer yields, the former yields being expressed in columns below the horizontal line and the latter above it. This figure brings into clear relief the fact that the differences between the various birds are not nearly so marked in summer as in winter. During the summer months, the best birds lay at only a slightly higher rate than the worst—the tendency is for all to attain to the same level of efficiency. Thus, in 1924-25, the average yields for the whole of the birds were:—

Winter months ..	..	..	..	..	77
Summer months ..	..	..	..	..	83

The corresponding figures, however, for the worst and best groups were:—

	Worst group	Best group
Winter average ..	30	129
Summer average ..	67	93

Thus, with the best birds, the "levelling up" process was carried so far that their summer total was actually less than their winter total. The same tendency is observable, though not to the same extent, in the light breeds.

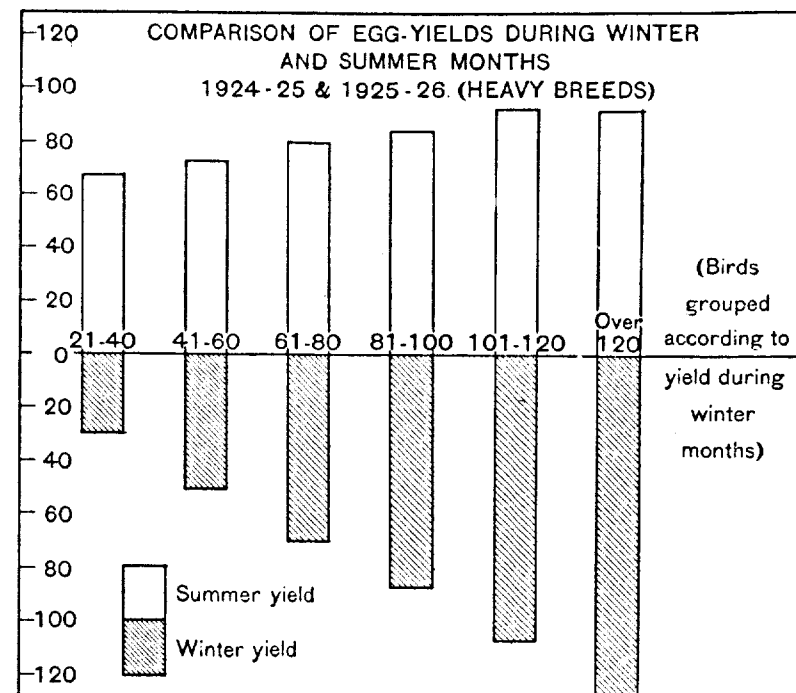


FIG. 4

Financial Yields.—If the value of the eggs laid in different periods of the year is calculated, and the results expressed in a similar manner, these facts are more strongly emphasized (Fig. 5). Owing to the higher value of the winter eggs, the winter and summer returns from the worst layers are almost equal, while, with the best, the winter returns are nearly three times those of the summer. Thus winter, tests, despite the disadvantages already noted, have, at any rate, this value—they emphasize, even more than twelve-month trials, true differences in the profitability of hens. The wisdom of attempting to cull at the end of the winter period—a practice sometimes recommended—would seem to be extremely doubtful, since losses on poor stock have already been sustained before March, and good and bad layers are more or less on a level during the summer.

Effect of Broodiness.—Records were kept of the number of times each bird went broody. There was a striking difference in this respect between the light and heavy flocks.

In the light flocks, 11 birds or 14 per cent. showed broodiness.

" heavy " 35 " 70 " " "

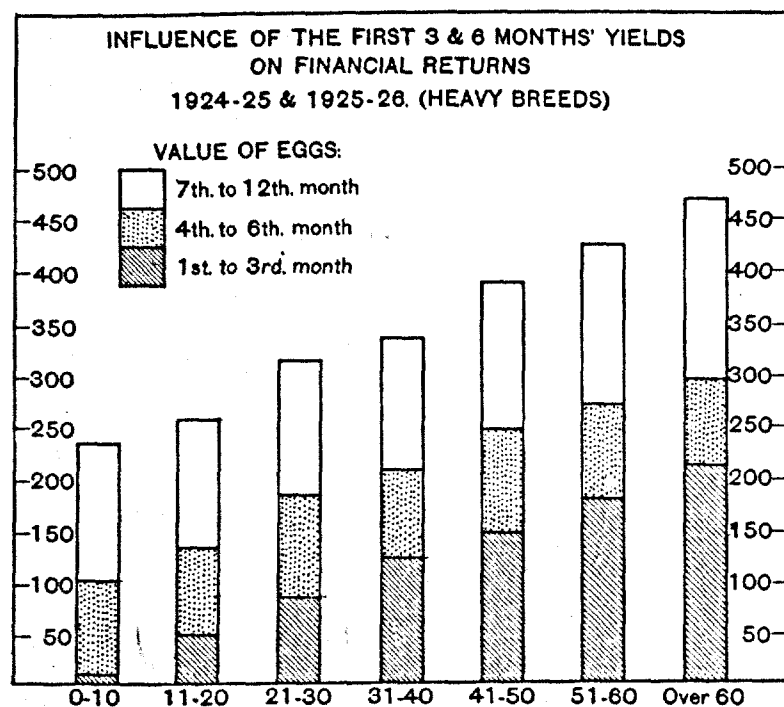


FIG. 5

No definite correlation between the number of times a bird went broody and her total egg-yield can be established—possibly because records were not made of the length of the broody periods. It was, however, noticeable that birds which laid for a short spell in the early autumn and then went broody, usually proved indifferent layers. Broodiness was most common during the summer months.

System of Grading and Scoring.—As the system of scoring in these tests is somewhat complicated, a short discussion on the points involved may not be out of place.

It has frequently been stated that home-produced eggs have, of late years, declined in size, and the system of scoring adopted in the earlier laying trials has been quoted as a contributory cause. In order to meet this objection, various systems of scoring, in which higher marks are awarded for heavier eggs, have been devised. The Ministry's system, adopted in these tests, provides not only for grading, but also for slightly different grade-standards during the first, second, and subsequent months, in order to give due advantage to those birds which lay the heaviest eggs early in the laying year; and the points allowed for each egg are varied in

accordance with the general trend of prices throughout a normal year.

The only serious criticism of this system which we have heard relates to the standard fixed for special-grade eggs. Certain breeders have argued that the weight demanded for a special-grade egg is too high, as extra large eggs are frequently poor in hatchability; and, since all birds tend to lay a slightly larger egg in their second season, there is a risk that the best scorers in the test may prove poor stock for the breeding pens. We have unfortunately no information regarding hatchability from any of the leading birds, but the scoring system does not demand more than $2\frac{1}{2}$ oz. for a special-grade egg, and the recognized weight for a good hatching egg is from 2 oz. to $2\frac{1}{4}$ oz. Furthermore, the special-grade egg of $2\frac{1}{4}$ oz. only represents, as a marketable commodity, 17 lb. per 120 eggs, whereas many consignments of Dutch and Danish eggs are graded up to 18 lb. per 120,

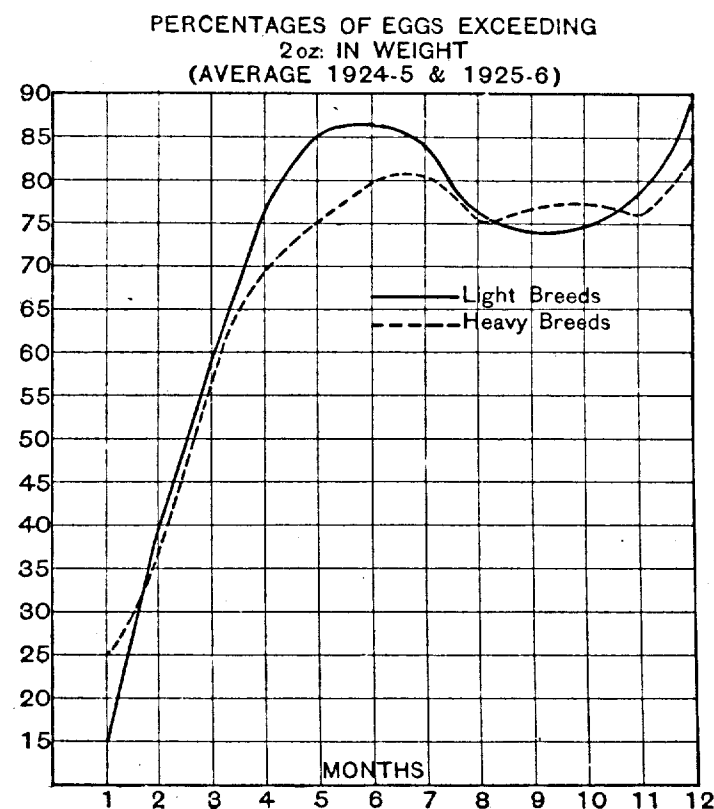


FIG. 6

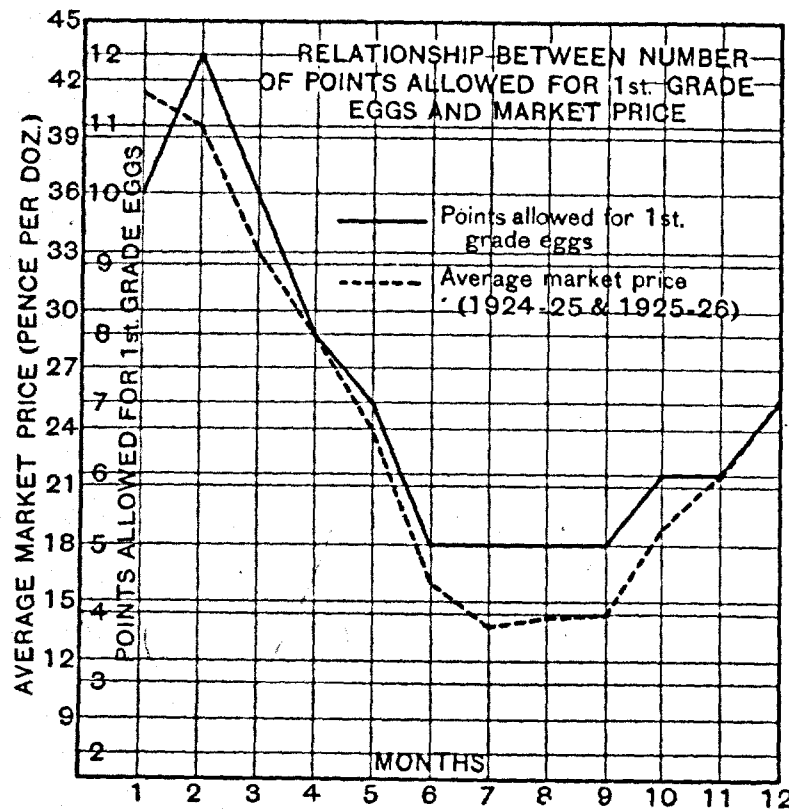


FIG. 7

while some French samples scale up to 20 lb. per 120 eggs. It appears to us, therefore, that the standards for special-grade eggs are not unduly high.

Seasonal Variation in Weights of Eggs.—A measure of the normal seasonal variation in weights of eggs can be obtained by calculating the average percentage of eggs over 2 oz. in weight laid by each pen of birds in each month. The figures so obtained have been expressed graphically in Fig. 6, the results for light and heavy breeds being given separately. It is noteworthy that the graphs for both light and heavy breeds follow very similar courses. In both cases, the proportion of 2 oz. eggs rose rapidly for the first five months, and then remained relatively steady. In both years, however, the proportion of 2 oz. eggs fell slightly during the early summer, to rise again in September.

The adoption of lower weight standards for special and first-grade eggs during the first two months is, therefore, fully justified, but it would seem, from the figures, that some

concession in the matter of weight might also be made during the third, fourth, and fifth months.

We are indebted to our colleague, Mr. L. T. Lowe, B.Sc., for much of the clerical and mathematical work involved in the preparation of this paper.

* * * * *

SOME OBSERVATIONS ON THE SWEDE MIDGE IN NORTH WALES

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THE following preliminary account of an attack of the Swede Midge is given chiefly to draw attention to the damage done by this insect, which appears to have assumed unusual proportions and shown unusual symptoms during 1926.

The Swede Midge (*Contarinia nasturtii*) has been recognized as a swede pest for some time, and, during the years 1908-12, received especial attention from Mr. T. H. Taylor, of Leeds University, who issued a Bulletin in 1912, entitled *Cabbage Top in Swedes*. This publication was well illustrated, and is the basal source of information for subsequent workers in this country.

The insect is described as "a small, delicately formed, two-winged fly or midge, light yellowish-brown in colour, and about one-sixteenth of an inch in size. The male fly is distinguished by its long graceful antennæ, and the female by having its tail segments extended into a slender egg-laying tube or ovipositor." Mating and egg-laying are quickly accomplished, and the adult midges are short-lived, and do not feed. The eggs are very small and are laid in strings and clusters on the leaves, sometimes on the upper surface of the blade or the upper surface of the stalk, whilst the young leaves in the heart of the crown are frequently selected. Hatching takes place in a few days, the numerous legless pale yellow larvæ feeding generally where hatched, and gnawing away the plant tissues. The amount of actual damage is slight, the ill-effects resulting from the abnormal growth by the plant as a response to irritation set up by the larvæ. Taylor states "the stalks of the affected plants become swollen, and, bending sharply inwards across the top of the plant, press upon and compact the terminal bud. Moreover, the leaf-blades become delicately crumpled, thus resembling the leaves of a savoy cabbage." As a result, the growth of the plant is

checked. The feeding stage lasts about three weeks, when the larvæ attain a length of about 1-10 of an inch and possess the power of hopping (as in other members of the gall midge family). They forsake the host plant and pupate in the ground enclosed within silken cocoons. The normal number of broods appears to be three, each taking six to seven weeks to pass through all its stages, the first brood appearing during early June. In addition to swedes, other cruciferous crops may be attacked. The above notes are taken from Taylor's article.

The writer noted the presence of the swede midge in North Wales in 1920, when characteristic leaf symptoms were plentiful in some districts, but, beyond leaf crumpling, no ill-effects were apparent and the crops were not seriously affected.

In subsequent years, also, similar slight attacks were observed here and there, none of them in any way approaching the Yorkshire outbreaks described by Taylor. In 1926, however, a widespread and serious infestation occurred, the earlier stages of which were not observed owing to preoccupation with other lines of work. A stream of complaints from growers then commenced, practically none of whom knew the cause of damage, (although a few stated that similar damage had occurred prior to 1920. The symptoms were: (1) leaf crumpling, (2) surface damage to leaf lamina, stalk and base, (3) distortion of young shoots, (4) death of the leading shoot, (5) double or multiple "necking" (resulting from growth of secondary shoots), (6) rotting of the crown, neck and bulb. These symptoms were all present in severely infested crops, whilst in others subjected to less serious or later attack, only stage (1), or a limited amount of the remainder, occurred. Rotting, due to bacterial infestation, followed on in plants injured by the death of the leading shoot, or through marked damage to the leaf base close up to the neck or bulb. Under drier conditions, healing appears to take place with little or no rotting, but, under damp conditions, rotting followed in serious amount, aided by the accumulation of water in the hollow (and already injured) leaf bases, and also, in many instances, in a concavity formed on the summit of the swede and within the encircling growths of the new shoots or "necks," arising subsequently to the death of the original growing point. These conditions were encouraged by a period of damp weather which followed upon the damage and was undoubtedly responsible for the commencement of much of the rotting* which was

* The rainfall at the College Farm, Aber, was: May 5.15 in., June 2.79 in., July 3.07 in., August 3.71 in.

early established and followed the sequence, (a) rotting terminal shoot, (b) a rotting invading and progressing down to the "neck," and (c) rotting of the crown and "root." By the first week in September, it had, in many instances, extended well into the "neck" and, in some cases, invaded the crown. After that, the progress of rotting was checked by a considerable spell of dry weather, but the damage had been very considerable, both in stunting and rotting. Taylor notes a bacterial rotting in the Yorkshire outbreaks, which he names "crown rot." There seems little doubt that the prevalence of this condition in North Wales in 1926 was largely initiated by the feeding of midge larvæ, and intensified by the subsequent unfavourable weather conditions. Cases were frequent in which the "many neck" condition was not accompanied or followed by rotting; the central area healing over, and forming a bare and generally level or convex surface in which water did not lie (contrary to the usually resultant concavity). The bulk of the serious symptoms undoubtedly followed attack by the earlier broods of midge, when the plant tissues were young; later attacks appeared to be confined to the leafage and merely resulted in the usual crumpling and slight local patches of decay.

It may be mentioned here that (in addition to the midge) swedes in North Wales suffered severely from mildew, which caused the death and shedding of a majority of the primary leaves, and this, apparently, contributed to a prolongation of the growing point and an unusual and marked lengthening of the "neck," which, the writer considers, saved many roots from "crown" rotting, since, in such cases, neck rotting had not penetrated into the bulb by lifting time, when the neck, together with the rotting region, was removed. It is undoubtedly a fact that damage other than that due to midge may bring about the "many neck" condition and subsequent rotting, and this may be due to attack by other insects; but in 1926, with the exception of some local damage by flea beetles (chiefly in South Carnarvon), this was very slight. Damage to the crown by larvæ of the cabbage root fly may occur at times, and has been seen by the writer on turnips, but no larvæ of this pest were found on roots in 1926, despite search for them. Leaf miners belonging to the genera *Scaptomyza*, *Phytomyza*, etc., may attack the leaves and leaf stalks, and a marked attack occurred on the College Farm at Aber in 1923, but no rotting followed, the crop being lifted in a particularly sound condition. In 1926, these insects,

although present here and there, were comparatively scarce. Taylor remarks that "plants growing at the edge of the field are generally attacked first," and bases his "trapcrop" method of control on this habit. This observation is upheld by the incidence of cases in North Wales, where headlands generally showed a preponderance of cases of "many neck," etc., and it has been suggested that mechanical injury may bring about the same condition. It was difficult to obtain data for swedes owing to the very general infestation, but the following figures recently obtained from a crop of turnips in Herefordshire tend strongly to confirm this view. A count was made, on January 1 last, on a root field at 550 ft. elevation in the Leominster district. Swedes grown in this field had been lightly attacked, but the turnips showed no sign of infestation. One hundred roots growing along a headland, subjected not only to injury through normal cultural operations, but in addition to those resulting from its use for carting, and for to-and-fro traffic to other fields, showed 22 cases of double or multiple necking (but little rotting). A block of 500 roots were then examined in the adjacent body of the crop, with the result that only seven examples were found, and these were scattered here and there and in no way grouped. It would, therefore, appear that, in all counts of damage by such insects, a certain allowance must be made for mechanical injuries.

As regards the distribution of attack in North Wales, the maximum damage occurred in the lowlands and coastal districts of Carnarvon, the eastern portion of Anglesey, and the Conway valley. There was a marked diminution in the westerly area of North Wales, in the regions of high precipitation, where more marked cloudy weather and cooler climate prevail, the upland districts with rainfalls of + 50 inches being largely free. In Anglesey, the attack died out gradually in a westerly direction, being (as stated) severe on the west coast, moderate to slight in the centre, and very slight or nil in the eastern districts. In Flint and Denbigh the attack was slight in many districts, but severe in certain others.

Counts were made in 86 fields, totalling about 300 acres, and ranged up to 90 per cent. of severe stunting, rotting, etc. Analyses of types of damage were attempted, as for instance on the College Farm, Aber, on November 3, 1926, on "Model" sown May 18. The total percentage of swedes seriously affected was 65.

- (1) Leaf symptoms : 40 per cent. (but many had fallen through mildew).
- (2) Decaying leaf bases : 16 per cent. (but many had fallen through mildew).
- (3) Multiple necking (two to nine) : 27 per cent.
- (4) Rotting of neck and crown : 24 per cent.

In another count on "Best of All," the multiple neck rose to 44 per cent. and rotting to 30 per cent. Many cases were much worse than these.

Variety would appear to have little effect, for, though certain cases might seem to support this view, others reversed it, and, so far, no clear evidence can be given in this direction. Severe attacks were noted on "Balmoral," "Bangholm," "Best of All," "Buffalo," "Dreadnought," "Eclipse," "Lord Derby," "Magnum Bonum," "Model," "Monarch" and "Superlative."

Sowing date has also been considered in over 50 cases, these being grouped as early, mid and late; here again, no reliable conclusion appears; a 60 per cent. infestation being recorded on swedes sown as early as the end of April, and up to 42 per cent. on a crop sown as late as mid-June.

Although infestation was general in lowland districts of Carnarvon, etc., yet very variable degrees of infestation were sometimes found near one another, and, as will be seen from the above statements, these differences have not yet been satisfactorily accounted for. Differences in migration from field to field, or the presence or absence of a wild host plant, are other factors not yet investigated. An example of this variable distribution was seen near Bangor, where three adjoining fields yielded the following counts, all with practically identical soils, etc. :—

- (a) Crop sown May 14, variety (?). Damage 5 per cent.
- (b) " " " 15, "Magnum Bonum." Damage 10 per cent.
- (c) " " " 1, "Magnum Bonum." Damage 50 per cent.

As regards other cruciferous crops, early sown rape suffered very severely (in some cases 90 per cent. of shoots rotted, and the crops were markedly stunted), while late-sown crops escaped. Turnips were unaffected even when growing alongside heavily damaged swedes, slight leaf crumpling in one or two cases being all that could be found. Savoys were damaged in several places, many being "blind." It is hoped to obtain further information during 1927.

BROWN ROT OF APPLES: THE NEED FOR CAREFUL PICKING AND SORTING

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IN recent years, the brown rot disease of fruit, caused by *Sclerotinia fructigena*, has been very prevalent. The disease was particularly severe in 1926, and it was not only common on apples and pears, the usual hosts of this fungus, but considerable loss in the plum crop resulted from infection by the same parasite.*

So far as is known, primary infection of the fruit by *Sclerotinia fructigena* takes place only through wounds, such as those caused by biting insects, but, when one apple of a cluster becomes infected, the disease can extend from that apple to those touching it, across the points of contact. The fruit may be infected when young and growing, and also at maturity, while infection may also take place at the time of picking or during the subsequent handling. The disease is the most common cause of loss in apples during the early stages of storage, and the so-called "black rot" of stored apples is caused by the same fungus. As mechanical injury renders the fruit so liable to infection, it is obvious that, especially in years of epidemic infestations, care must be taken not to cause unnecessary injury when the fruit is picked and afterwards when it is graded and packed or stored.

One form of injury may occur at the time of picking, by removing the fruit from its stalk instead of picking it with the stalk attached. That injury of this kind may soon lead to loss in the crop is shown by observations made at East Malling in the autumn of 1926.

Early in September, as the apples were being picked and graded for packing and marketing, it was noticed that fruit, apparently quite sound when received from the pickers, showed very pronounced brown rot within two or three days. On investigation it was found that in nearly every instance the rot had started at the stalk end, and this condition only appeared on those apples which had been pulled away from the stalk when picked. Observations were made on a batch of apples which had been picked three days previously, and already a number of those without stalks showed the typical

* A closely related fungus, *Sclerotinia cinerea*, also causes brown rot of plums and cherries; in addition to causing fruit rot, it infects the flowers and so produces blossom-wilt.

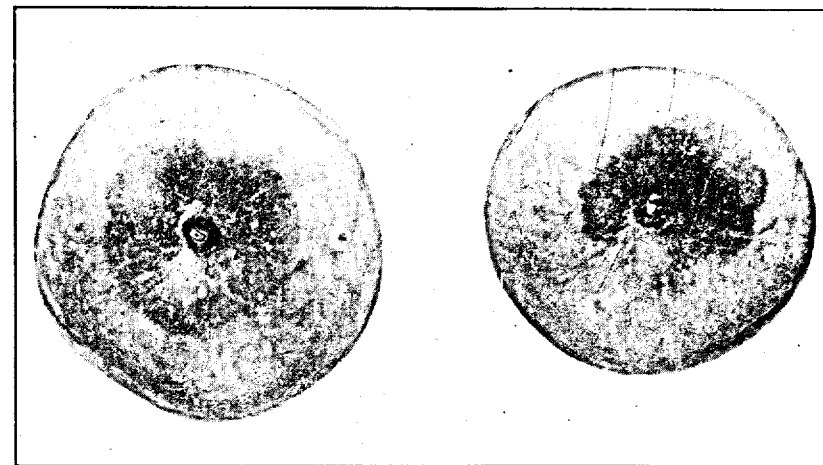


FIG. 1.—Apples three days after picking: infection has set in where the apples were pulled from the stalks.

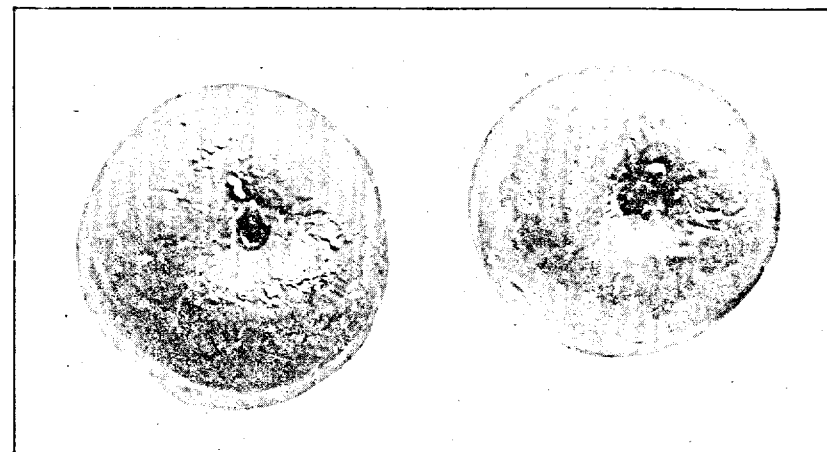


FIG. 2.—The same apples two days later. The rot has extended and the apple on the left bears fructifications of *Sclerotinia fructigena*.

[Photographs: copyright of the Horticultural Research Station, East Malling.]

brown rot, the discoloration in some cases extending for half an inch or more from the stalk end wound.

The variety in which this type of injury was observed was "James Grieve," which is not only very susceptible to brown rot infection of the fruit, but, being a soft-wooded variety, the rot often extends from the fruit into the spurs and also into the branches to form cankers.

To obtain some idea of the rate at which rot progresses in fruit infected in this way, apples showing rot starting at the stalk end were selected; two of them were photographed at this stage and are shown in Fig. 1. The margin of the brown area in each case was then marked with ink. The apples were placed on a bench in an unheated laboratory, the temperature of which was approximately that of the packing shed.

On the following day, it was found that the rot had extended 7 to 16 mm. (on the average about $\frac{1}{2}$ in.) beyond the marked line within the 24 hours. During the next 24 hours, the rot proceeded at about the same rate, so that nearly half the surface of each apple was brown, and a few yellowish spore-bearing tufts, the fructifications typical of the fungus, were appearing at this stage (*see* Fig. 2). A few days later, the apples were completely brown, and numerous fructifications were present. It is obvious that the apples had become infected soon after they were picked, and that the fungus had entered through the wound caused by removing the fruit from the stalk.

It is apparent, also, that, had these apples been sent to market, when they already showed evidence of infection, they would have been unsaleable soon after their arrival. However carefully apples are picked, a certain number will be pulled away with damaged "strigs." During grading, these should be set aside with the bruised fruit for immediate use. Such fruit should not be stored. Slight injuries in themselves are not necessarily very harmful, but, since they serve as ports of entry for certain parasites, such as the one under consideration, care in picking, grading and packing is essential for successful storing and marketing of fruit. Since it is impossible to eliminate mechanical injuries altogether, especially when large quantities of fruit have to be handled, the grower should endeavour to reduce the chances of infection to a minimum by removing as far as possible all sources of infection. In certain seasons, it is not uncommon, at the time of picking, to see the ground under apple and pear trees strewn with fruit infected with brown rot and bearing myriads of spores which

blow about and cause further infection. The collecting of such fruit and rendering them innocuous by burning or burying is possible in a garden or small plantation, but is hardly a practical proposition on large fruit farms.

The grower, however, should realize that rotting fruits, whether on the tree or on the ground, are a source of danger, and when it is at all practicable they should be destroyed. He is reminded, too, that apples infected with brown rot frequently remain on the tree through the winter. These "mummies," if left on the trees, produce, in the following spring, another crop of spores which serve to start infection in the young fruit. It is therefore sound practice to remove, during the winter, any withered apples that may be found on the trees.

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THE INTERNATIONAL ECONOMIC CONFERENCE, 1927: DOCUMENTS RELATING TO AGRICULTURE

A number of documents relating to agriculture were prepared for the use of the International Economic Conference, held at Geneva last May.* The more important of these are as follows:—*Agricultural Problems in their International Aspect* (C.E.I. 36), prepared by the International Institute of Agriculture, Rome. This is mainly a statistical summary of the data in the possession of the International Institute. It includes a general introduction, followed by statistical tables relating to:—

- (1) Production, trade, consumption, prices.
- (2) Materials relating to certain aspects of agricultural economics, including the distribution of landed property in agricultural holdings, agricultural population and certain data relating to index numbers of agricultural prices and costs. These are set out for a number of different countries.
- (3) The marketing of agricultural produce—consisting mainly of a comparison of index numbers of wholesale and retail prices relating to agricultural produce.

Two short sections are also included relating to the development of agricultural co-operation and to international agricultural credit respectively.

* These are obtainable from Messrs. Constable & Company, 10 Orange Street, London, W.C.2.

Agriculture and the International Economic Crisis (C.E.I. 43), prepared by three members of the Sub-Committee on Agricultural Questions of the Preparatory Committee for the International Economic Conference—M. Jules Gautier, Dr. Andreas Hermes and Mr. H. A. F. Lindsay. The document attempts to compare statistically the change which has taken place, as compared with pre-war conditions, in the relation of agricultural prices to working expenses. It also makes a rough comparison of the value of agriculture and industry in the world's economics. In its general conclusions, it calls attention to the dependence of agriculture upon the prosperity of the industrial community.

The Part played by Co-operative Organizations in the International Trade in Wheat, Dairy Produce and some other Agricultural Products (C.E.I. 14), prepared by the International Labour Office. This valuable document relates not so much to the ordinary aspects of agricultural co-operation, as to the growing importance of co-operative organizations in international trade, and to the relations of producers' and consumers' organizations. In the first section, a brief summary is given of the chief co-operative marketing associations engaged in international trade, including those of Canada, Denmark, the U.S.A., Australia and Russia. The second section deals with distributive co-operative societies and the part played by them in international trade. The third section deals with the relations of distributive co-operative organizations and agricultural co-operative marketing societies. Examples are quoted of the various methods which have been adopted to facilitate direct trading between producers' and consumers' organizations. An appendix follows dealing with a number of individual commodities.

The Relation of Labour Costs to Total Costs of Production in Agriculture (C.E.I. 27), prepared by the International Labour Office. The subject of this memorandum is an exceedingly difficult one; it attempts to ascertain the proportion between labour costs and total costs in agriculture for a number of countries. Necessarily, it has depended on the data of costs collected by methods which are dissimilar, and a great many considerations prevent the results being strictly comparable, as between one country and another, or between one system of farming and another; moreover, in several countries, the figures are based on data collected from very few farms. Thirteen countries are included in the

investigation. As might be expected, the results differ very widely.

Results of certain Inquiries for instituting a Comparison between Retail Prices in Private Trade and those of Distributive Co-operative Societies (C.E.I. 11), prepared by the International Labour Office. Inquiries undertaken both by co-operative societies and by public authorities are included and relate to a comparatively small number of countries. The results indicate that, on an average, the retail prices charged by co-operative societies are lower than those charged by private trade, in addition to which consumers, who are members of co-operative societies, in many cases have the further advantage of receiving a dividend on their purchases.

Apart from the above, there were issued for the use of the International Economic Conference a number of documents bearing on the general economic situation, which were of considerable interest to agriculturists. Of these may be mentioned, *Principal Features and Problems of the World Economic Position from the point of view of Different Countries* (C.E.I. 29). This was issued as a result of an invitation addressed to the representatives of the various countries taking part in the Conference to prepare statements of their respective national economic conditions. Only a small proportion of the total number of countries responded to this invitation, but the statements contain some important information as to the effect of post-war economic policy in the various States and its reaction upon agriculture, particularly in some of the Central European countries.

Memorandum on Production and Trade (C.E.I. 3). This memorandum was prepared by the Secretariat of the League of Nations with the collaboration of a Committee of Economists, and analyses the available statistical data in order to show the changes since 1913 in (1) Population and its territorial distribution, (2) production of raw materials and foodstuffs, (3) the total of world's trade. The results indicate that, in 1925, the population and trade of the world were both about 5 per cent. greater than in 1913. The production of foodstuffs (exclusive of China) and raw materials has increased by about 16 to 18 per cent. In the case of Europe, however, with an increase in population of a little over 1 per cent., the production of raw materials and foodstuffs (the latter owing largely to a favourable harvest) was, in 1925, 4 to 5 per cent. above pre-war. European trade was, however, probably 10 per cent. below that level. Within Europe, eastern and central countries are

below the western, but have made considerable progress in the last two years. The big increases which have taken place are in the rest of the world, conspicuously in North America, where there is an increase of about 20 per cent. in population, 25 per cent. in the production of foodstuffs and raw materials, and over 33 per cent. in trade.

Summary Memorandum on Various Industries (C.E.I. 19) prepared by the Economic and Financial Section of the League. The subjects of productive capacity, production, international trade, prices and tariffs are dealt with, and this is followed by a short analysis of the causes of the economic depression. It also includes an outline of various proposals put forward for international action. This document was one of the most important summaries of the general position which the Conference had before it.

Other important publications are: *Population and Natural Resources* (C.E.I. 39), giving a list of the main sources of raw materials, together with the production in each country in 1925, and a table showing the density of population in relation to cultivated areas; *Migration in its various Forms* (C.E.I. 25); *Standard of Living of Workers in various Countries* (C.E.I. 26); and *Marks of Origin* (C.E.I. 20).

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SEPTEMBER ON THE FARM

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Seasonal Notes.—The summer of 1927 will long be remembered both for its dry and for its wet periods, but particularly for the wetness which impeded or prevented haymaking operations for such a long time. At the end of July, many farmers had secured no good hay at all, and now—nearing the middle of August—unmown meadows adjoin wheat that is yellowing or winter oats that are dead ripe. In some cases, the uncut or spoiled hay crop adjoins a particularly luxuriant field of mangolds or cabbages, emphasizing the lesson that in such a climate as ours the green crop has a special value as an insurance against the effects of a bad hay harvest.

The hope that July might be free from tempests was not realized, and, consequently, there are now many cornfields where harvesting operations will be retarded by the inability of the self-binder—even when fitted with ear lifters—to cut

on all sides. Corn cutting, therefore, will probably extend well into September. Formerly, when the acreage of corn grown in this country was greater and all the reaping and binding had to be done by hand, the *harvest moon* was a matter of special interest. This year the time of harvest moon is roughly from September 9, when the nearly full moon rises at 6.18 p.m., to the 15th, when the time of rising is still no later than 8.23 p.m.

Weeds in Straw.—The abundance of daisy-like weeds in corn crops this year has brought in queries as to whether the straw from infested crops is likely to be injurious to live stock consuming it. One correspondent asks whether the infested straw might safely be fed as chaff. As a rule, fodder containing plants of doubtful character should not be chaffed, as this prevents the cattle from rejecting—as they often will—herbs of unpleasant odour and injurious properties.

As regards mayweeds or chamomiles, there are several plants which are not easily distinguishable by the layman, but the most objectionable species—stinking mayweed—has an unmistakable odour. Long, in his *Plants Poisonous to Live Stock*, states that, considering the prevalence of mayweeds, there would be more evidence of the damage they would cause if they were poisonous. He quotes investigations, however, which throw suspicion on the seeds of stinking mayweed and corn chamomile and includes them among the plants liable to impart taints to milk.

The tainting of milk and its products by mayweed, infesting seeds hay, was specially investigated at Reading in 1924-26, where it was found that a daily allowance of 10-13 lb. of hay containing 17 per cent. of mayweeds of several species imparted a strong taint to milk within 12-36 hours after commencing to feed the hay. Further studies of the potency of the various kinds of mayweed showed that the chief offender was the species known as stinking mayweed, while the other kinds had either definitely no effect or gave a doubtful result.

Charlock seeds are well known to be dangerous to cattle, but, fortunately, the seeds are usually thrashed out when the corn passes through the thrashing mill. As regards younger plants of charlock, such as sometimes occur in crops cut for silage before the seeds have formed, there appears to be little danger from this source. Last winter the writer had under observation a herd of Shorthorn cows to which was fed a daily

ration of 25 lb. of silage containing a large proportion of flowering charlock, and no ill effects were noticed.

Wheat Seed.—There is little land ready for drilling with wheat in September, the only fields available being such as have been bare-fallowed or half-fallowed after early-cut silage crops. It is in this month, however, that the farmer decides whether to thrash and sow his own seed or to obtain new; he has also to consider the question of varieties. If the decision is to adhere to the same varieties as have been grown during the past season, change of seed may or may not be advisable according to circumstances. The case of seed corn is not comparable with that of potatoes, where, in certain districts, the crop becomes so full of virus diseases as to be unfit for planting again after two or three seasons' growth. The main considerations in the case of seed corn are the ripening and harvesting of the sample. Given two equally well-fed, well-ripened, and well-harvested samples of wheat, the one home-grown and the other brought from a distance, the chances are in favour of the first producing the heavier crop.

New seed should be obtained when the home-grown sample is defective, as it may be if the crop has grown unevenly, ripened badly or suffered from bad weather at harvest time. The presence of more than traces of bunt in the crop and the occurrence of blow-away smut, as mentioned in last month's notes, should condemn the sample for seed purposes, as should also undue adulteration with seed not belonging to the variety desired. After a wet, late harvest, the need for new seed becomes all the greater, especially in northern and western districts. It is common knowledge that seed which is rather soft and immature germinates both slowly and unevenly, but improves in these respects on further drying and keeping. Such delay in the case of wheat is impossible owing to the short interval between harvest and seed time; it is sound economy in this case to purchase new seed from an earlier district where harvesting conditions have been more favourable. I have seen several cases where complete failure has followed the sowing of local seed after a late harvest, or when the variety has been a late-ripening sort, while adjoining plots of southern-grown seed drilled on the same day have come up quickly and evenly, stood the winter well and made full crops.

Varieties of Wheat.—As a general policy, it is doubtless safest to rely mainly on sorts that have gained a good

reputation in the district and given satisfactory yields on the farm in question; but, on every farm where wheat is an important crop, there should be one or more trial plots in which a different variety is compared with that grown as the main crop. Even where the trial is not carried to the point of comparing yields per acre after thrashing, valuable information can be gained by observation of such matters as strength of straw, date of ripening, and, in the earlier stages, resistance to winter conditions. This year, different varieties have shown appreciable differences in their capacity to suppress weeds, which capacity may be of special interest in certain rotations.

It is not intended here to enter into the comparative merits of the many different sorts of wheat, or to review the trials carried out in various counties. Particulars of local results are obtainable on application to the Agricultural Organizer for the county in which the experiments have been carried out. Special attention may, however, be called to the following results of trials conducted in 1924-25 by, or on behalf of, the National Institute of Agricultural Botany. The trials were carried out at four centres, and at each centre there were ten pairs of comparisons between variety under test and control (Squarehead's Master). The yields are here (approximately) stated with reference to Squarehead's Master as 100:—

	Cambridge (heavy clay)	Hants (heavy clay)	Norfolk (loam)	Salop (sandy loam)	Average
Wilhelmina ..	112	97	109	109	106.7
Iron III ..	114	81	98	113	101.3
Cambridge					
Browick ..	97	90	108	111	101.3
Little Joss ..	103	96	113	93	101.2
The Fox ..	103	99	108	94	100.8
Yeoman II ..	100	92	108	91	97.7

The order of ripening was as follows: Squarehead's Master, Little Joss, Yeoman II, Wilhelmina, Browick, Fox, and Iron III. The order of length of straw was almost exactly the same, the only difference being that Yeoman came between Browick and Fox.

Beet and Potatoes.—This year, potato crops, where grown from good seed and suitably manured, are particularly luxuriant, so that, if disease does not damage the tops and blight the tubers, good yields are likely to be harvested. There is, however, one field where the luxuriance of the potato crop is a matter of special interest, not only to the

grower, but also to a large party of farmers who saw the same field last year. A year ago, the field was an almost complete failure of beet and mangolds, patched with moderate success with common turnips; and a keen discussion arose among the party visiting the farm (which had gained a high place in the County Farm Competition) as to the cause of the failure of the intended crops. The cultivations had been skilfully carried out, the manuring had been both liberal and timely in application, and there was evidence that the seed had germinated with sufficient regularity to make a full plant; but there were large patches where the seedlings had not grown beyond the three- or four-leaf stage by the end of August, some places where they had died out, and smaller areas where the crop had made excellent progress. The most confident opinions were that the root of the trouble was bad drainage.

The writer recognized the symptoms as those of soil sourness, and subsequent tests revealed a high lime requirement. The farmer first decided to lime the field during the ensuing winter and follow with spring oats and small seeds, but, partly because of the difficulty of obtaining lime and its high price for some time after the settlement of the coal dispute, he accepted the advice to try potatoes without the application of lime. The land having been well manured for the crop that failed and the yard manure being more needed on other parts of the farm, the only dressing applied to the potato crop was 2 cwt. of sulphate of ammonia, 3 cwt. of superphosphate, and 2 cwt. of sulphate of potash per acre. The variety planted was King Edward, Scotch seed. The resulting crop is the best that the field in question has been known to bear for many years, although it must be mentioned that potatoes had not been tried there since the field began to give unsatisfactory results. This is not the first instance within the writer's experience where the great differences between potatoes and beet in their reaction towards soil acidity have been observed as sufficient to cause failure of the beet crop, while not sufficient to interfere visibly with the success of potatoes. It will, of course, be necessary to lime this field before success may be expected with wheat, barley, clover, or other crops that are less tolerant of soil sourness than are rye, potatoes, and turnips.

Live Stock.—Given weather conditions which permit of field operations, September should be one of the busiest months of the year. Indeed, the wisdom of active progress at this season is expressed by the saying that "Fools grow fat in

September." In the live-stock departments, also, careful management and strict oversight are now needed to avoid the many ills which are associated with the end of the grazing season and the incidence of colder nights and heavy dews. Calves should be housed at night, cows require increased rations of dry food to avoid loss of condition and fall in milk yield, and sheep are not yet free from the dangers of fly attack, while additional attention is required to control foot

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ending August 10				Cost per unit at London
	Bristol	Hull	L'pool	London	
Nitrate of Soda (N. 15½%)	£ s.	£ s.	£ s.	£ s.	s. d.
Sulphate of ammonia :—	..	..	..	12 15	16 5
Neutral (N. 20.6%)	9 18*	9 18*	9 18*	9 18*	9 7
Calcium cyanamide (N. 19%)	8 6†	8 6†	8 6†	8 6†	8 9
Kainit (Pot. 14%)	3 2	2 17	2 17	2 16	4 0
Potash salts (Pot. 30%)	4 17	..	..	4 12	3 1
" (Pot. 20%)	3 12	3 2	3 9	3 4	3 2
Muriate of potash (Pot. 50.53½%)	9 10	8 5	8 13	9 5	3 5
Sulphate " (Pot. 48.51½%)	11 10	10 5	10 16	11 2	4 4
Basic Slag (T.P. 32%)	3 4§	..	2 19§	..	..
" (T.P. 30%)	3 2§	2 18§	2 17§	2 15e	1 10
" (T.P. 28%)	..	2 10§	2 10§	..	..
" (T.P. 26%)	..	2 5§	2 5§	..	..
" (T.P. 24%)	2 10§	2 1§	2 2§	..	..
Ground rock phosphate (T.P. 58%)	..	..	..	..	..
Very fine grade¶	2 15	..	..	2 10d	0 10
Fine grade||	2 10	..	..	2 7d	0 10
Superphosphate (S.P. 35%)	..	..	3 4	3 0	1 9
" (S.P. 33%)	..	..	3 2	..	..
" (S.P. 30%)	..	2 15	2 18	2 15	1 10
Bone meal (N. 3½%, T.P. 45%)	8 15	8 10	8 10	8 0	..
Steamed bone flour (N. 1½%, T.P. 60.65%)	6 0†	6 2†	6 5	5 17	..

Abbreviations: N.—Nitrogen; S.P.—Soluble Phosphate; T.P.—Total Phosphate; Pot.—Potash.

* Delivered in 6-ton lots at purchaser's nearest railway station. For lots of 4 tons and under 6 tons the price is 1s. per ton extra and for lots of 2 tons and under 4 tons 5s. per ton extra.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in 4-ton lots at purchaser's nearest railway station.

§ Prices for 4-ton lots delivered to purchaser's nearest railway station in neighbourhood of towns mentioned above.

¶ Fineness 80% through standard screen of 14,400 holes to the square inch (120 mesh sieve).

|| Fineness 80% through standard screen of 10,000 holes to the square inch (100 mesh sieve).

d Prices for 4-ton lots f.o.r. at Northern London Stations. At G.W.R. and S.R. London Stations the cost to purchasers is 2s. 6d. per ton extra.

e F.O.R. Northern rails; 3s. 6d. per ton extra on Southern rails.

rot. Where the seeds layers are being broken up for wheat the sheep now begin to be folded on roots and, to avoid scour as a result of the change to more watery and less mature diet, the change should be made gradually and a little extra dry food should be provided. The ewe flock, where not already mated up for early lambs, should now be prepared for mating by being "flushed," which means more liberal feeding for the purpose of ensuring a heavier crop of lambs.

NOTES ON FEEDING STUFFS FOR SEPTEMBER

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The Composition and Feeding Value of Sugar Beet Tops.—

With the approach of autumn, the manifold problems connected with the lifting and disposal of the sugar beet crop begin to engage the attention of the farmer. Soon, in the fields, the labourer will be busy topping the beets, and large quantities of tops will be left strewing the ground after the roots have been dispatched to the sugar factory. At first glimpse, these crop residues strike one as distinctly unattractive, and it may be that the farmer will be inclined to plough them into the land in order to save both time and trouble. He will thereby make a mistake, however, for these wilting, soil-stained tops are endowed in reality with quite surprising nutritive qualities, and constitute, when properly understood, a very useful food for farm stock.

That this is the view held by the German farmer, whose experience of this crop is riper than that of the farmer in this country, is manifest from the following quotation from Kellner's well-known text-book on animal nutrition: "Liberal feeding with the *leaves* of the sugar beet, which often takes place during and after harvesting of the beets, has the same effect as with good pasture or clover feeding, and gives a milk richer in dry matter and fat because of the quantity of protein in the fodder." Indeed, sugar beet tops are so prized as a feed for farm animals in Germany, that the sugar factories go to a great deal of trouble and expense in drying down artificially large masses of the wet tops for preservation for winter use.

During the past year, there has been carried out at Cambridge an investigation into the question of the composition and nutritive value of sugar beet tops. Digestion experiments were conducted on sheep in which the daily ration was composed

of 4,000 grammes of sugar beet tops and 600 grammes of chaffed meadow hay of known digestibility, together with a few grammes of precipitated chalk. The tops, before being given to the animals, were allowed to wilt on the stone floor of a cool room for periods varying from three to six days. In connexion with this question of wilting, the object of which will be dealt with in the Notes for next month, it may be mentioned that, under such conditions, it was possible to leave the tops for over a month without decay setting in, excepting traces on the cut surfaces of the roots. Indeed, after fourteen days' wilting, it was noted that the material had acquired a pleasant odour not unlike that of good hay.

The sheep consumed the mixed ration of sugar beet tops and meadow hay with evident relish, displaying marked fondness for the tops. Such small food residues as were left in the experiment consisted entirely of hay. That stock are appreciative of sugar beet tops is not, however, demonstrated merely by the observations in this single trial. It is also borne out by experience on a much larger scale on the University Farm, where animals are annually permitted access to these sugar beet residues; and it is further confirmed by the unanimous opinion of all those farmers with whom the writer has had the opportunity of discussing the matter. This is an encouraging fact to keep in mind, then, that no difficulty of any kind need be expected in inducing farm animals to consume the crop of sugar beet tops.

The main features of sugar beet tops in respect of chemical composition are summarized below.

Moisture Content.—Sugar beet tops must be classified with the succulent foods. The percentage of water usually amounts to 83 to 85 per cent. The wettest tops are those grown on fen soils, and, in this case, the moisture content may be as high as 88 per cent. In other words, such fen-grown tops may contain as much water as milk or mangolds.

Carbohydrate Content.—The most important food ingredient in the sugar beet tops is the sugar of the crowns. The percentage of this constituent is naturally dependent on the ratio of crown to leaf. The results of numerous German analyses indicate that the percentage of sugar may vary from 14 to 23 per cent. of the dry matter of the tops. In the Cambridge investigation, the ratio of crown to leaf was fairly high, the leaves being somewhat stunted in growth, whereas the roots were of medium size. It was found that sugar constituted as much as 4.4 per cent. of the *moist* tops. Since the percentage

of dry matter in the tops after wilting was 21.7 per cent., it follows that roughly one-fifth of the total dry substance in the sample consisted of sugar. Obviously, a material which contains such a significant amount of this valuable constituent is not to be despised as a feeding stuff. The total amount of carbohydrate of all kinds accounted for approximately one-half of the dry substance of the tops.

Protein Content.—The dry matter of sugar beet *leaves* contains about 26 per cent. of protein and only about 10 per cent. of fibre. The leaves may, therefore, be looked on as possessing the characteristics of an immature green fodder like young pasture grass. The percentage of protein in the tops will be governed by the value of the ratio of crown to leaf, and will be high when the percentage of carbohydrate is low, and low when carbohydrate is present in large amount. In numerous analyses, carried out in the Cambridge laboratory, of beet tops from many different types of soils, values were obtained for the protein content ranging from 9 to 19 per cent. of the dry matter.

Oil Content.—As with roots and green fodders in general, the amount of oil in beet tops is very low. Oil from such a source has no great value in the nutrition of animals.

Fibre Content.—The amount of fibre in sugar beet tops is relatively low, usually less than 10 per cent. of the dry matter.

Ash Content.—Beet tops are very rich in inorganic constituents, and the amount may be augmented very considerably if care is not exercised in the field to prevent unnecessary contamination with soil.

The various facts cited above are brought together in the following table, which records the composition of the sugar beet tops used in the digestion trial:—

COMPOSITION OF SUGAR BEET TOPS

	Dry matter basis		Wet tops (83.8% moisture)	
	Per cent.		Per cent.	
Protein	12.55	..	2.03	..
Oil	2.76	..	0.45	..
Carbohydrate ..	53.61	..	8.68	..
Fibre	9.92	..	1.61	..
Ash	21.16	..	3.43	..

Digestibility.—The results of the digestion trial demonstrated that sugar beet tops constitute a highly digestible food. No less than 79 per cent. of the organic matter in the tops was digested and utilized by the sheep. The carbohydrate constituent, which included the sugar in the crowns, was especially well digested, the digestion coefficient attaining to

the very satisfactory value of 83 per cent. Even the fibre in the tops was well utilized, the sheep being able to digest more than 70 per cent. of this constituent.

It was further shown that 100 lb. of the dry substance in sugar beet tops contained 61.8 lb. of digestible organic matter, equivalent to about 53 lb. of starch, and including 8.9 lb. of digestible protein, 1.7 lb. of digestible oil, 44.2 lb. of digestible carbohydrate and 7 lb. of digestible fibre. A more concrete idea of the nutritive value of beet tops may be gained, however, from the data given in the table below, where it is shown that 40 lb. of mangolds (containing 89.3 per cent. of

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follow :—

	Starch equivalent Per cent.	Protein equivalent Per cent.	Per ton £ s.
Barley (Imported)	71	6.2	11 6
Maize	81	6.8	8 9
Decorticated ground nut cake	73	41.0	11 5
" cotton cake	71	34.0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2.66 shillings, and per unit protein equivalent, 0.82 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent Per cent.	Protein equivalent Per cent.	Food value per ton, on farm £ s.
Wheat	72	9.6	9 19
Oats	60	7.6	8 6
Barley	71	6.2	9 14
Potatoes	18	0.6	2 8
Swedes	7	0.7	0 19
Mangolds	7	0.4	0 19
Beans	66	20.0	9 12
Good meadow hay	31	4.6	4 6
Good oat straw	17	0.9	2 6
Good clover hay	32	7.0	4 11
Vetch and oat silage	13	1.6	1 16
Barley straw	19	0.7	2 11
Wheat straw	11	0.1	1 9
Bean straw	19	1.7	2 12

DESCRIPTION	Price per qr. s. d. lb.	Price per ton £ s.	Manu- rial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Pro- tein equiv. %
Wheat, British	—	—	12 15	0 13	12 2	72	3 4	1.78
Barley, Canadian No. 3 Western	42 0	400	11 15	0 10	11 5	71	3 2	1.70
" Algerian	40 9	—	11 8*	0 10	10 13	71	3 1	1.65
" Persian	38 6	—	10 15	0 10	10 5	71	2 11	1.56
Oats, English, white	—	—	10 13	0 11	10 2	60	3 4	1.78
" " black and grey	—	—	10 0	0 11	9 9	60	3 2	1.70
" Scotch white	—	—	11 10	0 11	10 19	60	3 8	1.96
" Irish white	—	—	11 5*	0 11	10 14	60	3 7	1.92
" Canadian No. 2 Western	32 3	320	11 5	0 11	10 14	60	3 7	1.92
" " feed	28 0	—	9 17*	0 11	9 6	60	3 1	1.65
" American	24 3	—	8 10*	0 11	7 19	60	2 8	1.43
" Argentine	27 0	—	9 8	0 11	8 17	60	2 11	1.56
" Chilean tawny	27 6	—	9 12	0 11	9 1	60	3 0	1.61
" New Zealand	33 3	—	11 13*	0 11	11 2	60	3 8	1.96
Maize, American	40 3	480	9 8	0 10	8 18	81	2 2	1.16
" Argentine	35 0	—	8 3	0 10	7 13	81	1 11	1.03
" South African	33 6	—	7 17*	0 10	7 7	81	1 10	0.98
Peas, Indian white	—	—	12 0*	1 2	10 18	69	3 2	1.70
" Japanese	—	—	21 0*	1 2	19 18	69	5 9	3.08
Dari, Egyptian	—	—	10 10	0 12	9 18	74	2 8	1.43
Millers' offals—								
Bran, British	—	—	7 7	1 3	6 4	42	2 11	1.56
" broad	—	—	8 7	1 3	7 4	42	3 5	1.83
Middlings, fine, imported	—	—	9 17	0 18	8 19	69	2 7	1.38
" coarse, British	—	—	9 10	0 18	8 12	58	3 0	1.61
Pollards, imported	—	—	7 15	1 3	6 12	60	2 2	1.16
Meal, barley	—	—	11 17	0 10	11 7	71	3 2	1.70
" maize	—	—	9 5	0 10	8 15	81	2 2	1.16
" " germ	—	—	8 15	0 16	7 19	85	1 10	0.98
" " gluten feed	—	—	8 15	1 1	7 14	76	2 0	1.07
" locust bean	—	—	8 10	0 8	8 2	71	2 3	1.20
" bean	—	—	12 0	1 6	10 14	66	3 3	1.74
" fish	—	—	20 10	3 10	17 0	53	6 5	3.44
Maize, cooked flaked	—	—	10 15	0 10	10 5	85	2 4	1.25
Linseed—								
" cake, English 12% oil	—	—	12 0	1 10	10 10	74	2 10	1.52
" " " 10% "	—	—	11 12	1 10	10 2	74	2 9	1.47
" " " 9% "	—	—	11 5	1 10	9 15	74	2 8	1.43
" " " 6% "	—	—	11 10	2 3	9 7	69	2 9	1.47
Soya bean	—	—	6 12	1 8	5 4	42	2 6	1.34
Cottonseed cake	—	—	6 10	1 8	5 2	42	2 5	1.29
" " Egyptian, 5 1/2% "	—	—	6 10	1 8	5 2	42	2 5	1.29
Decorticated cottonseed meal, 7% oil	—	—	11 2*	2 3	8 19	74	2 5	1.29
Coconut cake, 6% oil	—	—	9 10	1 5	8 5	79	2 1	1.12
Ground-nut cake, 7% oil	—	—	9 12*	1 8	8 4	57	2 11	1.56
Decorticated ground-nut cake, 7% oil	—	—	11 5*	2 3	9 2	73	2 6	1.34
Palm kernel cake, 6% oil	—	—	8 17	0 18	7 19	75	2 1	1.12
" " meal, 6% "	—	—	9 0*	0 18	8 2	75	2 2	1.16
" " " 2% "	—	—	8 2	0 19	7 3	71	2 0	1.07
Feeding treacle	—	—	6 10	0 8	6 2	51	2 5	1.29
Brewers' grains, Dried ale	—	—	6 17	0 19	5 18	49	2 5	1.29
" " " porter	—	—	6 7	0 19	5 8	49	2 2	1.16
" " " Wet ale	—	—	0 16	0 7	0 9	15	0 7	0.31
" " " " porter	—	—	0 12	0 7	0 5	15	0 4	0.19
Malt culms	—	—	6 5*	1 8	4 17	43	2 3	1.20

* At Hull.

† At Bristol.

‡ At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of July and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is 18s. per ton. The food value per ton is therefore £9 2s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N 3s. 7d. P₂O₅ 3s. 10d. K₂O 3s. 6d.

moisture) are equivalent to 25 lb. of beet tops (containing 83.8 per cent. of moisture).

REPLACEABILITY OF MANGOLDS BY SUGAR BEET TOPS

	Dry matter lb.	Starch equivalent lb.	Digestible protein lb.
40 lb. mangolds ..	4.30	2.20	0.28
25 lb. sugar beet tops ..	4.05	2.14	0.36

The precautions which should be observed when sugar beet tops are fed to farm animals will form the subject for discussion in the Notes for next month.

* * * * *

MISCELLANEOUS NOTES

Home Produce in Empire Displays.—A note on the display of home produce at the Advertising Exhibition, held at Olympia in July, appeared in this JOURNAL last month (p. 395). A photograph of the stand is reproduced opposite. The Exhibition attracted large crowds, and a considerable amount of business was done by firms contributing to the Great Britain stand. It is confidently hoped that the interest shown in home produce will be sustained, and that a corresponding benefit will accrue to the industry.

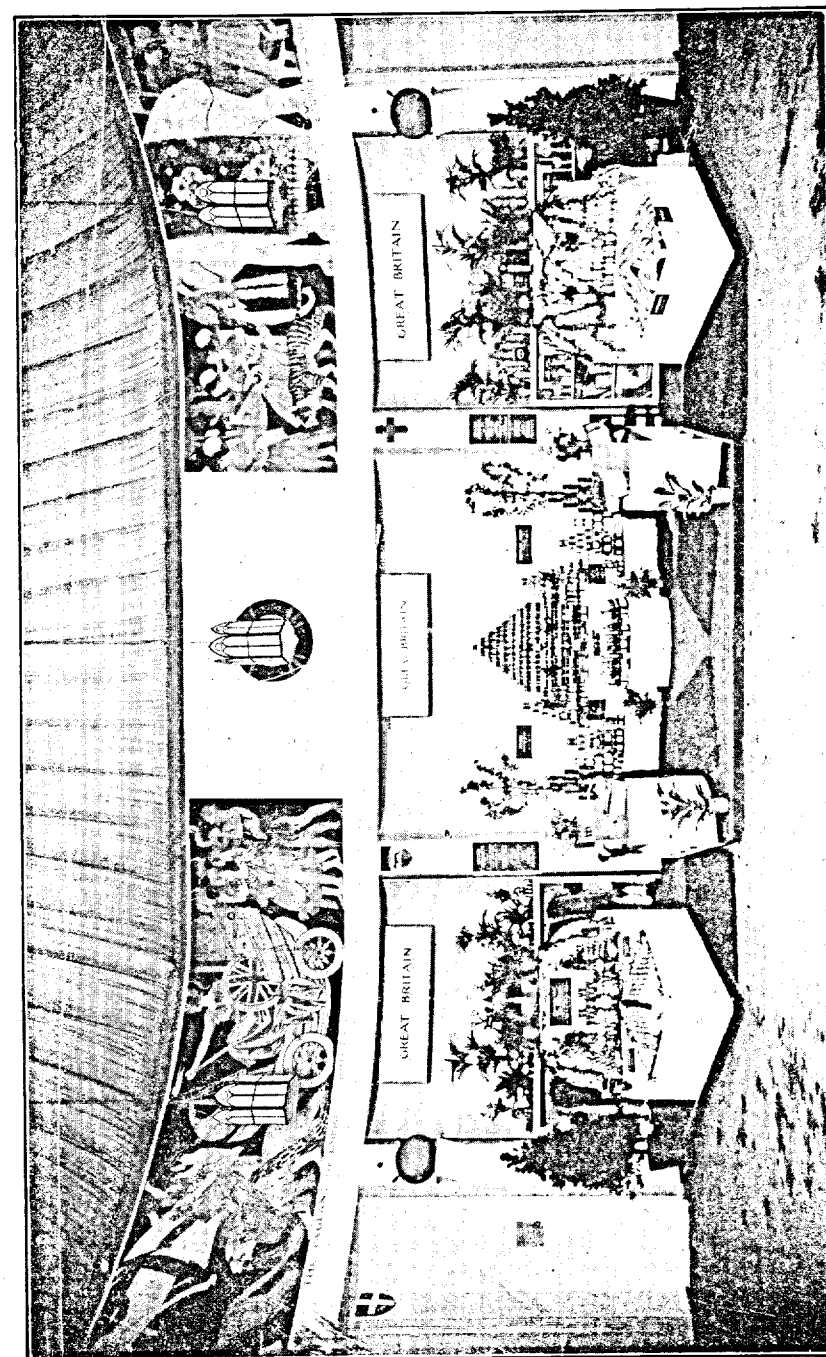
An Empire Exhibition was held at Edinburgh from July 27 to August 6. A small stand was erected by the Empire Marketing Board, and, on one side of this, an effective display of home produce was arranged by the Ministry through the usual channels (photo opposite page). The Exhibition was well patronized, and much interest was evinced in some of the English products which are not so well-known in Scotland as they should be.

Empire Marketing Board Advertisements.—An article on this subject appeared in this JOURNAL last month (p. 444), with reproductions of three of the recent advertisements. Three further advertisements, which have appeared in the daily Press, are now reproduced, and also a photo of a 16-sheet poster in favour of home-grown fruit and vegetables.

* * * * *

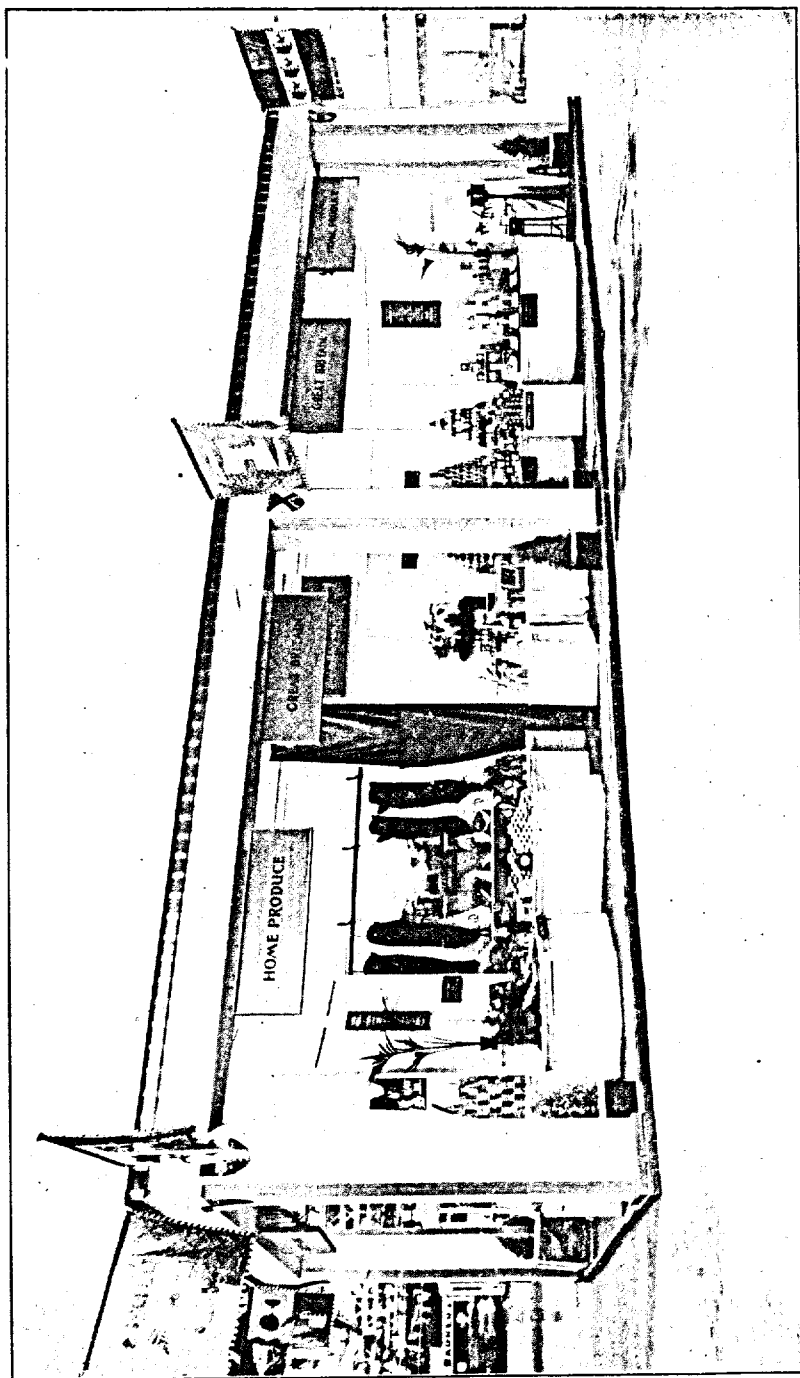
AMONGST the new nitrogenous fertilizers, now being manufactured in Germany, is a material known as Urea, which owing to its high content of nitrogen—46 per cent.—is of importance, if only for the saving which is effected in its transport.

Urea



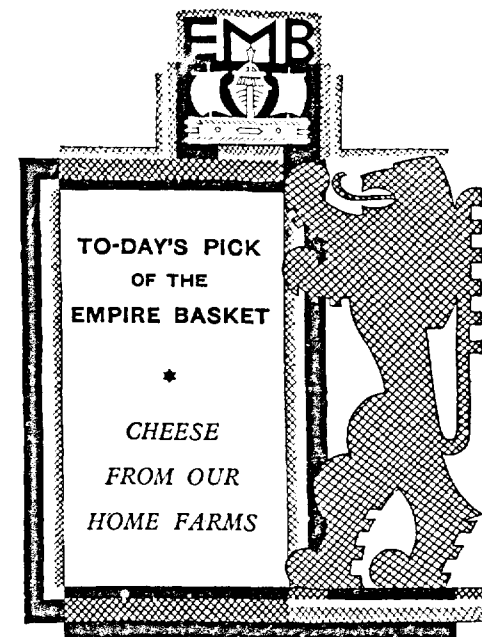
Display of Home Produce at the Advertising Exhibition, Olympia, London.

B



Display of Home Produce at the Edinburgh Empire Exhibition.

D



DO you know that cheese is one of the richest and most valuable foods that you can buy?

Our home cheeses have long been famous, and nowhere will you discover finer cheese than comes from our own countryside.

There is a variety to suit every taste and every purse.

Those who desire Cheshire Cheese of guaranteed origin and quality should note that Cheshire Cheese Manufacturers, under a scheme approved by the Ministry of Agriculture, now apply the trade mark  (Choicest Cheshire Cheese) to their guaranteed produce.

BUY
EMPIRE PRODUCE
from HOME and Overseas

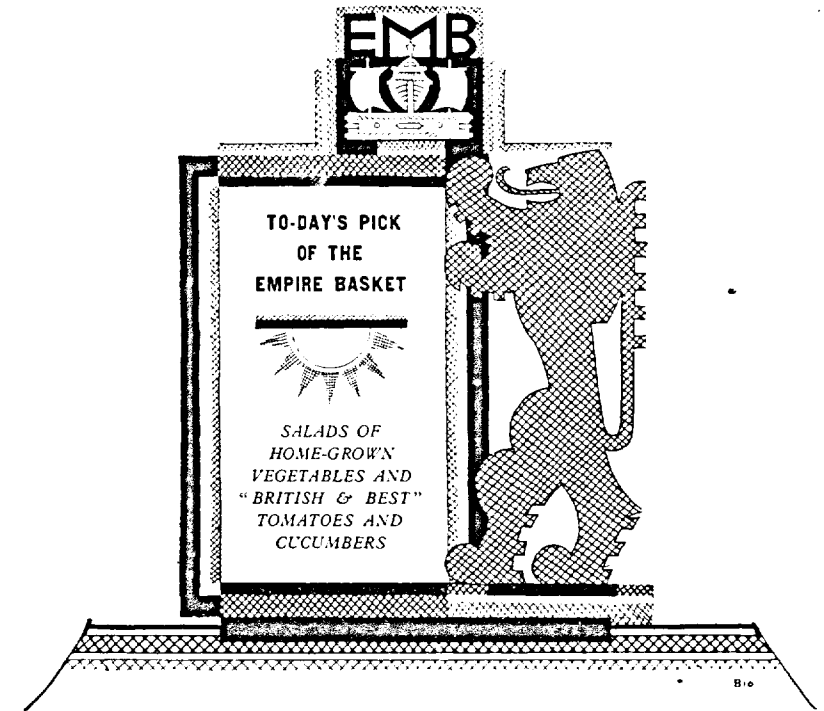
ISSUED BY THE EMPIRE MARKETING BOARD

568.C

568.E



An Empire Marketing Board poster, favouring home-grown fruit and vegetables.



BUYERS OF THE SUN

You cannot grow a green plant in a dark room.

What does this mean to you? It means that every leaf in a green salad has the hall-mark of the sun upon it; and that when you buy lettuces and cresses, cucumbers and tomatoes for a salad, you are buying something else besides a delightful summer dish.

You are buying a store of sun-

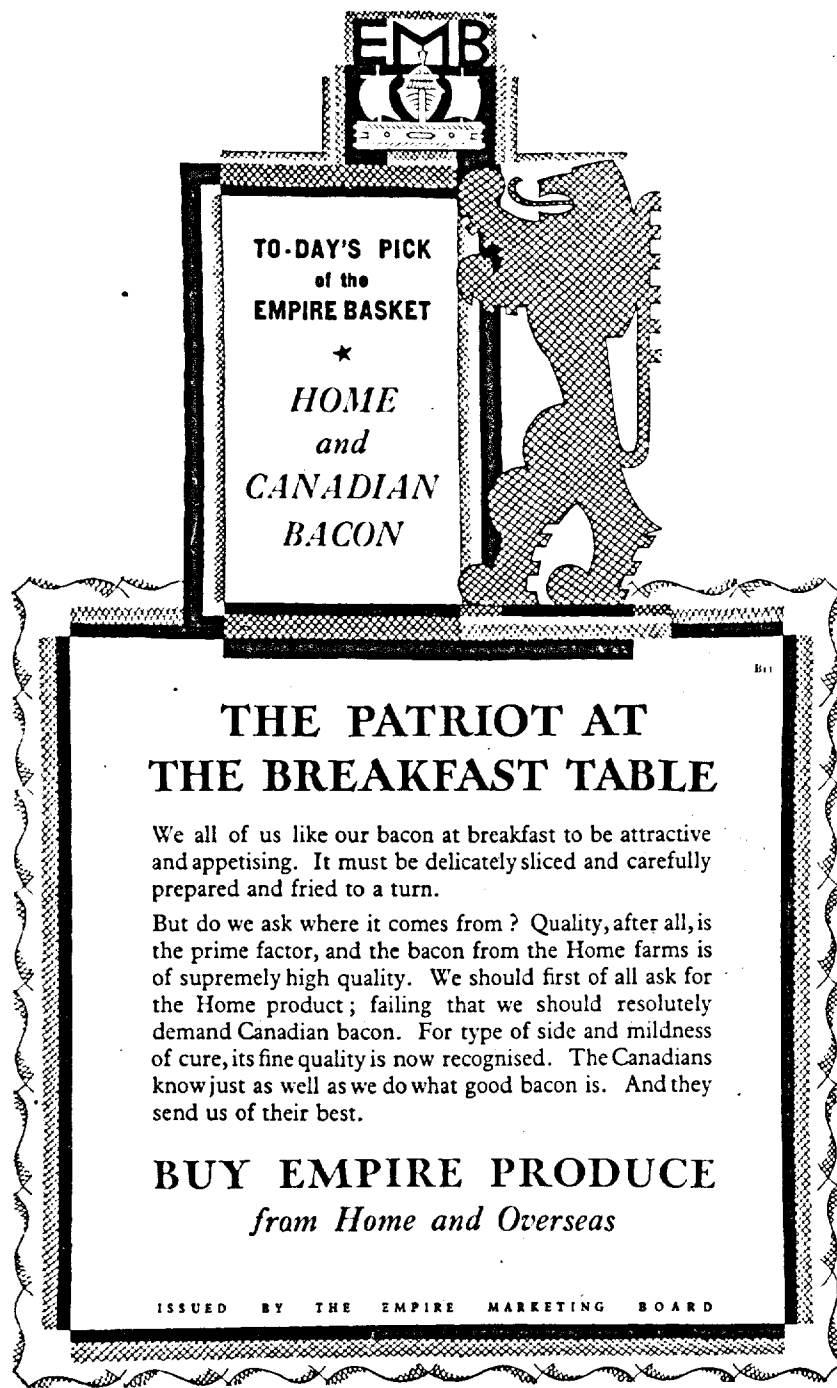
shine against the dark winter days; and sunshine, as everyone knows nowadays, is the great enemy of ill-health and depression and disease. Buy your salad now, and insist that it is home grown.

All produce sold under the trade mark "British and Best" is grown in English glass houses. A recipe book on tomatoes and their many uses may be obtained free on application to the British Glasshouse Produce Marketing Association, Ltd., Sentinel House, Southampton Row, London, W.C.1.

BUY EMPIRE PRODUCE

from HOME and Overseas

ISSUED BY THE EMPIRE MARKETING BOARD



EMB

TO-DAY'S PICK
of the
EMPIRE BASKET

★

HOME
and
CANADIAN
BACON

**THE PATRIOT AT
THE BREAKFAST TABLE**

We all of us like our bacon at breakfast to be attractive and appetising. It must be delicately sliced and carefully prepared and fried to a turn.

But do we ask where it comes from? Quality, after all, is the prime factor, and the bacon from the Home farms is of supremely high quality. We should first of all ask for the Home product; failing that we should resolutely demand Canadian bacon. For type of side and mildness of cure, its fine quality is now recognised. The Canadians know just as well as we do what good bacon is. And they send us of their best.

BUY EMPIRE PRODUCE
from Home and Overseas

ISSUED BY THE EMPIRE MARKETING BOARD

Small quantities of Urea have been imported into this country for experimental purposes, but its use has been handicapped by the fact that, up to recently, it has been subject to an Import Duty of $33\frac{1}{3}$ per cent. *ad valorem* under the Safeguarding of Industries Act, 1921.

It is understood that steps are being taken which, it is hoped, will lead to the future manufacture of the material in this country; but, in the meantime, owing to an Order recently made by H.M. Treasury exempting it for a period—from June 27, 1927, to March 6, 1928—from the duty imposed by the Safeguarding of Industries Act, it is now possible to obtain supplies for use in this country at a cheaper rate than formerly.

* * * * *

THERE has been appreciable variation in the prices of some classes of agricultural produce during July, but, as the alterations have usually been due to customary

The Agricultural Index Number seasonal causes, the effect upon the index numbers has mostly been small. On the whole, there was a slight general improve-

ment in the level of prices from 41 per cent. above pre-war in June to 42 per cent. for the month under review. A year previously, prices were 48 per cent. above the level of 1911-13.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1922:—

				Percentage Increase compared with the Average of the corresponding month in 1911-13					
Month	1922	1923	1924	1925	1926	1927			
January	71	67	60	71	58	49			
February	75	63	61	69	53	45			
March	73	59	57	66	49	43			
April	66	54	53	59	52	43			
May	69	54	57	57	50	42			
June	64	49	56	53	48	41			
July	67	50	53	49	48	42			
August	68	52	57	54	49	—			
September	59	52	61	55	55	—			
October	61	50	66	53	48	—			
November	63	51	66	54	48	—			
December	61	55	65	54	46	—			

Grain.—Higher prices have been realized for barley and oats, the former being 4d. per cwt. and the latter 2d. per cwt. dearer than in June, at 11s. 9d. and 10s. 2d. per cwt. respectively. The index figure for oats remained unchanged at 33 per cent. above the level of July, 1911-13, while that for barley was three points higher at 57 per cent. Wheat was slightly cheaper

at 56 per cent. above pre-war, the higher prices realized in June not having been fully maintained.

Live Stock.—The index numbers for both fat and store cattle were five points higher than in June at 30 per cent. and 26 per cent. above pre-war respectively, prices having been almost maintained whereas it is usual for some decline in values to occur at this season. Some improvement was noticeable in the prices paid for dairy cattle, the average quotations rising by about 20s. per head, and the index figure advanced four points to the level of 25 per cent. above the base years. There was a slight fall in fat sheep prices to 45 per cent. above pre-war, and fat pigs showed a further decline, reductions of 7d. per stone for baconers and 8d. per stone for porkers causing the relative index figures to fall by 11 points to 43 and 49 per cent. respectively above pre-war. Store pig prices were 10 points lower at 80 per cent. above the level of 1911-13.

Dairy and Poultry Produce.—The customary rise in egg prices was experienced, the average increase of 1½d. per dozen leaving the index figure practically unchanged on the month at 31 per cent. above the pre-war level, which compares with 33 per cent. a year ago. Poultry continued plentiful and fowls and ducks were cheaper than in the previous month, but, as this is the usual trend of summer prices, the index figure was only one point lower at 52 per cent. above pre-war. Butter was ¾d. per lb. dearer than in June and 42 per cent. above 1911-13 while cheese prices, although slightly lower, were 58 per cent. above pre-war in the month under review as compared with 54 per cent. in the previous month. Both butter and cheese were considerably cheaper than in the corresponding month a year ago when they were 56 and 78 per cent. dearer than pre-war. Milk was 55 per cent. above the level of the base years as compared with 53 per cent. in June and 60 per cent. in July, 1926.

Other Commodities.—The change from old crop potatoes to first early varieties which occurs in July resulted in the average price increasing by nearly 30s. per ton, but as this increase was very similar to that which took place in the corresponding period of the base years the index figure remained at 61 per cent. above the level of 1911-13 as in the previous month. New potatoes were, however, considerably dearer than in July, 1926, when the index figure stood at only 21 per cent. above pre-war and dearer also as compared with the prices ruling in July, 1925, when a level of 43 per cent. was recorded.

Hay prices advanced a little on account of the poor prospects for the new crop, but at 6 per cent. above the base years the index figure is two points lower than in July, 1926.

Index numbers of different commodities during recent months and in July, 1925 and 1926, are shown below :—

Percentage Increase as compared with the Average
Prices ruling in the corresponding months of
1911-13 .

Commodity	1925	1926	1927			
	July	July	Apr.	May	June	July
Wheat	47	73	52	53	60	56
Barley	24	17	41	46	54	57
Oats	34	33	18	27	33	33
Fat cattle ..	48	40	25	24	25	30
Fat sheep ..	79	59	53	53	48	45
Bacon pigs ..	51	83	61	58	54	43
Pork pigs ..	52	84	73	66	60	49
Dairy cows ..	50	38	26	24	21	25
Store cattle ..	42	33	23	23	21	26
Store sheep ..	115	82	40	38	53	55
Store pigs ..	53	139	108	99	90	80
Eggs	61	33	37	28	30	31
Poultry	75	52	25	41	53	52
Milk	57	60	63	53	53	55
Butter	73	56	43	42	41	42
Cheese	70	78	36	46	54	58
Potatoes	43	21	60	74	61	61
Hay	0	8	-1*	2	3	6
Wool	32	23	34	31	33	40

* Decrease.

* * * * *

A REVISED leaflet (Form No. 732/T.E.) showing the types of instruction which will be available at Farm Institutes during the session of 1927-28 has been issued by the Ministry. The leaflet gives the names of the farm institutes, a short description of the courses at each, the fees payable, either for tuition only, or for board, lodging and tuition, as the case may be, and the address to which inquiries for further particulars should be sent. Two new institutes have recently been opened, viz., the East Sussex Agricultural Institute, Plumpton, and the Pibwrlwyd Farm Institute, Carmarthen.

Copies of the leaflet may be obtained free of charge, and post free, on application to the Ministry, 10 Whitehall Place, London, S.W. 1.

NUMBER and declared value of animals, living, for breeding, exported from Great Britain and Northern Ireland in the three months ended June, 1927, compared with the corresponding period in 1926. (From returns supplied by H.M. Customs and Excise.)

Country to which exported	April to June, 1927		April to June, 1926	
	Number	Declared value	Number	Declared value
CATTLE		£		£
Argentina	104	17,809	89	14,258
Belgium	34	837	0	0
Colombia	2	130	0	0
Denmark	0	0	2	150
France	0	0	10	785
Uruguay	13	3,200	13	2,300
Irish Free State ..	1,828	24,526	1,637	19,565
Kenya Colony	12	904	3	143
Nyassaland	0	0	6	260
Union of South Africa ..	0	0	13	800
Australia	46	6,943	0	0
Other countries	7	593	18	575
Total of Cattle	2,046	54,939	1,791	38,836
SHEEP AND LAMBS				
Argentina	4	100	2	30
Brazil	0	0	6	190
Ecuador	0	0	7	56
Germany	2	70	3	55
Peru	9	158	0	0
Spain	2	24	15	125
Irish Free State ..	100	268	448	737
Australia	65	1,121	0	0
Other countries	3	95	11	85
Total of Sheep and Lambs	185	1,836	492	1,278
SWINE				
Argentina	3	120	5	162
Czecho-Slovakia	4	84	0	0
Denmark	4	20	0	0
France	7	301	0	0
Germany	8	82	18	534
Italy	0	0	5	92
Netherlands	0	0	5	150
Poland	4	100	0	0
Japan	10	636	0	0
Irish Free State ..	368	1,153	409	2,040
Other countries	6	180	3	80
Total of Swine	414	2,676	445	3,058

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1927.

ACREAGE UNDER CROPS AND GRASS AND NUMBERS OF LIVE STOCK ON HOLDINGS ABOVE ONE ACRE IN EXTENT IN ENGLAND AND WALES AS RETURNED BY OCCUPIERS ON JUNE 4, 1927.
(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 ACREAGE under all CROPS and GRASS ..	25,589,000	25,676,000	—	—	87,000	0·3
*ROUGH GRAZINGS ..	5,125,000	5,063,000	62,000	1·2	—	—
ARABLE LAND ..	10,310,000	10,548,000	—	—	238,000	2·3
PERMANENT GRASS:						
For Hay ..	4,318,000	4,358,000	—	—	40,000	0·9
Not for Hay ..	10,961,000	10,770,000	191,000	1·8	—	—
TOTAL ..	15,279,000	15,128,000	151,000	1·0	—	—
Wheat	1,636,000	1,592,000	44,000	2·8	—	—
Barley	1,051,000	1,148,000	—	—	97,000	8·4
Oats	1,748,000	1,864,000	—	—	116,000	6·2
Mixed corn ..	110,300	114,400	—	—	4,100	3·6
Rye	35,800	47,900	—	—	12,100	25·3
Beans, harvested as corn ..	189,400	201,700	—	—	12,300	6·1
Beans, picked or cut green ..	12,100	12,600	—	—	500	4·0
Peas, harvested as corn ..	77,100	72,700	4,400	6·1	—	—
Peas, picked or cut green ..	41,600	46,400	—	—	4,800	10·3
Potatoes ..	514,300	499,400	14,900	3·0	—	—
Turnips & swedes	715,700	767,000	—	—	51,300	6·7
Mangold ..	305,600	338,500	—	—	32,900	9·7
Sugar beet ..	221,700	125,800	95,900	76·2	—	—
Cabbage for fodder, Kohl-rabi and rape ..	129,100	135,900	—	—	6,800	5·0
Vetches or tares	80,600	97,000	—	—	16,400	16·9
Lucerne ..	44,200	47,000	—	—	2,800	6·0
Mustard for seed	37,900	45,500	—	—	7,600	16·7
Cabbage for human consumption ..	26,000	25,400	600	2·4	—	—
Brussels sprouts	23,700	25,500	—	—	1,800	7·1
Cauliflower or broccoli ..	11,800	13,300	—	—	1,500	11·3

* Mountain, Heath, Moor, Down and other rough land used for grazing

CROPS AND GRASS—*continued.*

Distribution	1927	1926	Increase		Decrease	
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Per cent.</i>	<i>Acres</i>	<i>Per cent.</i>
Carrots ..	8,900	8,300	600	7.2	—	—
Onions ..	1,700	1,900	—	—	200	10.5
Celery ...	5,700	5,400	300	5.6	—	—
Rhubarb ..	6,800	6,400	400	6.2	—	—
Linseed ..	2,500	2,800	—	—	300	10.7
Hops ..	23,000	25,600	—	—	2,600	10.2
Small fruit ..	69,300	69,500	—	—	200	0.3
Orchards ..	248,800	240,700	8,100	3.4	—	—
CLOVER and ROTATION GRASSES:						
For hay ..	1,585,000	1,578,000	7,000	0.4	—	—
Not for hay ..	875,000	924,000	—	—	49,000	5.3
TOTAL ..	2,460,000	2,502,000	—	—	42,000	1.7
BARE FALLOW ..	422,800	417,700	5,100	1.2	—	—

The total acreage returned this year as under crops and permanent grass on agricultural holdings exceeding one acre in extent in England and Wales is 25,589,000 acres, a reduction of 87,000 acres as compared with 1926. Some 62,000 acres more land has, however, been classified as rough grazings, so that the total area of land coming within the scope of the returns shows a decrease of only 25,000 acres.

During the past year more land has been laid down to permanent grass. The acreage of arable land is 10,310,000 acres, or 238,000 acres less than in 1926, and practically 690,000 acres or 6 per cent. less than in 1914.

Cereals.—The acreage of wheat shows a further increase this year, the total of 1,636,000 acres being 44,000 acres greater than in 1926 and 136,000 acres more than in 1925. Most of the eastern and north-eastern counties increased their areas, Norfolk and Essex showing additions of 7,000 acres each, while Lancashire and Cheshire with additions of 6,800 and 3,400 acres have increased their wheat areas very considerably, the additions in the latter two counties being about 35 per cent. and 25 per cent. respectively.

Although last year's area under barley was the lowest on record there is a further sharp reduction this year, the total acreage being only 1,051,000 acres against 1,148,000 acres in 1926. As compared with 1914 the barley area is about one-third less. Practically every county reduced its area, but there was an increase in the south-western counties. Norfolk shows a decrease of 9,500 acres or about 5 per cent., but several other counties in the east have relatively sharper reductions. Essex reduced its area by 13,400 acres or 19 per cent., and Suffolk shows a decrease of 15,500 acres or 12 per cent. In Lincoln (Lindsey) the proportionate decrease was about the same as in Norfolk, but Kesteven reduced its area by 4,100 acres, or 8 per cent.

The area under oats has also been reduced appreciably, the total of 1,748,000 acres being 116,000 acres less than in 1926. Every county in England and Wales with one exception shows decreases, with relatively the smallest declines in the eastern counties.

Forecasts of the yields per acre of corn crops, based on the condition of the crops on August 1, suggest that the total production of wheat, barley and oats this year will be approximately as shown in the following table. It must be borne in mind that the forecasts of the yields were made when practically all the crops were still uncut and are consequently subject to revision.

		Forecast	Production
		1927	1926
		Tons	Tons
Wheat ..	..	1,407,000	1,304,000
Barley ..	..	819,000	916,000
Oats ..	..	1,336,000	1,490,000

Beans and Peas.—Although the total area of beans is 12,800 acres less on the year at 201,500 acres, the total is 10,700 acres more than in 1925. Some 4,400 acres more land is returned under peas for harvesting as corn, but the area for picking or cutting green is reduced by 4,800 acres to 41,600 acres. The total area of peas, 118,700 acres, is the smallest recorded with the exception of 1916.

Potatoes.—The area under potatoes shows a further small addition this year, the total acreage of 514,300 acres being 14,900 acres more than in 1926. This is the first year since 1922 in which the acreage of potatoes has exceeded half a million acres. Most counties increased their areas, but the Isle of Ely and Huntingdon show decreases of about 10 per cent. Lincoln shows a relatively small increase and Norfolk a small reduction, while Lancashire and Cheshire practically repeat last year's areas. The West Riding of Yorkshire, however, increased its area by nearly 10 per cent. and Durham and Essex each added 16 per cent.

Sugar Beet.—A further very substantial increase in the acreage of sugar beet falls to be recorded this year, and the total of 221,700 acres is 95,900 acres larger than in 1926, and fully four times that of 1925. Norfolk now has over 51,000 acres under this crop, an increase of practically 19,000 acres on the year; Suffolk is growing nearly 36,000 acres, an increase of 10,900 acres, and Lincolnshire 32,000 acres, an increase of over 15,000 acres. There are relatively very large additions in Yorkshire and Salop, the total in the whole of Yorkshire this year being 17,000 acres against only 5,100 acres in 1926, while Salop now has 10,000 acres against only 2,300 acres last year.

Fodder Roots.—The acreage of turnips and swedes is 715,700 acres, or 51,300 acres less than last year, and the smallest area ever recorded. There has been a relatively sharper reduction in the mangold area, the total of 305,600 acres being nearly 10 per cent. less than in 1926, and the lowest figure recorded for over fifty years. A few counties in Wales show small increases in their mangold areas, but there are only two counties in the whole of the country which do not show reductions in their areas of fodder roots.

Other Crops.—All the other farm crops are being grown on reduced areas this year. The decrease in the case of hops is about 10 per cent., the total area being 23,000 acres. Mustard for seed shows a decrease of 7,600 acres, but the total of 37,900 acres is 15,000 acres greater than in 1925. Vetches cover 80,500 acres, or 16,400 acres less than in 1926; lucerne shows a decrease of 2,800 acres, or 6 per cent., and rye is being grown on 12,100 acres, or 25 per cent. less than last year.

Vegetables.—The area of carrots has been increased by 600 acres to 8,900 acres, but onions show a further decline of 200 acres to 1,700 acres. Celery shows a further increase to 5,700 acres, and rhubarb now occupies 6,800 acres, an increase of 400 acres on the year. Following last year's increases, brussels sprouts and cauliflowers were returned

as occupying reduced areas at the beginning of June, but the former occupied considerably more land than in 1925.

Fruit.—The total area of orchards is returned at 248,800 acres, an increase of 8,100 acres. Kent, with an addition of 2,200 acres, and Worcester and Hereford, with additions of over 1,000 acres, show the largest increases. There is practically no change in the total of 69,300 acres of small fruit, but strawberries have been heavily reduced, and currants and gooseberries increased. All the most important counties for strawberries show reductions, and the total of 23,200 acres is 3,200 acres less than last year. Most counties increased their areas of currants and gooseberries, Kent adding 1,100 acres and Norfolk nearly 800 acres, the total in the country being 35,500 acres, or 3,500 acres more than in 1926. The raspberry area at 6,500 acres shows little change.

Clover and Rotation Grasses and Meadow Hay.—The total area of clover and rotation grasses is 2,460,000 acres, a decrease of 42,000 acres on the year. Some counties, mostly on the eastern side of the country, however, have increased areas this year. The whole of the decrease is in that used for grazing, the area of "seeds" hay being 1,585,000 acres, or 7,000 acres more than in 1926. The area of meadow hay is, however, reduced by 40,000 acres to 4,318,000 acres, but some counties in the north and extreme south-west of England and in Wales show increases.

Bare Fallow.—There is a small increase in the area returned as bare fallow this year, the total of 422,800 acres being 5,100 acres larger than in 1926. Changes vary considerably in the different counties, but the eastern division shows an increase of 7,100 acres, or 5 per cent. The difficulty in working heavy land during the long spring drought may be responsible for this increase.

LIVE STOCK

CATTLE

	1927	1926	Increase		Decrease	
	No.	No.	No.	Per cent.	No.	Per cent.
Cows and heifers in milk ..	2,096,400	2,065,100	31,300	1·5	—	—
Cows in calf, but not in milk ..	307,100	294,600	12,500	4·2	—	—
Heifers in calf ..	387,100	389,600	—	—	2,500	0·6
Other cattle :—						
Two years and above ..	1,060,100	1,052,900	7,200	0·7	—	—
One year and under two ..	1,226,100	1,221,400	4,700	0·4	—	—
Under one year ..	1,198,100	1,229,500	—	—	31,300	2·6
TOTAL OF CATTLE	6,275,000	6,253,100	21,900	0·4	—	—

The total number of cattle shows an increase of 21,900 as compared with last year's figure, which was the highest recorded up to that date. The total of 6,275,000 is 321,000 above the average of the ten years 1917-26. The increase was practically confined to the north of England and Wales, most counties on the eastern side of the country and in the south showing reductions. It may be noted that the changes were in the opposite direction last year, when practically all the

decreases were confined to the north and Wales. The number of cows and heifers in milk or in calf also again constitutes a record, the total of 2,790,000 being 41,300 larger than in 1926. Changes in the numbers vary appreciably in the different counties, increases being heaviest in the north of England and in Wales. Calving heifers at 387,100 show a decrease of 2,500, but this class increased by 11,100 last year. The number of cattle under one year has been reduced by 31,300 to 1,198,200, but this year's figure has seldom been exceeded, except during the war. The number of feeding cattle (other cattle above two years old) has been increased by 7,200, while yearlings also show a small addition.

SHEEP

	1927	1926	Increase		Decrease	
	No.	No.	No.	Per cent.	No.	Per cent.
Ewes kept for breeding ..	6,958,600	6,754,800	203,800	3·0	—	—
Other sheep :—						
One year and above ..	2,832,100	2,890,700	—	—	58,600	2·0
Under one year ..	7,279,500	7,213,200	66,300	0·9	—	—
TOTAL OF SHEEP	17,070,200	16,858,700	211,500	1·3	—	—

A further increase is recorded in the number of sheep, but the rate of increase is much smaller than in the previous four years, and, apart from Wales and the north of England, most counties show reductions. The total number is 17,070,200, or 211,500 more than in 1926, and only 60,000 less than in 1913. The increase is relatively greater in breeding ewes than in the total of sheep and lambs, there being 6,958,600 ewes against 6,754,800 in 1926. Most counties increased their breeding flocks, but 17 counties spread over the midlands, eastern and southern counties show decreases. The increase in lambs was only 66,300, against the addition of 203,800 to the breeding flocks. Other sheep above one year old declined by 58,600 to 2,832,100, the bulk of the counties showing decreases.

PIGS

	1927	1926	Increase	
	No.	No.	No.	Per cent.
Sows kept for breeding	392,500	300,800	91,700	30·5
Other pigs ..	2,294,800	1,899,200	395,600	20·8
TOTAL OF PIGS ..	2,687,300	2,200,000	487,300	22·1

There has been a sharp increase in the number of pigs on agricultural holdings, and last year's decrease has been more than wiped out. The total number returned is 2,687,300, or 487,300 more than in 1926, and, apart from 1924, is the highest number recorded since 1904. Every county in England and Wales shared in the increase. There is a relatively sharper addition in breeding sows than in other pigs, an indication that breeding was probably still being increased when

the returns were collected at the beginning of June. Breeding sows number 392,500, or 91,700 more than last year, and an increase of over 30 per cent. This is the largest number recorded with the exception of 1924 and 1895, since sows were first separately distinguished in the returns in 1893. Every county increased its number of breeding sows

HORSES

	1927	1926	Decrease	
	No.	No.	No.	Per cent.
Horses used for agricultural purposes (including mares for breeding)	746,200	760,600	14,400	1.9
Unbroken horses (including stallions) :—				
One year and above	107,200	125,200	18,000	14.4
Under one year ..	40,200	41,000	800	2.0
Other horses	183,600	202,000	18,400	9.1
TOTAL OF HORSES	1,077,200	1,128,800	51,600	4.6

The number of horses on agricultural holdings shows a further reduction this year, but it should be noted that the sharp decline in breeding has been nearly stopped. The number of foals is 40,200, or only 800 less than last year. The greater part of this decrease is in foals described as light, the decrease in heavy foals being only 100, and several counties, more particularly in Wales and the north of England together with Cornwall and Devon, record increases in this class of foal. Horses used for agricultural purposes are reduced in practically every county, the total being 746,200, against 760,600 last year. The decrease in "other horses" would not have been so appreciable but for the fact that a number of pit ponies not normally on farms were included in the returns last year. As compared with 1925 "other horses" are reduced by 14,000.

Farm Workers' Minimum Wages.—Meetings of the Agricultural Wages Board were held on July 27 and August 9, Mr. W. B. Yates, C.B.E., presiding in the absence of the chairman, Lord Kenyon.

The Board received notifications from the following Committees of decisions fixing minimum and overtime rates, and made Orders carrying these decisions into effect :—

Dorset.—An Order continuing the operation of the existing minimum and overtime rates of wages for male and female workers from August 28 (when the existing rates are due to expire) until further notice. The minimum rates in question are in the case of male workers of 21 years of age and over 30s. per week of 51 hours in summer and 48 hours in winter, with overtime at 8d. per hour, and in the case of female workers of 15 years of age and over 5d. per hour, with overtime at 6d. per hour.

Suffolk.—An Order fixing special minimum rates of wages for male workers employed on the corn harvest in 1927. The special minimum rates in question in the case of male workers employed on farms of at least 60 acres of corn are for such workers of

21 years of age and over employed throughout the corn harvest on harvest work a sum of £5 for the period in addition to the ordinary minimum weekly wage, and in the case of workers of similar age who are employed for a part only of the corn harvest 10d. per hour for all employment on harvest work. In the case of farms of less than 60 acres of corn the special minimum rate for male workers of 21 years of age and over is 10d. per hour for all employment on harvest work.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board, 7 Whitehall Place, S.W. 1.

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Enforcement of Minimum Rates of Wages.—During the month ending August 15 legal proceedings were instituted against five employers for failure to pay minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases are as follows :—

County	Court	Fines			Costs			Arrears of wages			No. of workers
		£	s.	d.	£	s.	d.	£	s.	d.	
Hereford ..	Ledbury ..	8	0	0	2	0	0	13	16	6	3
Devon ..	Barnstaple ..	—	—	—	—	—	—	16	10	0	1
Montgomery ..	Llanfair	—	—	—	—	—	—	—	—	—	—
	Caereinion ..	—	—	—	0	9	0	28	8	11	1
Northants ..	Peterborough	—	—	—	—	—	—	—	—	—	—
	Liberty ..	2	0	0	2	2	0	5	1	4	1
Pembroke ..	Narberth ..	2	0	0	2	12	0	To be agreed	—	—	2
		£12	0	0	£7	3	0	£63	16	9	8

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Foot-and-Mouth Disease.—One further outbreak of foot-and-mouth disease has been confirmed since the August issue of the JOURNAL, viz., at Hunton, near Maidstone, Kent, confirmed on July 27 on premises in close proximity to the original Hunton outbreak confirmed on July 19.

No further outbreak having occurred in the Staffs (Wigginton) area restrictions in this area were withdrawn on August 8. Infected area restrictions are now in force in one small area only, of about two miles' radius round Hunton, Kent, and, in the absence of developments, these restrictions will be withdrawn by August 24.

Twenty-seven outbreaks in all have been confirmed since January 1 last, involving nine counties and the slaughter of 1,175 cattle, 893 sheep and 366 pigs.

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NOTICES OF BOOKS

The Agricultural Landowner's Handbook. By R. Strachan Gardener, F.S.I. Foreword by Lord Clinton. Second edition. Pp. 178. 1927. (London: Central Landowners' Association, 7 Charles Street, St. James's, S.W. 1. Price 5s. net.)

According to the official report on the Agricultural Output of England and Wales, recently issued, it is estimated that over 25 per cent. of the agricultural holdings in this country are owned by their occupiers. In the cases of owners of large estates it is often difficult enough to deal satisfactorily with the many involved and technical questions arising out of the ownership of the land. When an owner-occupier of a farm is faced with these problems, he may well be appalled by

the prospect, and he may feel compelled to spend time and money which he can ill spare in obtaining legal advice as each knotty point develops.

It was apparently to provide, for large and small owners alike, a handy and convenient book of reference that the *Agricultural Landowner's Handbook* has been written, and its main sections, dealing with income tax, super tax, land tax, local rates, tithe rentcharge, death duties, including succession and legacy duties, give an indication of the scope of the work. Much useful information is embodied as to the bases of assessment, etc., and the method of compilation adopted is to state what are the facts with regard to these various outgoings and charges, the information being given in a form easily understandable by a layman. Reference to legal cases and the use of legal terms has been restricted as far as possible, with a corresponding increase in clarity. Each of the subjects dealt with is, in itself, of sufficient importance and complexity to demand a large text book for detailed treatment, but in the handbook under review a successful attempt has been made to condense the whole of the information required by an agricultural owner under each heading within the limits of a handbook of a size which can be slipped into the pocket for convenient reference. It is obvious that the author has been at great pains to select the best books of reference and to consult the various Acts of Parliament, regulations, etc., relating to the subjects with which he deals, and has summarized the information so obtained in a form which should prove extremely useful to all owners of agricultural land. The price at which it is published should render the handbook available to a considerable number of occupying owners who purchased their holdings during recent years, when so many large agricultural estates were being broken up.

Sugar Beet : Costs and Returns for the Year 1925-26. By A. Bridges and R. N. Dixey. (Oxford : Agricultural Economics Research Institute, Price 2s. 6d.)

This monograph forms a sequel to a similar study by the same writers for the 1924 crop, and contains the results of an inquiry into the financial and economic aspects of the sugar beet crop for the latest year for which complete information is at present available. The fifty-three costs on which the study is based have been grouped according to variations of soil and district, and the costs of the crop both for land and materials are discussed in turn. Considerable attention has been given to a detailed study of the labour costs for each stage of the cultivation of the crop. Comparisons are also drawn between the results of the two years.

A chapter is devoted to the question of the risk of failure, and another deals with the various means adopted in disposing of the tops and leaves. The value to the farmer of those by-products, according to the methods of utilization, has been estimated. The difficulties encountered by farmers before deciding to buy pulp from the factories are also touched upon, and a table is given showing the value of the subsidy.

Throughout the book attention has been drawn to points which seem to offer scope for improvement and, in the concluding statement, the authors mention some of the difficulties confronting the future development of the industry.

Animal Nutrition and Veterinary Dietetics. By R. G. Linton. M.R.C.V.S. (Edinburgh : W. Green & Son, Ltd. 1927. Pp. xii + 399. Price 21s. net.)

It has been a pleasure to read and review this admirable treatise by Professor Linton. The title of the book might suggest that it has been

written solely with the object of meeting the requirements of the student of veterinary science. This, however, is by no means the case, as a survey of the summary of contents will readily prove. It is in every sense a book which should be in the possession of all who are in any way concerned with the sound and economical feeding of domestic animals.

It may be recommended to the stockowner, because the treatment of the subject is broad and lucid and displays an intimate and a sympathetic understanding of the manifold difficulties which the feeder of animals must encounter in the pursuit of his calling. The reader, even though his store of science be small, will not fail to gain a substantial insight into the scientific principles underlying successful feeding and management. It may also be recommended to the scientific reader, because Professor Linton has written with a fine sense of the value and significance of the most recent research in animal nutrition. Here is a book which may fairly claim to be up-to-date, at least so far as this is possible in an age when an overworked Press is scarcely able to keep pace with the onward march of scientific discovery.

The work is divided into six main sections. Section I deals with the composition and functions of feeding stuffs ; those much discussed questions of the rôle of minerals in nutrition and the mineral requirements of farm animals are discussed very comprehensively in this section. Section II is devoted to an unusually thorough and interesting description of the composition, properties and uses of all the possible feeding stuffs which are likely to be encountered on any farm in the kingdom. Section III introduces the reader very simply to the various methods which are in use for assessing the productive values of feeding stuffs. A brief fourth section is given over to a consideration of the problems involved in the preparation and storage of foods, this leading up to a highly important section in which the principles underlying feeding and management are dealt with in great detail. Professor Linton's interests show a wide range in this section, the subjects dealt with including the rearing of calves, the fattening of cattle and the feeding of dairy cows, horses, pigs, sheep, dogs and poultry. The sixth and final section, entitled "Some Harmful Foods," constitutes a useful concluding feature.

In the preparation of this volume, Professor Linton has enjoyed the assistance of several colleagues, who have contributed chapters on subjects in which they are specially interested. The book is none the less valuable on this account. Such is the opinion of Professor Linton himself, who states in the preface that "the utility of the book and any success it may achieve will be due in no small measure to their co-operation."

The work is generously illustrated and has been splendidly arranged and printed. To the publishers and the printers, no less than to the author and his collaborators, congratulations may be offered for the production of a really notable addition to nutritional literature.

Chinese Agriculture. *Die Chinesische Landwirtschaft.* By Dr. Wilhelm Wagner. (Berlin : Verlagsbuchhandlung Paul Parey, Hedemannstrasse, 10 & 11 1926. Pp. xv + 668. 204 illustrations and two maps. Price 42 Reichsmarks.)

The author, in March, 1911, arrived from Germany to take charge of the agricultural section of the German-Chinese College at Tsingtau, on the bay of Kiaochow, then a German protectorate. The sole apparatus he found on arrival was a blackboard and a piece of chalk. In August, 1914, the outbreak of war saw him in possession of a well-equipped agricultural institute, with valuable collections, a laboratory with

three permanent assistants, a 15-acre experimental field, and a representative stock of animals. From 1915 to 1920, as a prisoner of war in Japan, he had full opportunity of working up his materials. On his return to Germany he was unable to take up the work again until 1924. The success of his efforts at Tsingtau is enough in itself to arouse great expectations of the book before us, expectations that will not be disappointed. He has made good use of his eyes and has read widely—witness a bibliography of over 200 entries.

The first two chapters of this work describe minutely the climate and soil of the six divisions into which China, in these respects, naturally falls. The next section, of four chapters, discusses the influence of the social and economic conditions of the people on agricultural production. The agriculture of prehistoric China presents a marked analogy to that of early Babylonia, though the link between the two civilizations would seem to have been broken at a very early period. A significant mark of the independence of Chinese development is the fact that though the Chinese had cattle since the remotest times, and though they were frequently invaded by milk-drinking nomads, they never themselves took to milk. As regards implements, their ploughs, which lack mould-boards—unless that name should be given to a plate set across the direction of motion—turn the soil but imperfectly, and that only when they are tilted over to one side. They are constructed of wood or iron, or both, according to the material available in the district. Traction is supplied by buffaloes or, on poorer holdings, by human kind. Their harrows, rollers and soil pressers are primitive types. China, as was said of Egypt, is a sphere of machine-saving man.

The chief manure is human faeces, though canal mud and composts of various kinds are used. The ploughing under of leguminosae is understood, and grass, weeds and young shrubs are collected and ploughed in. Ashes are also used. What we call artificials are not used at all. Drills are primitive in design—a kind of double funnel discharging into furrows cut by two small shares—the implement being drawn by men or by an animal. As regards rotations, the Chinese get the utmost out of the land, using wheat, beans, etc., as nurse crops for cotton. Rice is of course a staple crop. Every form of thrashing is employed: treading out by stock, flail and primitive machines.

The latter half of the book describes the various field and orchard crops grown and the stock raised by this patient and industrious people. Among the former, rice, soya beans, sweet potatoes, oil plants, cotton and tea are of special interest; of the latter, the section on silkworms is naturally attractive. A chapter on costings rounds off the work. The book is excellently printed in roman type; the illustrations, of which there are some 200, are clear and instructive; there are two helpful maps, one orographical, the other geological. German books are not always easy reading, even for those who know German well. This book is written in the simple style of the eye-witness, and its perusal should not present much difficulty to any reader with an average knowledge of the language. The interest of its well-informed pages will fully reward the effort.

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