1950

SCOTTISH SOCIETY FOR RESEARCH IN PLANT-BREEDING.

REPORT.

THE Directors of the Scottish Society for Research in Plant-Breeding have pleasure in submitting the Twenty-ninth Annual Report to members of the Society.

The farm steading and about 100 acres of land at Dryden Mains, Roslin, Midlothian, have been allocated for plant-breeding work by the Edinburgh Centre of Rural Economy, but until the Society is in a position to use the land the various fields will be farmed on their behalf by the Teaching Unit, Edinburgh Centre of Rural Economy. The farm buildings will be altered and reconditioned to suit the Society's work, and a new building will be erected for the cleaning and storing of seeds. It is probable that a start will be made this year with the erection of the main offices, laboratories, greenhouses, &c., which are to be erected on the campus area near Bush House.

An account of the work at the Plant-Breeding Station, Corstorphine, at the Sub-Station, Boghall, and at Dundonnell, Wester Ross, is given in the report by the Director of Research on pages 5 to 36.

Crops of the two new potato varieties, Craigs Royal and Craigs Snow-White, were grown in Aberdeenshire in 1949 under contract for the Society. Each variety was awarded a Stock-Seed Certificate by the Department of Agriculture for Scotland, and the amounts of seed applied for by members of the Society were much in excess of the quantities available. Allocation was made by ballot, and 32 tons of Craigs Royal and 15 tons of Craigs Snow-White were sold to members of the Society.

The Lord Derby Gold Medal Certificate was awarded to the Society in 1949 in respect of the potato variety, Craigs Royal.

A Silver-gilt Medal was awarded to the Society in 1949 by the Trustees of the Finlayson Trust in respect of the new variety of potato, Craigs Alliance.

Messrs David Bell Ltd., Leith, again kindly agreed to clean, store, and despatch bulk quantities of Cereal and Grass Seeds for the Society, and the Directors of the Society wish to express their thanks to Messrs Bell for their expert assistance in this work.

Staff.

Messrs H. D. Garvin, B.Sc., A. W. Macarthur, B.Sc., and F. Earnshaw, M.A., Ph.D., were appointed to the Society's staff in the autumn of 1949 for work with cereals, potatoes, and herbage plants respectively.

Dr J. W. Gregor was granted leave of absence to attend the Fifth International Grassland Congress at Noordwijk, Holland, 22nd June to 2nd July 1949, and Dr J. C. Haigh was granted leave of absence to attend the Fifth International Congress of Comparative Pathology at Istanbul, 13th to 20th May 1949. Both were awarded Travelling Fellowships by the Agricultural Research Council to meet their travelling and subsistence expenses.

Membership.

Three members of the Directorate—Dr J. M. Caie, C.B., Messrs Ian C. Menzies, W.S., and John Stirton, O.B.E.—died during the year, and the Directors wish to record their appreciation of the valued services they rendered to the Society in the course of many years.

In the past year 13 members died, 8 resigned, and 125 new members were elected. The total membership at 31st March 1950 was 582, comprising 190 life members and 392 annual members (14 at the 5s. rate and 378 at the 10s. rate of subscription). A list of members appears on pages 39 to 55 hereof.

Donors of £10 and over are entitled to become life members without further payment. Donors of £5 may become members

of the Society by payment of an annual subscription of 5s., and others by payment of an annual subscription of 10s.

The attention of members is again drawn to the intimation received from the Agricultural Research Council that the Scottish Society for Research in Plant-Breeding has been approved as a Research Association for the purposes of Section 27 of the Finance Act, 1944. "Payments by an agriculturist to an approved institution engaged on agricultural or horticultural research will rank as an expense in his accounts for the purpose of income tax, even if intended as a contribution towards a definite capital project to be carried out by the research organisation."

List of Varieties of Crop Plants raised or selected by the Society and introduced into Commerce.

		Date of Registration.
Oats—		
Elder	Registered by the Department of Agriculture for Scotland as new varieties.	1930
Bell		1932
Early Miller		1934
Wheat—		
Scottish Iron III.		
Barley—		
Craigs Triumph.		
Potatoes—		
The Alness	Registered by the Department of Agriculture for Scotland as new varieties.	1934
Craigs Defiance		1939
Craigs Royal		1948
Craigs Snow-White		1948
Craigs van Riebeeck		
Grasses—		
"Scotia" Cocksfoot, Ref. No. *Cc* 196.		
"Scotia" Timothy, Ref. No. *Cb* 224.		

STAFF, 1949-50.

Director of Research. . . WILLIAM ROBB, N.D.A., F.R.S.E.

Chief Assistant . . . J. W. GREGOR, Ph.D., D.Sc., F.L.S.

Cereal Breeding—WILLIAM ROBB, N.D.A., F.R.S.E.; D. CAMERON, B.Sc.; * H. D. GARVIN, B.Sc.

Potato Breeding—WILLIAM BLACK, B.Sc., Ph.D., F.R.S.E.; J. C. HAIGH, B.Sc., Ph.D., A.R.C.S.

Virus Disease Investigations—G. COCKERHAM, B.Sc., Ph.D.; Miss T. M. R. M'GHEE, B.Sc.; * A. W. MACARTHUR, B.Sc.

Herbage Plant Investigations—J. W. GREGOR, Ph.D., D.Sc., F.L.S.; Miss PATRICIA J. WATSON, M.A., Ph.D.; * F. EARNSHAW, M.A., Ph.D.

Root Crop Breeding—V. M'M. DAVEY, B.Sc., Ph.D.; F. J. W. ENGLAND, B.Sc.

Secretary . . . . . R. M. LEMMON, B.L.

Clerical Staff—Miss A. A. MALCOLM; Miss J. K. GORDON; † Mrs Helen H. Gray.

* Appointed 1949.
† Appointed 1950.

REPORT

BY

DIRECTOR OF RESEARCH

I. Research Programme.

Grain Crops.

Oats.

In the oat-breeding programme the main objectives have been to produce oat varieties adapted to the varying sets of soil and climatic conditions in Scotland and to produce general-purpose varieties for more or less average conditions. Through the hybridisation of selected varieties endeavours have been made to find which pairs of varieties give the best combinations in their progenies showing resistance to lodging, early ripening, high yield of good quality grain, and resistance to disease. Soil and climatic conditions influence the degree of lodging of cereal crops, but there are inherent differences among varieties, some being more resistant than others to lodging. Differences in the length and strength of straw, and in the root development of the plant are important factors which affect the capacity of the plant to withstand adverse conditions. By selecting plants with short, stout straw and a strong root system, which gives the plant a good anchorage in the soil, progress has been made in obtaining a greater degree of resistance to lodging. The first oat variety produced at the Station to show improvement in the quality of the straw was rather too late in ripening to suit the requirements

of most growers in Scotland, and attempts have since been made to combine its high degree of resistance to lodging with a capacity for earlier maturity. This combination of upstanding straw and early ripening is seen in "Craigs Afterlea," the Society's promising new oat variety, which may be put into commerce in 1951. It is apparent that there is some incompatibility, however, between characteristics such as early ripening and high grain yield, and it may be necessary that a grower who prefers a variety which will ripen early should be prepared to accept a rather lower grain yield than he would obtain from some of the high-yielding varieties. Further, it would appear that the short-strawed cereals in general require a high fertility level in order to produce a yield of grain comparable with that of the best longer-strawed types.

There is doubtless scope for the plant-breeder to produce better and more productive oats for northern areas and upland soils in Scotland, where a combination of hardiness, resistance to shattering, earliness in ripening, and improvement in grain yield is required. The Society's Bell oat continues to show adaptability for some of these areas, and attempts are being made to produce earlier-ripening and higher grain-yielding types by using Bell as a parent.

In some seasons, especially in the high rainfall areas in Scotland, sprouting in the stook occurs and this entails loss, but there are prospects of reducing these losses by breeding improved varieties resistant to prompt germination at harvest time. From a few crosses with the wild oat, *A. fatua*, selections showing dormancy in the greenhouse have been made over a number of years, and a few of these are now in the early stages of multiplication. When sufficient seed is available they will be included in field trials.

A number of years ago requests were received indicating that a higher-yielding type of oat was required for the alkaline soils which occur in various parts of the West and North of Scotland, where low-yielding varieties, like the Bristle-pointed oat and Myrtle oat, are still grown because modern varieties do not seem well adapted to these soils. After reviewing the problem it was thought that the possibilities of single-plant selection should be examined, and selections were therefore made from the Bristle-pointed oat. Comparisons were made, but no plants of a more desirable type were discovered. The Bristle-pointed oat cannot be crossed directly

with the ordinary cultivated oat as their chromosome complements are widely different. Progress could not be expected by this means, and another line of approach was tried by using *A. byzantina* (reputed to be lime tolerant) for crossing with an old Scottish oat variety, and a selection from this cross has been giving promising results in trials in the Island of Tiree, where much of the soil is highly alkaline. Requests have been received from growers in other areas, where the soil is alkaline, for seed of this selection, and as soon as adequate supplies of seed are available, more extensive trials will be made. The grain of the new hybrid selection is larger and more attractive than the grain of the Bristle-pointed oat or that of the Myrtle oat.

Since 1945 increased facilities have been gradually becoming available for testing the many hybrid selections raised at the Plant-Breeding Station during the war years. The merits and the defects of these selections are being ascertained in outside trials carried out by the Agricultural Colleges and the National Institute of Agricultural Botany. Four of the most promising selections will be included in field trials in 1950—the variety Ref. No. *Aa* 676 on soils of low fertility; *Aa* 698 on soils of average fertility; *Aa* 714 for late districts, where early ripening and good bulk of straw is required; and *Aa* 720 for more fertile soils in lowland areas. About thirty acres of the Society's new oat, "Craigs Afterlea," will be grown in 1950, and a stock of seed should be available for distribution early in 1951.

The unfixed hybrids were grown as spaced plants, and many individual plant selections were made at harvest. The pedigree method of breeding has been mainly practised, but in recent years the bulk method of breeding has also been tried. The hybrids in this group, however, have not yet reached the stage at which individual plants should be selected. A few years ago some multiple crosses were made and several unfixed selections of this type are being grown for observation and comparison.

Forty-five unnamed hybrid selections were included in a replicated trial of forty-nine varieties—Onward, Yielder, Star, and Sun II. being included as standards for comparison. Data on grain yield, length of straw, and growing period were obtained and subjected to statistical analysis.

For convenience of comparison the varieties have been

divided into three approximately equal groups—early, mid-season, and late (Table I.). The early and late groups are subdivided into short, medium, and tall. The ranges of plant height in the mid-season group were not sufficiently great to justify its subdivision, and all the varieties in this group are regarded as being of medium height.

The varieties in each sub-group are arranged in order of yield in cwt. per acre in the 1949 trial, and the average yields for 1948 and 1949, and for 1947, 1948 and 1949 have been included for those varieties which have been in the trials in previous years. Also included in the Table are figures showing height in inches, growing period in days, 1000-grain weight, and percentage kernel of all grains passing over a 0·095-in. slotted-mesh sieve—all from the 1949 data.

If the trial is taken as a whole it will be seen that the variety Sun II. (AY) is outstanding and has out-yielded by a significant amount all the other varieties in the trial, with the exception of Q and S, but is some six days later in ripening than either.

Of the early and mid-season groups, the varieties L, AG, and AI again show promise, as also do V, BD, and BE—the last two being selections from Early Miller. These have all out-yielded Yielder (AV) and Early Miller (BC).

X, Y, BJ, and AU are the most promising of the late varieties, being of the same order of yield as Onward (AW) and Star (AX).

The seven Maturity-Height classes into which the forty-nine varieties in the trial have been grouped may be considered as a guide to utilisation, the short-strawed varieties being worth a trial under conditions of high fertility, the late varieties Y and F in early districts, and the early varieties "Craigs Afterlea" (AT), a reselection of "Craigs Afterlea" (BF), and *Aa* 676 (BH) in the later districts; the tall varieties, on the other hand, being tried under conditions of low fertility.

It is unlikely that Sun II. will be surpassed in yield by any of the varieties in the late medium group, but when earliness is desired in a variety other varieties in the mid-season and early medium groups should be tried.

The yields of the varieties in these groups are most readily compared in Table I., where it will be noted that, generally speaking, the relative positions of the varieties in the 1949 trial are little changed when the results of the 1947 and 1948 trials are included.

TABLE I.

DATA WITH REFERENCE TO TRIAL OF OAT VARIETIES

Identification letter	Name of Variety or Station No., if allocated, of Hybrid Selection	Estimated Yield of Dressed Grain per acre in cwt.			Average Plant Height in Inches	Days to Mature	1000-Grain Weights of Grain over 0·095-in. sieve in grammes	Percentage Kernel in the Grain over 0·095-in. sieve
		1949	1948-49 Average	1947-48-49 Average	1949	1949	1949	1949
Late Short								
Y		27·6	29·3	..	25·7	138·7	34·58	72·35
F		26·7	29·4	..	28·9	139·8	37·34	72·74
Late Medium								
AY	Sun II. . .	32·9	..	..	32·3	136·4	41·11	73·41
X		28·4	27·0	..	33·1	134·9	40·45	72·06
AX	Star . . .	28·3	28·5	26·6	32·7	135·4	42·69	72·97
BJ		28·3	..	..	32·0	138·1	36·20	70·85
AU		27·7	28·5	26·0	32·1	135·1	40·48	73·17
AO		27·0	27·0	..	32·7	134·5	43·68	71·99
AW	Onward . .	26·9	29·4	..	33·5	138·2	42·51	70·45
AM		26·8	24·4	..	33·3	134·9	46·01	73·38
R		26·0	29·0	28·1	32·0	133·9	43·44	73·24
AC		24·3	23·1	..	33·0	134·0	36·62	73·27
BA	Elder . .	23·2	..	..	30·5	138·1	35·08	71·83
Late Long								
BK		27·3	..	..	36·4	133·4	41·68	67·64
AB		26·9	26·2	..	34·2	133·4	36·97	75·54
BB	Bell (R) . .	23·8	..	..	36·4	135·4	35·31	74·82
U	*Aa* 722 . .	22·0	22·6	..	36·4	137·0	34·62	75·90
Mid-Season Medium								
Q		30·2	33·3	..	32·1	130·6	43·60	73·76
S		29·3	30·7	28·6	34·5	129·6	40·44	73·19
AG		28·1	31·2	..	29·4	129·7	44·95	71·94
AI		27·6	30·0	..	33·6	129·9	41·71	72·60
I	*Aa* 719 . .	27·4	27·9	24·0	31·9	130·5	36·47	70·79
AP		27·4	28·8	..	31·0	132·0	41·89	69·27
BD	Early Miller 349 .	27·3	..	..	28·8	129·7	39·03	72·39
BE	Early Miller 364 .	27·3	..	..	29·6	130·0	38·65	72·81
J	*Aa* 723 . .	26·9	29·8	26·6	29·9	132·3	36·04	71·67

Identification letter	Name of Variety or Station No., if allocated, of Hybrid Selection	Estimated Yield of Dressed Grain per acre in cwt.			Average Plant Height in Inches	Days to Mature	1000-Grain Weights of Grain over 0·095-in. sieve in grammes	Percentage Kernel in the Grain over 0·095-in. sieve
		1949	1948-49 Average	1947-48-49 Average	1949	1949	1949	1949
Mid-Season Medium —*continued*								
O		26·3	26·0	..	30·6	130·2	44·57	72·89
A	*Aa* 698	26·0	28·8	28·0	30·8	130·2	46·41	69·76
AN		26·0	25·6	..	33·8	130·2	43·37	71·12
BC	Early Miller	24·8	..	..	30·5	132·4	39·17	73·92
AH		24·7	27·3	..	31·7	130·2	44·74	72·34
AQ		24·2	27·0	..	34·0	131·2	43·94	74·14
AD		23·4	25·4	..	30·9	132·5	40·29	71·40
BI	*Aa* 704	21·7	..	..	32·9	130·2	39·84	76·10
Early Short								
BH	*Aa* 676 (R)	24·2	..	..	27·5	127·2	37·08	70·20
BF	Craigs Afterlea (R)	22·6	..	..	25·7	128·1	38·16	71·25
AT	Craigs Afterlea	19·1	23·4	20·3	23·5	127·8	38·36	70·36
Early Medium								
L	*Aa* 720	28·1	31·4	28·5	31·7	127·2	42·43	69·71
BG		27·2	..	..	30·6	127·0	43·83	71·16
N		26·6	27·7	..	30·5	127·4	40·05	75·36
G	*Aa* 718	25·7	27·2	26·2	33·0	127·2	37·14	71·81
H		24·2	27·4	25·6	32·2	128·1	37·07	71·04
AV	Yielder	23·9	27·6	..	32·3	128·4	43·16	70·69
Early Long								
AA		26·6	27·6	26·0	34·8	126·8	46·76	71·66
E	*Aa* 714	24·0	24·5	..	36·0	125·8	47·51	74·65
C		23·8	26·5	24·5	36·9	125·4	48·42	72·18
D		23·7	27·1	25·4	33·8	125·0	46·10	73·71
AR		23·4	26·3	..	34·0	125·9	35·90	75·13
V	*Aa* 716	22·0	26·4	23·3	34·1	128·5	40·75	73·29
Differences for significance between Means — 5 per cent		3·7	2·7	2·3	3·4	3·3	1·63	1·15
Differences for significance between Means — 1 per cent		4·8	3·5	3·0	4·5	4·4		

A grading cylinder has been designed and constructed to facilitate the comparison of the grain sizes in the different varieties, but the assembling of this machine was not completed in time to include grading data from the trial in this report.

The hybrid *Avena barbata* × *Avena strigosa* was treated with both Colchicine and Acenaphthene during 1949 in an attempt to synthesise a fertile hexaploid, but without success. The plants have been propagated vegetatively and a further attempt will be made in 1950.

A preliminary cytological examination of the abnormal plants of *Avena strigosa* obtained after treatment with Colchicine indicates that two of these plants are tetraploid. Seed of these has been sown in the spring of 1950 to build up a stock, and they will be used in the 1950 crossing programme in an attempt to synthesise a hexaploid *Avena strigosa*.

A number of crosses were made during 1949 with the variety "Rothenburger," a black oat reported to be tolerant of mineral deficient conditions in Australia. These hybrids when multiplied will be tried on the alkaline soils of the Hebrides and the Orkneys.

About 200 of the Station collection of Named Oat Varieties were grown in 1949, part in the greenhouse and part in the open, and further observations were made on the botanical characters.

Mr Cameron visited a number of farms in Northern Scotland from Angus to Easter Ross, and one in Orkney, in connection with the Department of Agriculture for Scotland Trial Oat Inspection Scheme, 1949, and gained thereby further experience of cultural conditions in Scotland and of the constancy of botanical characters in commercial oat crops.

A satisfactory testing technique for the presence of the leaf-spot disease (*Helminthosporium avenae*) on oat seed has been worked out in co-operation with Dr Noble of the Plant Pathology Department of the Seed Testing Station, East Craigs, and it is proposed to study inoculation techniques in 1950, with a view to testing varieties for resistance to the disease, and including breeding for resistance to leaf-spot in the work of the Cereal Department of the Station.

Barley.

The breeding and selection of prompt germinating barleys was continued in 1949, and the seed from twenty first-genera-

tion hybrids was sown immediately after the 1949 harvest. There was a very high germinative rate and groups of plants of each hybrid, selected at random, were grown over winter in the greenhouse.

The second-generation plants of the six hybrids grown in the greenhouse in 1949 were harvested and have been lined out in the spring of 1950 in the open for further selection.

Naked or huskless barley is not grown commercially in this country, but a few varieties of this type have been grown in the reference barley collection at Corstorphine. As this type of barley may be useful for the production of pearl barley and also for the feeding of pigs and poultry, some further investigation of its characteristics seems worth while. The yields from naked barley are usually lower than those obtained from the commonly grown husked varieties, and the straw is weak, but these defects might be overcome by crossing and selection.

Beans.

In 1949 some 300 bean plants were " bagged " during the flowering period to prevent natural cross-pollination by insects. A large proportion of these 300 plants were of new lines selected in 1948 for earliness and for attractive shape and size of beans. Observations were made during the season on flower and stem colour, and on bean size and shape, and the most promising lines were chosen for further inbreeding in 1950. A few very prolific plants were selected from open-pollinated populations for future work.

A number of true-breeding lines were again multiplied in spatial isolation, and seven of these were also included in a small-scale field trial. Comparative yields, heights, and ripening dates were recorded, and the most promising of these lines will be included in trials on a larger scale when sufficient seed is available.

The isolation trial which has been carried on in 1948 and 1949 has been completed, and has shown that up to 9 per cent of the seed obtained from a single row of twenty bean plants growing amongst wheat became contaminated by cross-pollination at distances of from 200 to 300 yards from a field crop of beans. This method of spatial isolation for small numbers of plants has been discontinued. A preliminary

investigation into the possibility of preventing black fly and green fly attacks on the "bagged" plants by means of "Pestox III.," a systemic insecticide, was carried out, but with inconclusive results. A more extensive trial is planned for 1950.

A reference collection of named varieties from various sources was maintained in the greenhouse, and seed of the same varieties from open-pollinated plants was again sown in the open to provide natural hybrids for future selection.

Potatoes.

Breeding—Boghall Sub-Station.

Progress in the breeding of blight-resistant varieties has frequently been retarded by the appearance of new specialised strains of the pathogen capable of attacking seedlings which had hitherto been regarded as resistant. Altogether some sixteen different strains, mostly of foreign origin, have now been employed for test purposes, but it appears that only four or five of them are of practical importance in the experiments. The remainder have a limited range of host plants and are classified as relatively unimportant variants of the common strain. The most virulent biotypes of local origin are strains B and C, but a new strain which exceeds B in the range of its host varieties was obtained from East Africa and was employed in most of the routine tests during 1949. It is known as strain E. In the course of these tests a new mutant type was isolated—viz., F—which had the power to attack certain varieties which successfully resisted strains A, B, and E. The F strain appears to belong to the B group and represents the highest degree of virulence so far obtained within that group. In the autumn of 1949 a further strain appeared on certain seedlings growing in field plots. The tests which were carried out indicated that it belonged to the C group and was similar to, if not identical with, strain D, which was found a few years ago under similar circumstances. Strain D is regarded as a closely related but weaker form of strain C.

Resistance to blight in potatoes is a complex which embraces two distinct forms of resistance—viz., resistance by the plant

to infection by the pathogen, and reaction of the plant after infection has taken place. The former can offer only partial protection, and is exemplified by those commercial varieties which suffer less damage under normal growing conditions by preventing the penetration of a proportion of germinating zoospores. Several wild species exhibit even greater resistance to infection than commercial types—*e.g.*, *S. simplicifolium*, which when inoculated gives a very weak growth of sporangiophores. A feature of this form of resistance is the similarity of the plant's response to the different biotypes of the disease.

Blight resistance as found in *S. demissum*, on the other hand, is based on the hypersensitivity of the plant's cells. After infection of such a plant has taken place the cells react so quickly that the fungus is destroyed in the necrotic tissue formed at the point on entry and the plant is therefore virtually immune from the known strain of the pathogen. It is the purpose in the breeding experiments to introduce the maximum degree of resistance to infection as a safeguard against the appearance of further new biotypes of the fungus.

An examination of isolates from local races of *Phytophthora infestans* occurring in Italy was carried out in collaboration with Dr Alberto Mezzetti, Rome. Minor differences in pathogenicity between races from different parts of the country were observed, but it was also found that isolates from the same locality sometimes differed appreciably in virulence.

Field immunity from the mosaic viruses A, X, and Y, and resistance to leaf-roll are available in certain commercial type varieties and seedlings, and these have been intercrossed with blight-resistant plants in order to combine the various qualities. Many of the blight-resistant seedlings which have successfully passed the initial trials have proved to be field-immune from virus X, whilst a few are blight-resistant and field-immune from virus Y.

Tests for resistance to the leaf-roll virus, and also for resistance to scab, are limited to observations following exposure to natural infection in the field. Wide differences in the behaviour of selections have been apparent, suggesting that those remaining free from symptoms of the diseases are inherently resistant to them.

Further experiments concerning " bolting " in potatoes have been carried out in co-operation with the John Innes Horti-

cultural Institution ; acknowledgment is made of the assistance rendered by Dr R. M. Nattrass, Scott Agricultural Laboratories, Nairobi, in growing and providing material for these studies.

The search continues for resistance to blackleg — a bacterial disease—but so far without success, in greenhouse, laboratory, or garden. In a trial plot planted in the garden there were no diseased plants ; in the greenhouse there were very few successful inoculations ; whilst in the laboratory an unsuccessful attempt was made to discover resistance by means of an agglutination test. Twenty-four representatives of the genus *solanum*, together with two cultivated varieties as controls, were used in tests with the blackleg organism *B. phytophthorum*, and in every case the organism was unaffected, while in parallel tests *B. coli*, a saprophytic used as control, was strikingly " clumped."

The eelworm trial of 1948 was repeated on a larger scale in 1949 ; the test plants were widely spaced and each was completely surrounded by plants of a susceptible commercial variety, not only to increase the chances of infection, but also to ensure that the eelworm population of the plot was maintained even in the presence of possibly resistant material. The results of the trial are not yet analysed, but sufficient information is available to make it clear that the eelworm population of the plot is reasonably good (an average of 5·5 cysts per g. of soil) and to indicate that results similar to those of last year are likely.

Preliminary investigations into the possibility of breeding for frost resistance are being made in collaboration with Dr Cockerham.

During 1949 fully 10,000 seedlings were raised to provide material for the above investigations. Many were destroyed for various reasons, particularly susceptibility to blight, and the survivors, numbering over 4000, were planted in the field and grown to maturity. In the autumn 736 seedlings were selected and retained for further trial. Growth during the season was exceptionally good ; heavy crops were obtained, and in comparison with previous years losses were small. Unfortunately the field proved to be infected with wart disease, and a small proportion of the seedlings developed typical disease symptoms.

Seedlings in their second year of growth numbered 215,

to infection by the pathogen, and reaction of the plant after infection has taken place. The former can offer only partial protection, and is exemplified by those commercial varieties which suffer less damage under normal growing conditions by preventing the penetration of a proportion of germinating zoospores. Several wild species exhibit even greater resistance to infection than commercial types—*e.g.*, *S. simplicifolium*, which when inoculated gives a very weak growth of sporangiophores. A feature of this form of resistance is the similarity of the plant's response to the different biotypes of the disease.

Blight resistance as found in *S. demissum*, on the other hand, is based on the hypersensitivity of the plant's cells. After infection of such a plant has taken place the cells react so quickly that the fungus is destroyed in the necrotic tissue formed at the point on entry and the plant is therefore virtually immune from the known strain of the pathogen. It is the purpose in the breeding experiments to introduce the maximum degree of resistance to infection as a safeguard against the appearance of further new biotypes of the fungus.

An examination of isolates from local races of *Phytophthora infestans* occurring in Italy was carried out in collaboration with Dr Alberto Mezzetti, Rome. Minor differences in pathogenicity between races from different parts of the country were observed, but it was also found that isolates from the same locality sometimes differed appreciably in virulence.

Field immunity from the mosaic viruses A, X, and Y, and resistance to leaf-roll are available in certain commercial type varieties and seedlings, and these have been intercrossed with blight-resistant plants in order to combine the various qualities. Many of the blight-resistant seedlings which have successfully passed the initial trials have proved to be field-immune from virus X, whilst a few are blight-resistant and field-immune from virus Y.

Tests for resistance to the leaf-roll virus, and also for resistance to scab, are limited to observations following exposure to natural infection in the field. Wide differences in the behaviour of selections have been apparent, suggesting that those remaining free from symptoms of the diseases are inherently resistant to them.

Further experiments concerning " bolting " in potatoes have been carried out in co-operation with the John Innes Horti-

cultural Institution ; acknowledgment is made of the assistance rendered by Dr R. M. Nattrass, Scott Agricultural Laboratories, Nairobi, in growing and providing material for these studies.

The search continues for resistance to blackleg — a bacterial disease—but so far without success, in greenhouse, laboratory, or garden. In a trial plot planted in the garden there were no diseased plants ; in the greenhouse there were very few successful inoculations ; whilst in the laboratory an unsuccessful attempt was made to discover resistance by means of an agglutination test. Twenty-four representatives of the genus *solanum*, together with two cultivated varieties as controls, were used in tests with the blackleg organism *B. phytophthorum*, and in every case the organism was unaffected, while in parallel tests *B. coli*, a saprophytic used as control, was strikingly " clumped."

The eelworm trial of 1948 was repeated on a larger scale in 1949 ; the test plants were widely spaced and each was completely surrounded by plants of a susceptible commercial variety, not only to increase the chances of infection, but also to ensure that the eelworm population of the plot was maintained even in the presence of possibly resistant material. The results of the trial are not yet analysed, but sufficient information is available to make it clear that the eelworm population of the plot is reasonably good (an average of 5·5 cysts per g. of soil) and to indicate that results similar to those of last year are likely.

Preliminary investigations into the possibility of breeding for frost resistance are being made in collaboration with Dr Cockerham.

During 1949 fully 10,000 seedlings were raised to provide material for the above investigations. Many were destroyed for various reasons, particularly susceptibility to blight, and the survivors, numbering over 4000, were planted in the field and grown to maturity. In the autumn 736 seedlings were selected and retained for further trial. Growth during the season was exceptionally good ; heavy crops were obtained, and in comparison with previous years losses were small. Unfortunately the field proved to be infected with wart disease, and a small proportion of the seedlings developed typical disease symptoms.

Seedlings in their second year of growth numbered 215,

of which 30 were selected for further trial. The older seedlings, amounting to 231 varieties, were reduced to 63 at the end of the season. Trial plots of some of the latter were also grown at Craigs House. This material contains a number of promising disease-resistant varieties which were adjudged to be suitable for inclusion in the Regional Trials conducted by the Department of Agriculture for Scotland. The presence of wart disease in the field, however, made it necessary to postpone the inclusion of the seedlings in official trials until 1951.

A few characteristics of the seedlings included in official trials in 1949 are shown in Table II.

TABLE II.

Name or Reference Number	Maturity	Resistant to blight strains	Field-immune from viruses	Trials		
				D.O.A.S. Year	M.O.A.F. Year	L.D.G.M. Year
Craigs Royal	2nd E.	—	A, X	+	+	3rd
Craigs Alliance	1st E.	—	A, B	+	2nd	—
834*c*(29)	2nd E.	A, C	A, B, C, X	4th	+	+
1092*a*(4)	E.M.	A, C	B	3rd	+	1st
1085(6)	M.	A, C	—	2nd	+	—
1095*b*(22)	E.M.	A, C	A	2nd	2nd	—
1253*a*(12)	2nd E.	A, B, C	A, X	2nd	1st	—
1256*b*(13)	E.M.	A, B, C	B	—	2nd	—
1256*c*(7)	1st E.	A, B, C	A, B, X	2nd	1st	—
1435(3)	1st E.	A, B, C	A, B, C	2nd	1st	—
1439*a*(4)	L.M.	A, B, C	A, B, C, X	2nd	1st	—
A49.1092*b*(3)	1st E.	A, C	B, C	1st	—	—
B49.1427*a*(8)	M.	A, C	X	1st	—	—
C49.1436(5)	M.	A, B, C	—	1st	2nd	—
D49.1488*b*(1)	E.M.	A, B, C, E	X	1st	—	—
E49.1508*a*(4)	M.	A, B, C, E, F	—	1st	—	—
F49.1510*a*(1)	L.M.	A, B, E, F	—	1st	—	—
G49.1512*c*(11)	M.	A, B, C, E, F	—	1st	—	—
H49.1512*c*(16)	E.M.	A, B, E, F	X	1st	—	—
J49.1512*d*(4)	M.	A, B, C, E, F	—	1st	—	—
K49.1518*b*(10)	M.	A, B, C	—	1st	—	—

Key to contractions :—

M. = Maincrop.
E.M. = Early maincrop.
1st E. = 1st Early.
2nd E. = 2nd Early.

\+ = Trials completed.
L.D.G.M. = Lord Derby Gold Medal.
M.O.A.F. = Ministry of Agriculture and Fisheries.
D.O.A.S. = Department of Agriculture for Scotland.

The Registration Trial conducted by the Department of Agriculture for Scotland in 1949 contained eighteen of the Society's seedlings—ten in the first-year, six in the second-year, one in the third-year, and one in the fourth-year test. The Registration Committee recommended that eight from the first-year, two from the second-year, and one from the third-year trials should be continued in their appropriate sections in 1950.

The trials conducted by the Ministry of Agriculture and Fisheries at the School of Agriculture, Loughborough, in 1949 contained eight seedlings—four in the first-year and four in the second-year test. Ten seedlings were also included in the Preliminary Test. These trials were adversely affected by the dry season, but favourable reports were received.

Two varieties—Craigs Royal and 1092*a*(4)—were included in the Lord Derby Gold Medal Trials in 1949. Seedling 1092*a*(4) failed to attain the necessary standard, but Craigs Royal compared favourably with the control varieties and was awarded the Lord Derby Gold Medal Certificate.

The regional trials of Craigs Royal and Craigs Alliance conducted in 1949 gave results which were, on the average, favourable for Craigs Royal and very favourable for Craigs Alliance. The trial crop of Craigs Alliance at Sweethope Musselburgh, which was watered once during the dry weather in July, yielded over 18 tons per acre. Quantities of seed tubers of Craigs Royal, Craigs Snow-White, Craigs Alliance, and Craigs Bounty have been forwarded to the National Institute of Agricultural Botany to provide stocks for regional trials in England.

Multiplication plots of Craigs Royal (4 acres), Craigs Snow-White (2 acres), Craigs Alliance (½ acre), 834*c*(29) (½ acre), and 1092*a*(4) (½ acre) were grown in 1949 under contract in Aberdeenshire by Mr A. Milne, Netherton of Mounie, Old Meldrum. Craigs Royal and Craigs Snow-White were inspected by the Department of Agriculture for Scotland and awarded Stock Seed Certificates. In February 1950, stocks of Craigs Royal and Craigs Snow-White were offered for sale to members in 1 ton lots. The quantities of tubers applied for exceeded the supplies on hand, and allocation was made by ballot. In all, 20 tons seed and 12 tons ware of Craigs Royal and 8 tons seed and 7 tons ware of Craigs Snow-White were sold for planting. Arrangements have been made to grow multiplica-

tion crops of Craigs Royal, Craigs Snow-White, Craigs Alliance, and 1092*a*(4) in 1950.

Virus-free stocks of the Society's named varieties, together with two unnamed seedlings were grown in multiplication plots at Strathallan in 1949, through the helpful co-operation of Sir James Denby Roberts, Bt., who is keenly interested in the development of healthy stocks of new potato varieties.

Samples of tubers were again forwarded to centres in many different countries for experimental and trial purposes. In South Africa seedling 914*a*(12) is now grown commercially and has been described and named "Craigs van Riebeeck." Two other seedlings—1253*a*(12) and 1488*b*(1)—have been found by Dr J. E. van der Plank to show considerable promise. Trials of certain blight-resistant selections are being carried out in Tanganyika Territory under the supervision of Mr C. J. M'Gregor. Seedlings 914*a*(91) and 833*b*(98) are now being grown on a wider scale. The problem of blight resistance in Tanganyika is of extreme importance and resistant varieties are urgently required. In Kenya, trials conducted by Dr R. M. Nattrass have shown that 914*a*(12) (Craigs van Riebeeck) and 1427*a*(8) are capable of yielding heavy crops and are suitable for commercial cultivation. Seedling 914*a*(91) has been grown commercially in Kenya in recent years.

Virus Diseases—Craigs House.

Work on potato viruses has been directed towards (1) the improvement of methods of testing potato material for virus-resistant characters; (2) the classification and evaluation of virus resistance in potato varieties and seedlings; (3) the examination of the genetical background of virus resistance; and (4) the synthesis of virus-resistant material for use in future commercial breeding. Attention has also been paid to problems of virus strains, to the development of serological methods appropriate to the work in progress, and to an investigation of genetical aberrancy in *Solanum simplicifolium*.

With a view to commencing investigations on frost resistance a preliminary examination was made of potential parental material and methods of test.

The responses of thirty-two potato varieties and seedlings upon exposure to infection with the leaf-roll virus and virus Y

were compared in a combined trial laid down in 1948 and assessed in 1949. This trial was substantially more successful than those of previous years, partly through a fairly high incidence of infection and partly through the adoption of a more suitable experimental design. The trial contained seven new varieties and seedlings raised at the Society's Sub-Station, twelve Continental varieties reputedly resistant to either leaf-roll or virus Y, and thirteen British varieties to serve as variety controls and trial controls. Six of the Society's seedling varieties—viz., Craigs Alliance, Craigs Royal, Craigs Snow-White, 834*c*(29), 833*b*(98), and 1092*a*(4)—were well placed on the scale of susceptibility to leaf roll, each having received fewer infections than their respective control varieties —viz., Arran Pilot, Craigs Defiance, Great Scot, King Edward, Majestic, and Arran Banner. In addition, there were fewer infections with virus Y in Craigs Alliance, Craigs Royal, and 1092*a*(4) than in the corresponding controls. Of the Continental varieties Flava, Imperia, and an unnamed seedling showed marked resistance to leaf-roll, and Imperia, Lorch, and three unnamed seedlings were superior to the control varieties in their resistance to virus Y.

Forty seedlings were entered into the 1949-50 advanced trial and 310 seedlings into the second stage leaf-roll trials.

In laboratory experiments further progress was made towards substituting controlled infection tests in place of field trials for the evaluation of resistance to infection.

Tests for the recognition of hypersensitive reactions to infection, and hence of potential field immunity from one or more numbers of the A, X, and Y groups of viruses, were applied to 160 seedlings submitted by the Potato Breeding Section, 147 new varieties and seedlings of external origin, and approximately 1300 seedlings used in experimental work.

Studies of the resistance to virus Y found in *S. Rybinii*, C.P.C. 979, were continued. No clear-cut segregation ratios were obtained in genetical investigations, and it is concluded that the resistance is quantitatively expressed. Proportions of the hybrids between C.P.C. 979 and parents killed with virus Y were extremely difficult to infect, and their reactions on infection gave every indication that the combination of resistance with lethal response offers a most promising source of field immunity from virus Y.

An examination of the reactions of hybrid seedlings derived

from *S. brevimucronatum, S. jujuyense, S. saltense, S. simplicifolium,* and *S. Rybinii* provided data from which linkage relationships were established between the genes conditioning responses to infection with viruses A and X and between the genes conditioning responses to infection with viruses A, C, and Y. In the case of the Nx-Na linkage the crossover value was similar to that already found in commercial tetraploid material, thus indicating similarity if not identity of the genes concerned. This investigation of gene inter-relationships has been extended during the year to a study of the Na-Nc-Ny gene complex in hexaploid material.

Earlier work on virus reactions in *S. simplicifolium* was obscured by genetic abnormalities in the species. These abnormalities have now been traced to a partial female sterility of genetic origin.

Two second backcross progenies were raised in the attempt to combine resistance to viruses A, X, Y, and leaf-roll with resistance to blight. More selections were made from earlier backcross material and these were used as parents in further breeding. For the purpose of introducing into tetraploid material the resistance to virus Y of C.P.C. 979, a number of inter-specific crosses were successfully accomplished.

A number of strains of virus X isolated from field selections were compared in their effects on a variety of Solanaceous hosts, including a range of potato varieties. No further aberrant strains have come to light. Differences between strains were found in their stability and infectiousness, in the detailed symptoms they cause on a wide range of host plants, and in their effects on the vigour and yield of potato varieties. In replicated field trials plants affected with certain mild strains of the virus out-yielded healthy controls, a result which confirms the observations made in 1947 on material raised from infected tubers, but conflicts with those of 1948, which were obtained on material infected after germination by leaf inoculation. Differences in manurial treatment and in times of lifting had relatively little effect on inter-strain differences.

Wherever possible serological methods have been used to facilitate the detection of viruses X and Y. They have proved invaluable in many ways, and experimental work is in progress with the object of widening the scope of their usefulness.

The spring migration of aphides to potatoes was first observed

on 14th May. One week later 53 per cent of the plants examined were found to carry one or more winged aphides, the largest infestation on record for Craigs House. Contrary to expectation, however, populations of wingless forms were slow to increase, and the population maximum of 541 aphides per 100 leaves was reached on 1st September, about six weeks later than usual.

Herbage Plants.

In contrast to the attention which has been given to the development of bred strains of the herbage grasses, the amount of information which has been ascertained regarding the hereditary composition of regional populations which have long been subjected to the selective action of the prevailing environmental conditions is extraordinarily limited. Yet judging by the important contributions which regional races such as Ayrshire perennial ryegrass and Carse timothy make to the seed stocks of this country, they deserve serious consideration in any comprehensive programme of herbage plant improvement. It was with such thoughts in mind, linked with the hope of finding a type characterised by early spring growth, that the collection of perennial ryegrass plants was made in the South-West of England in 1947.

The examination of the plant collections was completed during the past year and a considerable volume of data has been obtained, most of which has now been statistically analysed, so that it is possible to determine accurately one or two points of immediate practical interest. Taking into consideration all the populations sampled, certain trends may be observed, and these still remain evident when populations from a part of the area are analysed by themselves. An example of this is to be found in the differences between average dates of first ear emergence. The whole area sampled, which covers Devon, Cornwall and the Scilly Isles, includes local communities which differ by fifty-seven days in the average time of ear emergence; but when Devon populations are considered by themselves the difference is still as high as thirty-five days; and if the grazed pastures only within Devon are examined the difference is only slightly diminished, remaining statistically significant at twenty-eight days. It

is important to remember that while the average date of ear emergence does represent the date for the greatest number of plants within a population, nevertheless there is a range of maturity variation which also differs from one population to another. The least amount of spread is thirteen to fourteen days, but a range of fifty to sixty days has also been found. Thus in the latter case some plants had completed flowering before others from the same local community had begun to flower ; but this does not necessarily argue a sharp division between the early and late types, since there are usually intermediate types which act as a bridge.

It is of interest to note that the local population from which the current certified stock of Devon Eaver is derived falls at the early end of the county maturity range and has a spread of twenty-two days, which is relatively low. The maturity type of this stock is, therefore, not typical now of the Devonshire populations as a whole. Accordingly it would appear that opportunities for harvesting stock of similar type from other old grasslands in Devon are rather limited. A closer examination of the data, however, reveals some points which are worth careful consideration. As has been mentioned, the population from the present stock seed field is considerably earlier in average date of ear emergence than populations from other fields of roughly similar age, yet in general there is a statistically significant correlation between the date of ear emergence and the age of the pasture—*i.e.*, the older the pasture the later in time of ear emergence. It would seem, therefore, that the constant taking of seed crops from a pasture tends, over a period of time, to render the pasture earlier, and this has probably happened in the case of the stock seed field mentioned above. This may be caused in two ways. If the seed crop is taken when the earliest plants have set seed the later types are prevented from maturing seed, and cannot, therefore, contribute to the natural replacement which is continually taking place in the pasture. The seed sample from such an early cut pasture will contain the produce of the earlier types. If, on the other hand, the taking of the seed crop is delayed, the earlier types in the pasture will have shed their seed, so that a high proportion of the replacements will be of this type, but the seed sample will contain a preponderance of the seed produced by later types. In short, where a seed crop is regularly taken, the spread in

time of flowering is almost inevitably reduced after a considerable period whatever the time of cutting, but where an appreciable range still remains the seed sample will contain a higher proportion of earlies or lates according to time of cutting. Two points arise which are of practical value and may be considered by growers. The type of seed crop can be controlled to a certain limited extent by altering the time of cutting. In the light of these findings it should be decided whether it is advisable to take frequent seed crops from one old pasture only—*i.e.*, maintain a single stock seed field—or whether it would not be wiser to have several such pastures which could be used at intervals.

A further point of interest is that there is a statistically significant correlation between the date of ear emergence and the amount of early spring growth if only populations within a district are concerned. Populations with an early date of ear emergence also begin to grow earlier in the season. If, however, all populations from the collected area are analysed together this correlation does not hold good, since populations from the Scilly Isles are very late to show the flowering stems yet commence growth quite as early in the spring as some mainland populations which have a much earlier date of ear emergence. It is interesting to note that many of these Scilly Isles populations have also a very large plant size.

It has already been stressed that regional races are valuable as direct sources of commercial seed. Regional races being essentially the selected products of traditional farming systems are, however, not necessarily the best performers under specialised farming practice, although certain elements within regional races or in smaller local populations do provide material for the breeding of special-purpose strains. The exceptionally large size and high yielding ability in early spring of some of the constituents of local communities in the Scilly Isles illustrates this point. Such a combination of attributes would seem to have a special usefulness under intensive methods of cultivation, and attempts are being made to establish a bred strain predominantly of this type. Cocksfoot is also receiving attention, and here also the emphasis is being placed upon special-purpose types, and especially upon types capable of early spring growth and responsive to liberal manurial treatment.

The preliminary assessment of strain characteristics is

conducted at Corstorphine, and those strains which are considered to be of sufficient merit to warrant further study have been transferred to the trial centres at Dalmahoy, Midlothian, and at Dundonnell, Wester Ross. There are obviously many possible agricultural environments under which strains may be tested, and in deciding upon which of the many to adopt preference was given to a farming system which involved intensive cultivation and at the same time appeared worthy of experimental investigation on its own account. As indicated in previous reports, the problem of enhancing the nutritional value of small acreages of low elevation arable land in the interests of hill cattle was considered worth further experiment, and so the complementary use of cultivated and relatively poor quality natural herbage was adopted as the basic trial environment. It is, therefore, against this admittedly rather unusual agricultural background that the strain tests at the two centres have been deliberately planned, but since the main feature of such an environment is the intensive manurial treatment of small areas of comparatively good land, the trial results, so far as strain performance is concerned, have also a general interest, for they furnish useful information regarding the probable suitability to other intensive systems of grassland farming.

At the Dalmahoy Centre the aim has been to determine the varietal composition of swards best able to produce protein-rich complementary grazing from mid-April until the end of May, and again in September and October, as well as silage or hay crops during the summer months. The Dundonnell Centre has been used as an important extension—namely, as a centre for testing the practical applicability of the results obtained at Dalmahoy—in an area where such a system would be most valuable. The results are instructive and enable a more realistic programme to be drawn up as time goes on. Under farming conditions it has not been found possible to maintain herbage of very high protein quality throughout the spring grazing period from early varieties alone, and it is now clear that late varieties are useful in this connection. It was also thought that by using late varieties it would be possible to increase the production of autumn grass, but, on the contrary, no appreciable autumn increases have been obtained ; indeed, by late September the protein yields from pure stands of early and late strains of

perennial ryegrass proved to be remarkably similar. In the early years of the investigations swards containing both early and late varieties were used, but early production from such mixed swards have tended to fall rather rapidly under the intensive nitrogenous manuring and the effect of early spring grazing. An analysis of the relative frequencies of early and late plants in a three-year-old upland sward originally sown with equal quantities of both maturity types showed that earlies represented only 6 per cent of the population. It would seem, therefore, that when the highest possible yields are required at a particular time of year it is much wiser to use swards of specialised maturity composition.

So far as intensive methods of grass cultivation are likely to affect moorland farms, the problem is essentially one of increasing the supply of food for breeding cattle during the time when the rough grazings remain unproductive, though where dairy cows also are kept the provision of high quality summer grazing is also necessary. That the latter may be provided without ploughing and reseeding is suggested by a series of preliminary trials concluded last summer. The results show that by intensive nitrogenous manuring of selected areas of *natural vegetation* it is possible, though it may not always be economic, to provide very high quality summer pasturage from unploughed permanent grassland. In fact, after four years of lavish manurial treatment the protein yields from "natural grasses" in June and July approached, and the percentages of protein in the dry matter actually exceeded, those obtained from an adjacent reseeded sward of early ryegrass which had been similarly treated. If, then, natural vegetation could be profitably used to supply rich summer grazing it would be possible to keep dairy cows and still free the arable land to fulfil its most important summer function—that of growing food for the winter. The promise of a method of successful treatment for natural grasslands in moorland areas which is given by the experiments carried out over the last four years makes it advisable to acquire a more complete knowledge of the strains of hill species which are indigenous to those areas. Further investigations are, therefore, being carried out on the sheep's fescue concerning which a considerable amount of information has already been gained from trials under uniform environmental conditions. The most interesting point which has so far emerged is the presence of

two chromosome races which seem to be indistinguishable morphologically in the field, but apparently have a different distribution within the British Isles. The existence of more than one chromosome race and the distribution of these races may be of considerable importance, particularly in other hill species of greater nutritive value, and further information on these points within the sheep's fescue will provide a useful working basis for practical extensions of the technique to more involved species.

Forty populations of meadow grasses, including both species and hybrids, have been planted out in a trial which is part of the inter-Continental plan initiated by Dr Jens Clausen, Director of the Carnegie Institution of Washington (Division of Plant Biology), Stanford, California. A strain of smooth-stalked meadow grass from the coast of Oregon which was included in last year's trial proved particularly vigorous and was seeded in order to allow of a more extensive test under field conditions.

Root Crops.

A full breeding programme was carried out this year with swedes and sugar beet, and there were also trials with kales and fodder beet. For seed production, ten isolation plots were arranged for swedes, four for kales, and fourteen for sugar beet, besides the usual propagation of swedes in pollen-proof bags, and of various plants in the greenhouse. Clubroot tests were carried out on a large number of seedling plants. Swede strains were assessed for dry matter content, and sugar tests were made on sugar beet and fodder beet.

Swedes.

The strain known as Ds 32, which was chosen for large-scale trials, was multiplied in an isolation plot and it yielded 3¼ lb. of seed. Attention was chiefly centred on groups of progenies from some recent crosses, and about twenty lines each of early and late types were tested in two yield trials. The main crops, which were sown later, grew fairly well until a wet period, following the long dry spell, caused widespread splitting, and decay started in many of the cracks. Bacterial soft-rot was prevalent in the trial of early types, and there was spasmodic

damage from the swede root fly maggot, but not much club-root or mildew. A new and serious trouble, however, was a late summer attack by the swede midge, which defoliated many plants and damaged the necks considerably.

Yield Trials.—In field " B " the trial of early types consisted of nineteen lines selected from a cross between two station strains, denoted " ACF " and " ABJ." It has been mentioned above that this trial suffered especially from bacterial soft-rot, and the dry matter percentages, even from apparently sound tissues, were exceptionally low, ranging from 8·7 to 7·4 per cent for the earlies and only 9·3 per cent for the control—Champion. Under these conditions the trial merely indicated degrees of resistance. The Victory control headed the list for dry matter content, being relatively high in both percentage and yield. One line was a good second with high yield and average dry matter percentage, and there were several others with relatively high yields. The lines were derived from two crosses, made reciprocally, and it was very apparent that one cross gave better progenies than the other.

The trial in field " A " was more satisfactory because the crops were in sounder condition and afforded wider ranges of results. The dry matter percentage ranged from 11·3 to 8·5 per cent, root weight from 1·7 to 2·7 lb., and dry matter content from 0·14 to 0·30 lb. per root. Victory with highest root weight and almost lowest percentage was placed fourth for dry matter content with 0·25 lb. Champion was just above average for yields of dry matter, its percentage being unusually low this year. There were two commercial samples of the Aberdeenshire type, but both came at the foot of the list. Conditions at Corstorphine seldom favour the growth of this type. The list of dry matter yields was headed by CHo, a pedigree line selected from Champion, which has done well in several trials. Six lines, chosen as high dry matter types from a cross, ANM, between Excelsior and Stirling Castle, were all above average. The best of them, line ANMaE, was second for dry matter yield, having an average percentage and very heavy root weight. A second group of nine lines from a cross, ANW, between Excelsior and a Danish clubroot resistant strain, was not so good. Only three of the lines were above average, but one of these, ANWeA, was placed third for dry matter yield with relatively high percentage

and root weight. There were several other lines from various crosses, but none of these was outstanding.

A freshly infected field plot was used to test twenty-seven strains sown out in 9-yard rows in triplicate. The plants grew well and showed few signs of disease until lifted. They were then classified as healthy, slightly or badly diseased, and as large, medium or small roots, and comparisons were made on the percentages falling in these categories. Two controls, Wallace and Bruce, resistant turnips, had 54 per cent healthy and 19 per cent badly diseased, but their root size was relatively poor, due to seasonal causes. At the other extreme a sample of dwarf rape showed none healthy and 85 per cent badly diseased. The twenty-four swede strains ranged from 32 per cent to 1 per cent healthy, and varied considerably in yield. Among the nine with 20 per cent or more healthy there was only one of the Station hybrids, the remainder being commercial disease-resistant varieties, mainly samples of Wilhelmsburger or lines selected from them. The next eight strains, with 10-20 per cent healthy plants, included four hybrid lines. Seedling tests were continued in boxes of infected soil, and those plants which remained apparently healthy were grown on in pots and kept for seeding.

Several strains undergoing trial and others which could not be tested were grown in observation plots. Besides the inter-varietal hybrid strains selected as types of good economic quality and appearance, there were others derived from clubroot tests, some strains being bred to combine purplish straw pigmentation with the good qualities of the yellow-fleshed swede, and some hybrids between swede and rape kale in which bulb formation is combined with curled leaves. There were some of the old pedigree lines, obtained by selection from swede varieties and self-fertilised for thirteen generations in some cases. A few strains of swede and turnip ancestry were also included. Selections were made to maintain most of these strains, and the more promising were chosen for propagation in isolation plots.

Kales.

As kales belong to the same species as broccoli it is undesirable to propagate both in the same area. The broccoli has to be seeded where it is grown on the Station land, so the kales, except for a few greenhouse isolations, have to be propagated

by seeding a few plants in isolation plots. The general effect of these small isolations has been to reduce yield, and means must be found to restore vigour by some method of out-crossing.

Two strains selected before the war from commercial varieties of Thousand-headed kale are still in existence. One of these, reference number T1, has a distinct leaf habit and shape, being relatively erect and uncurled. Attempts were made some years ago to find unrelated plants of similar type, but the strain is at present much inbred, for it has a tendency to be self fertile. It has not given economic yields in recent trials and needs further out-crossing. The second Thousand-headed kale, T5, has a large lax and moderately curled leaf, and this strain is also rather low yielding at present.

Thousand-headed kale strains have a rather low proportion of leaf to stem, but seem to maintain their feeding value during the winter. A strain, designated AMK, was selected from a cross between Thousand-headed kale and broccoli, and this has a considerably higher ratio of leaf : stem in the autumn, but during the winter the amount of leafage is much reduced. In the first and second hybrid generations the plants were very large and appeared to be good fodder types, but the next two generations showed a drop in vigour, though leafage in autumn is still comparable with that of Thousand-head.

There are two other hybrid strains, involving Perpetual kale. Strain AMT is a cross with Curly kale, and strain AOC is derived from this hybrid crossed with Thousand-headed kale. It is hoped to obtain strongly curled types which are capable of vegetative propagation like the Perpetual kale ancestor, but so far an ideal type has not yet been found, though the amount of flowering that occurs varies considerably. Cuttings from likely plants are being planted out, and the strains have also been propagated from seed. Strain AMT is very low yielding, but AOC is rather larger, and both have strongly curled leaves.

The above strains were tested in two small trials, one of which had not yet been weighed at the time of writing. Seed was obtained from four isolation plots.

Broccoli.

The harvest from a quarter of an acre of strain 9 : 3 broccoli seed in 1949 yielded 60 lb. of dressed seed after the break had been culled of plants showing frost damage or defective

curds. This strain, which was derived from Royal Oak, has been selected mainly for winter hardiness, and there is some diversity of leaf habit which has not hitherto been subjected to rigorous selection. In the 1949 seeding break there were five small plots containing the progenies of crossings between plants which survived the hard spring of 1947. Three of these progenies had the low, compact leaf habit which is desired in the strain, and their seed has been harvested separately for further tests. Another quarter-acre break was planted out in 1949 with plants of strain 9 : 3 grown from 1947 and 1948 seed. These two samples, and a strain from Cambridge, were also planted out in a small yield trial for observation in the spring of 1950.

Sugar Beet.

The second year of the sugar beet research programme, undertaken at the request of the Sugar Beet Research and Education Committee for Great Britain, involved field trials, sugar testing, and propagation. The main objects of the work are to find types of sugar beet suited to Scottish conditions and to propagate any promising strains to the field stage with the least possible delay. Consideration is being given at present chiefly to (1) a search for non-bolting and vigorous strains of true sugar beet for early sowing, and (2) an inquiry into the possible use of heavy cropping forms of beet for sugar production on farms where the soil is rather shallow and of medium fertility.

Resistance to Bolting.—A trial of twelve strains was sown on 25th-28th March to compare some non-bolting strains from the Cambridge Plant-Breeding Institute and elsewhere with the types of sugar beet most commonly grown in Scotland. The results again showed that the Cambridge method of selecting non-bolting families from among plants treated with artificial light is most effective and, furthermore, that no signs of deterioration in sugar yield was found on the non-bolting material.

A small trial was also carried out with Klein AA and Klein E to obtain information on the bolting behaviour of these strains when sown on different dates in March. The bolting behaviour of the Cambridge strains tested in 1948 was checked in an unreplicated block of plots sown on 22nd March.

Heavy Cropping Forms.—Five varieties of fodder sugar beet were compared with three of true sugar beet and two varieties of mangold in a trial sown in mid-April. Estimates were made on parts of the plots at the end of September, and on other parts in December. The results were compared with those of a similar trial tested in October 1948. In all three tests the fodder beet yielded the highest weight of sugar, and the excess over sugar beet amounted to 14 and 12 per cent in the early tests, but only 5 per cent in December. Individually, however, none of the fodder beet strains was significantly better than foreign Klein E, the best yielder among the sugar beet varieties. Hence, whatever the position may be on upland farms, there is no support for the suggestion that fodder beet would out-yield a good sugar beet variety on land similar to this station—*i.e.*, deep, medium loam at 200-ft. elevation. There are, of course, other considerations of a technical nature which also tell against the fodder beet, but they are outside the scope of this inquiry.

With regard to feeding value, the December test showed fodder beet to be considerably richer in dry matter yield than the mangolds, but in October 1948 the mangolds gave rather better yields. The top weights of fodder beet were not quite so heavy as those of sugar beet, but the individual varieties varied, and some yielded as much top as Klein E. As both trials were sown in mid-April there was not much bolting in the sugar beet, and rather less in the fodder beet, but the mangolds bolted badly (17 and 22 per cent).

Selection.—With the consent of the Director, Cambridge Plant-Breeding Institute, some more selections were made from the non-bolting material.

Propagation.—The season was unusually favourable for seed production in Scotland, and good quantities of seed were obtained from most of the thirteen isolation plots in this district. The harvest was late, however, and difficulties may be expected in wet years. The plants were harvested individually, some of the seed being bulked after threshing.

1950 *Trials.*—Early sowings were commenced on the 6th March, and yield trials of non-bolting sugar beet strains have been sown out.

II. Publications and Lectures by Staff for the Year ended 31st March 1950.

Publications (P) and Lectures (L).

Director of Research.

"Wheat Breeding." East of Scotland Flour Milling Students' Association, Edinburgh. (L.)

"Breeding of Crop Plants." Torwood and District Agricultural Discussion Society, Larbert. (L.)

"Plant Breeding." Corn and Agricultural Merchants Association, Glasgow. (L.)

"Cereal Breeding." Inter-College Conference, Edinburgh, 1949. (L.)

William Black, B.Sc., Ph.D., F.R.S.E.

"Potato Varieties of the Future." National Association of Seed Potato Merchants, Sutton Bonington. (L.)

"Breeding New Varieties." Potato Conference, Perth. (Edinburgh and East of Scotland College of Agriculture.) (L.)

"Potato Breeding." Inter-College Conference, Edinburgh, 1949. (L.)

"Potato Breeding in relation to the Seed Trade." Western District of Midlothian Agricultural Discussion Society. (L.)

"Inheritance of Resistance to Blight (*Phytophthora infestans*) in Potatoes: Comparison of 'A' and 'B' Strains." Proc. Roy. Soc., Edinburgh: LXIII., 290-301, 1949. (P.)

D. Cameron, B.Sc.

"Oat Varieties and Seed." West Fife Young Farmers' Club. (L.)

G. Cockerham, B.Sc., Ph.D.

"Potato Virus Diseases." Inter-College Conference, Edinburgh, 1949. (L.)

V. M'M. Davey, B.Sc., Ph.D.

"Root Crop Breeding." Inter-College Conference, Edinburgh, 1949. (L.)

J. W. Gregor, Ph.D., D.Sc., F.L.S.

"The Utilisation of Upland Vegetation." Glasgow University Botanical Society. (L.)

"The Special-purpose Sward." Grass Drying Conference, Aberdeen. (L.)

"Grass as a Source of Protein." Contribution to Farm Forum, British Broadcasting Corporation. (L.)

"Intra-Colonial Variation in Plant Size and Habit in Sea Plantain." New Phytologist, Vol., XLIX., No. 1, 1950. (P.)

"Early and Late Ryegrasses." In collaboration with R. G. Heddle and J. L. Dawson. Scottish Agriculture, Vol. XXIX., No. 4, 1950. (P.)

J. W. Gregor and Patricia J. Watson, M.A., Ph.D.

"The Distribution of Ecotypic Variation and its Bearing on the Conception of the Ecotype." Glasgow University. (L.)

Patricia J. Watson, M.A., Ph.D.

"Herbage Plant Programme." Inter-College Conference, Edinburgh, 1949. (L.)

William Robb, William Black, and V. M'M. Davey.

Joint Contribution to Farm Forum, British Broadcasting Company. (L.)

III. Visits.

Director of Research.

Agricultural Research Council Plant Breeders' Conference, Aberystwyth, June 1949.
Craibstone Experimental Farm, Bucksburn, Aberdeen.

William Black, B.Sc., Ph.D., F.R.S.E.

Plant Breeders' Conference, Aberystwyth.
West of Scotland Agricultural College Experimental Farm.

D. Cameron, B.Sc.

Plant-Breeders' Conference, Aberystwyth.
Statistics Department, Marischal College, Aberdeen.

G. Cockerham, B.Sc., Ph.D.

Plant-Breeders' Conference, Aberystwyth.

V. M'M. Davey, B.Sc., Ph.D.

British Sugar Corporation Ltd.—
Central Laboratory, Peterborough.
Beet Sugar Factory, Cupar, Fife.
Crops and Trials of Sugar Beet in Angus, Fife, and East Lothian.
Plant-Breeding Institute, Cambridge.

F. J. W. England, B.Sc.

British Sugar Corporation Ltd.—
Central Laboratory, Peterborough.
Beet Sugar Factory, Cupar, Fife.
Crops and Trials of Sugar Beet in Fife and East Lothian.

J. W. Gregor, Ph.D., D.Sc., F.L.S.

Fifth International Grassland Congress, Holland.
Institute for Plant-Breeding, Wageningen, Holland.
Plant-Breeders' Conference, Aberystwyth.

J. C. Haigh, B.Sc., Ph.D., A.R.C.S.

Fifth International Congress of Comparative Pathology, Istanbul.
Plant-Breeding Station, Yesilköy, Turkey.
Plant-Breeders' Conference, Aberystwyth.

IV. Acknowledgments.

Grateful acknowledgment is made to the undernoted departments, institutes, firms, and individuals for facilities for carrying out experiments and for gifts of samples or other material :—

Åkerberg, Erik, Swedish Plant-Breeding Station, Uppsala.
Allan, C. M., B.Sc., County Agricultural Organiser, Aberdeenshire.
Allison, William, Almond Hill, Kirkliston.
Bell, David, Ltd., 15 Coburg Street, Leith, Edinburgh.

British Sugar Corporation Ltd., Cupar and Peterborough (per Messrs Rose, Freed, Pierce, Parker, M'Cloy, Sutton, and Simpson).

Corner, H. H., County Agricultural Organiser, Newtown St Boswells.

Commonwealth Agricultural Bureau, Cambridge (per K. S. Dodds, R. H. Richens, W. R. G. Wortley, M. A. Keay).

Cross Seed Co. Ltd., Alexander, 21 Hope Street, Glasgow (per Thomas Hogg).

Dale, John R., Auldhame, North Berwick.

Department of Agriculture for Scotland, East Craigs, Corstorphine (per T. P. M'Intosh, C. E. Foister, M. Noble, James Mitchell, A. E. W. Boyd, D. M. Henderson, J. L. Hardie, I. Montgomery).

Drummond, William, & Sons Ltd., Stirling (per A. M. Riddel).

Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (per A. S. B. Wilson, A. R. Dobson, A. M. Smith, A. E. Cameron).

Findlay, W. M., Marischal College, Aberdeen.

Henderson, Colonel John C., Scotscraig, Tayport, Fife.

Hutton, E. M., Council for Scientific and Industrial Research, Canberra, Australia.

John Innes Horticultural Institution, Bayfordbury, Hertford (per C. D. Darlington, M. B. Crane, Gordon Haskell, W. R. Stanton).

Laing & Mather, Ltd., Kelso.

Larson, R. H., University of Wisconsin, Wis., U.S.A.

Lawson, Peter, & Son Ltd., 1A George IV. Bridge, Edinburgh (per F. Nagel).

Macarthur, John, Middleton, Tiree.

M'Dowall, Mrs Flora, Mungoswalls, Drem.

M'Gregor, C. J., Department of Agriculture, Pretoria, South Africa.

M'Kay, Dr R., Albert Agricultural College, Glasnevin, Dublin.

M'Leod, John, Brae House, Dundonnell.

National Institute of Agricultural Botany, Huntingdon Road, Cambridge (per F. R. Horne, K. O. Müller, J. C. Cullen).

Plant-Breeding Institute, Cambridge (per G. D. H. Bell, G. K. Graham Campbell, H. W. Howard).

Nattrass, R. M., Scottish Agricultural Laboratory, Nairobi, Kenya.
Plank, J. E. van der, Department of Agriculture, Pretoria, South Africa.
Roberts, Sir James Denby, Bt., Strathallan Castle, Auchterarder.
Scottish Agricultural Industries Ltd., Aberdeen.
Silcock, D. S. G., Glen Lake Farm, Versailles, Kentucky.
Smith, K. M., Moltena Institute, Cambridge.
University of Aberdeen, Department of Statistics (per M. H. Quenouille, F. H. C. Marriott).
West of Scotland Agricultural College (per J. Grainger, P. J. Jones).
Young, James, Meadowfield, Corstorphine, Edinburgh.

V. Visitors.

A. Ganguly, B.Sc., returned to India in September 1949 after a two-year course of study in the Virus Diseases Section.

Professor C. T. Wei, Agricultural College, Nanking University, was granted facilities for study in Virus Diseases Section during his tenure of a British Council Scholarship.

E. M. Hutton, M.Sc., Council for Scientific and Industrial Research, Canberra, Australia, assisted in the work of the Virus Diseases Section during August 1949.

M. B. Patkar, B.Sc., returned to India in March 1950 after completing a two-year course of study in potato-breeding at Boghall Sub-Station.

WILLIAM ROBB,
Director of Research.

ESTABLISHMENT FOR 1950-51.

BOARD OF DIRECTORS.

Trustees.

H.M. SECRETARY OF STATE FOR SCOTLAND, Scottish Office, St Andrew's House, Edinburgh.
JOHN FINLAYSON M'GILL, Kyle Street, Ayr.
SIR JOHN H. MILNE HOME, D.L., J.P., Elibank, Walkerburn.
ALEXANDER M'CALLUM, O.B.E., M.A., LL.B., 78 Craiglea Drive, Edinr.

Ordinary Directors.

1948.

DAVID BELL, 15 Coburg Street, Leith.
JAMES H. ELDER, B.Sc., Cregganore, North Berwick.
WM. HUGH HAMILTON, W.S., O.B.E., J.P., Cairns, Kirknewton.
ALEXANDER D. C. MAIN, B.Sc., Windyedge, Perth.
FRED. MILLS, M.C., J.P. (Roughead & Park, Ltd.), Haddington.
ANDREW M. RIDDEL (W. Drummond & Sons, Ltd.), Stirling.

1949.

Major R. F. BREBNER, C.B.E., The Leuchold, Dalmeny House, Edinburgh.
JOHN CROZIER, B.Sc. (Scottish Agricultural Industries, Ltd.), Charlotte Street, Leith, Edinburgh.
GEORGE G. MERCER, C.B.E., Southfield, Dalkeith.
JAMES B. MILLER, Easter Ferrygate, North Berwick.
A. GORDON PORTER, West Scryne, Carnoustie.
Sir JAMES DENBY ROBERTS, Bt., Strathallan Castle, Auchterarder.

1950.

W. J. CAMPBELL, Sibster, Hermitage Drive, Edinburgh 10.
ROBERT HOWIE, B.Sc., The Grange, Kirkcaldy.
ROBERT L. SCARLETT, O.B.E., Sweethope, Musselburgh.
WILLIAM A. SMITH, M.B.E., M.A., B.Sc., 10 South Castle Street, Edinburgh.
FRANK S. NAGEL (Peter Lawson & Son, Ltd.), 1A George IV. Bridge, Edinburgh.
DAVID LOWE, C.B.E., Elvingston, Gladsmuir.

Directors Co-opted.

WILLIAM ALLISON, Almond Hill, Kirkliston.
Principal JOHN KIRKWOOD, O.B.E., B.Sc.(Agric.), West of Scotland Agricultural College, 6 Blythswood Square, Glasgow.
Professor Sir WILLIAM WRIGHT SMITH, F.R.S., Inverleith House, Arboretum Road, Edinburgh.

Directors nominated by the Secretary of State for Scotland.

Sir PATRICK R. LAIRD, C.B., F.R.S.E., St Andrew's House, Edinburgh 1.
ALEXANDER M'CALLUM, O.B.E., M.A., LL.B., 78 Craiglea Drive, Edinr. 10.
T. P. M'INTOSH, O.B.E., B.Sc.(Agric.), Ph.D., East Craigs, Corstorphine, Edinburgh 12.
ALEXANDER NELSON, Ph.D., D.Sc., N.D.A., University of Edinburgh, Department of Botany, Royal Botanic Garden, Edinburgh 4.

Chairman of Directors—Sir JOHN H. MILNE HOME, D.L., J.P., Elibank, Walkerburn.
Vice-Chairman—W. J. CAMPBELL, Sibster, Hermitage Drive, Edinburgh 10.

COMMITTEES.

RESEARCH.

Fred. Mills, *Convener.*
William Allison.
David Bell.
Major R. F. Brebner.
W. J. Campbell.
John Crozier.
James H. Elder.
W. H. Hamilton.
Sir John H. Milne Home.
Robert Howie.
Principal John Kirkwood.
Sir Patrick R. Laird.
David Lowe.
Alexander M'Callum.
J. F. M'Gill.
T. P. M'Intosh.
A. D. C. Main.
George G. Mercer.
James B. Miller.
Frank S. Nagel.
Alexander Nelson.
A. Gordon Porter.
A. M. Riddel.
Sir James Denby Roberts, Bt.
Robert L. Scarlett.
Professor Sir William Wright Smith.
William A. Smith.

MANAGEMENT.

William Allison, *Convener.*
David Bell.
Major R. F. Brebner.
Sir John H. Milne Home.
Robert Howie.
Principal John Kirkwood.
Alexander M'Callum.
T. P. M'Intosh.
A. D. C. Main.
George G. Mercer.
James B. Miller.
Fred. Mills.
A. Gordon Porter.
A. M. Riddel.

FINANCE.

Alexander M'Callum, *Convener.*
William Allison.
W. J. Campbell.
W. H. Hamilton.
Sir John H. Milne Home.
Sir Patrick R. Laird.
George G. Mercer.
Fred. Mills.
Sir James Denby Roberts, Bt.
Robert L. Scarlett.
Professor Sir William Wright Smith.
William A. Smith.

LIST OF MEMBERS

Adam, A., Covesea, Elgin.
Adam, Robert, South Gilmerton, Edinburgh.
Adam, Robert M., Newhouse of Glamis, Glamis.
Adam, Thomas, Sutherland Estates Office, Golspie.
Adam, Major Tom, Denmore, Aberdeenshire.
Adams, J. W., Woodriffe Farm, Newburgh, Fife.
Aikman, John S., Jedneuk, Jedburgh.
Aitken, James (James Aitken & Sons), 81 Hope Street, Glasgow, C.2.
Aitken, G., Traprain, Haddington.
Aitken, G. R., Traprain, Haddington.
Aiton, R. Scott, M.C., Legerwood, Earlston.
Alexander, Robert F., Boyne Farm, Inchture.
Alexander, Thomas G., Newton, Garmouth.
Alexander, W., M.B.E., Home Farm, Eynsford, Kent.
Alison, John P., D'Arcy, Dalkeith.
Allison, Alex. Y., Turnhouse Farm, Corstorphine, Edinburgh.
Allison, David, Duddingston, South Queensferry.
Allison, John M., Overton, Kirkliston.
Allison, Robert, Turnhouse Farm, Corstorphine, Edinburgh.
Allison, Robert, jun., Norton Mains, Newbridge.
Allison, William, Almond Hill, Kirkliston.
Allison, William, Campend, Dalkeith.
Amour, John, Pinkiehill, Inveresk, Musselburgh.
Amour, Richard, Cramond Bridge, Barnton, Midlothian.
Anderson, R. Brewis ('Farming News and North British Agriculturist'), 5 South St Andrew Street, Edinburgh.
Anderson, R. Gayler, 41 Mitchell Street, Leith.
Anderson, Robert, Kirklawhill, East Linton.
Andrews, R. S., Cross Lanes, Ashburton, Devon.
Angus, T. C. (R. Carmichael & Son), Coldstream.
Arbuckle, John, Logie, Newburgh.
Archibald, Robert, "Viewpoint," Ashgrove Road, Kilwinning, Ayrshire.
Archie, Alex. R., South Leckaway, Forfar.
Atkinson, James, 37 St Andrew Street, Kilmarnock.
Austin, Robert (Charlton & Sons, Ltd.), 43 Whitesands, Dumfries.

Baillie, R. R. Webster, The Bensil, Carnoustie.

Baird, W. J., Estate Office, Elie.

Baldie, William, 71 Hendry Road, Kirkcaldy.

Balfour, David B. (Laird & Smith, Ltd.), Cupar.

Ballantyne, John, Balkaithly, St Andrews.

Bankier, William, Farms Manager (Corporation of Glasgow), Gartloch Farm, Gartcosh, Glasgow.

Bannatyne, John, Drumalbin, Biggar.

Barbour, Robert C. (Jamieson Bros.), 60 High Street, Annan.

Barnfather, William (Charles Sharpe & Co., Ltd.), Sleaford.

Barr, John M. (Pattullo, Barr & Co., Ltd.), West Dock Street, Dundee.

Barr, S., Woodhouse, Peebles.

Barr, William, Harelaw, Lanark.

Barron, J. R., Findowrie Farm, Brechin.

Batchelor, D. Hill, Ferry Road, Montrose.

Baxter, A. Manton (Baxter & Guion, Ltd.), Museum Buildings, Priestgate, Peterborough.

Baxter, Norman, Crieff Farm, Kirriemuir.

Baxter, Robert M., Darfield R.M.D., Canterbury, New Zealand.

Baxter, William, Templehall, Ormiston.

Bell, David (David Bell, Ltd.), 15 Coburg Street, Leith.

Bell, J. C. (David Bell, Ltd.), 15 Coburg Street, Leith.

Bell, P. A., Colluthie, Cupar, Fife.

Bennett, James L., Rulesmains, Duns.

Berwick, D. F. G., Ardross, Elie.

Berwick, P. W., Wadeslee, Elie.

Beveridge, Hugh V., Elphinstone Tower, Tranent.

Billett, A. M. (Boots Pure Drug Co.), Lenton Experimental Station, Lenton House Nottingham.

Black, George, Penston, Macmerry, Haddington.

Blackley, John L., Lochfield, Dumfries.

Blackwood, Adam, Balleave, Kinross.

Borland, T. W. (James Borland & Sons, Ltd.), 9 St Marnock Street, Kilmarnock.

Bowe, D. L., Skateraw, Dunbar.

Boyd, Alexander, Douglasfield, Murthly, Perthshire.

Braes, Robert, St Clement's Wells, Inveresk, Musselburgh.

Brebner, Major R. F., C.B.E., The Leuchold, Dalmeny House, Edinburgh.

Broadfoot, Abram, B.Sc., "Rhueval," Atholl Place, Dunblane.

Brooks, John, Kilduff, Drem.

Brown, A. B., Fordel Parks, Dalkeith.

Brown, G., South Melville, Lasswade.

Brown, J. Chalmers, Thornylee, Clovenfords.
Brown, James Hally (Brown & Polson, Ltd.), Paisley.
Brown, J. S., General Manager, Farmers' Co-operative, Ltd., Salisbury, Southern Rhodesia.
Bruce, James S., 34 Girnigoe Street, Wick.
Bruce, John B., B.Sc., Seton Mains, Longniddry.
Bruce, William, M.A., B.Sc., Seton Mains, Longniddry.
Buccleuch and Queensberry, The Duke of, Drumlanrig Castle, Thornhill.
Buckpitt, W. A., The Rowans, Duns, Berwickshire.
Burke, P. B. (Austin & M'Aslan, Ltd.), 91-95 Mitchell Street, Glasgow.

Cadzow, James, Duncrahill, Pencaitland.
Cadzow, James Brian, Glendevon, Winchburgh.
Cadzow, James Neil, Kilpunt, Broxburn.
Cadzow, Ralph Alastair, Duncrahill, Pencaitland.
Calder, Adam, Marigold, Duns.
Calder, Sir James C., C.B.E., Ledlanet, Milnathort.
Calderwood, William, Clachan Farm, Rosneath.
Campbell, A. D., jun., Sibster, Halkirk.
Campbell, Sir George I., Bt., of Succoth, Crarae Lodge, Minard, Argyll.
Campbell, W. J., Sibster, Hermitage Drive, Edinburgh 10.
Chisholm, Miss E. M., Gibston, Huntly.
Clapperton, George, Sheriffhall Mains, Dalkeith.
Clark, J. G. D., Luggate, Haddington.
Clarke, J., Glassaneeran, Mosside, Co. Antrim, Northern Ireland.
Clay, S. (John Swain, Ltd.), The Seed House, Bristol.
Cochran, John M., Knowes, East Linton.
Cockburn, G. B., Chapelhill, Cockburnspath.
Coghill, R. A., Wester Lovat, Beauly.
Combes, D., "Oakshade," Market Avenue, Chichester.
Cowan, R. J., Blair of Fintray, Dyce.
Cowper, M. C., Gogar Mains, Edinburgh.
Cowper, H. S., Montrose.
Cox, Michael G., Morghew Park, Tenterden, Kent.
Craig, George, Gilkey, Tullintrain, County Derry, Northern Ireland.
Crawford, James B., Caigton, Castle Douglas.
Crawford, Robert, Drumbeg, Turnberry.
Crawford, Lieut.-Com. W. H., Ugston, Haddington.
Crawford, William M., Crewe Hall Farm, Crewe.
Crozier, J., B.Sc. (Scottish Agricultural Industries, Ltd.), Charlotte Street, Leith, Edinburgh.

Cunningham, Alan U., Threepwood, Galashiels.

Cunningham, Howard U., C.B.E. (Scottish Agricultural Industries, Ltd.), 39 Palmerston Place, Edinburgh.

Cunningham, Thomas (Fisons, Ltd.), Nether Grange, Burntisland.

Currie, William, Greenhill, Deskford, Cullen.

Dale, John R., Auldhame, North Berwick.

Dalglish, William, West Mains, Tullibardine, Auchterarder.

Darling, Sir William Y., C.B.E., M.C., LL.D., 124 Princes Street, Edinburgh.

Davidson, George (The Highland Agricultural Co., Ltd.), Falcon Square, Inverness.

Davidson, George, Sunnyside, Haddington.

Davidson, George F., Nether Balfour, Durris, Drumoak.

Davies, D. S., Halkerston, Gorebridge.

Dawson, W. M., Whitelaw, Haddington.

Debenham, Charles Archer (C. W. Marsters, Ltd.), King's Lynn, Norfolk.

Dewar, Andrew (Joseph Gartshore & Sons), Stirling.

Dick, James M., Hamildean, Peebles.

Dick, John (St Cuthbert's Co-operative Association, Ltd.), 92 Fountainbridge, Edinburgh.

Dickie, John, Swinnie, Jedburgh.

Dickson, Alexander, 30 York Place, Edinburgh.

Dickson, John H., Howlet's Ha', Gordon.

Dobie, A. S., Easter Middleton, Gorebridge.

Dobie, K. L. (Kirkpatrick S. Dobie & Son), Loreburn Street, Dumfries.

Dods, Archibald, Finlarig, Killin.

Donald, George Graham (Wotherspoon, Donald & George Graham, Ltd.), 31 Herries Road, Maxwellpark, Glasgow.

Donald, John (Wotherspoon, Donald & George Graham, Ltd.), 22 Hamilton Avenue, Glasgow.

Douglas, A. (A. & W. Douglas), Dalkeith Mills, Dalkeith.

Drummond, John, Megginch Castle, Errol.

Drummond, Professor Montagu, Greengate, Bradham Lane, Withycombe Raleigh, Exmouth.

Drybrough, W. S., Cairnie, Musselburgh.

Dryburgh, Archibald, Methilhill Farm, Leven.

Dudgeon, A. N., Humbie, Kirkliston.

Dufton, A., Corse of Kinnoir, Huntly.

Dun, John (John Dun & Co., Ltd.), Valley Mill, Galashiels.

Duncan, John, Castlehill, Maybole.

Duncan, P. R. (Drummond Bros.), Central Station Buildings, Leith.
Duncanson, T. (M'Cash & Hunter), 8 Kinnoull Street, Perth.
Dunlop, James M., Hoprig, Cockburnspath.
Dunn, J. P., Catcune Farm, Gorebridge.
Durie, John, 20 Cluny Drive, Edinburgh 10.
Durno, James, Uppermill, Tarves.
Dykes, Robert, The Myles Farm, Tranent.
Dykes, Thomas S., Redheugh, Cockburnspath, Berwickshire.

Easton, A. L. (R. Smith & Son), West Mills, Mid-Calder.
Eccles, James, Caerlaverock, Tranent.
Eglinton and Winton, The Earl of, Skelmorlie Castle, Ayr.
Elder, Archibald J. (Hugh Elder & Son), City Mills, Dunfermline.
Elder, H. F. D. (William Dods & Son), Haddington.
Elder, Hugh, Stevenson Mains, Haddington.
Elder, James H., B.Sc., Cregganore, North Berwick.
Elder, John Storie, East Bearford, Haddington.
Elliot, A. D., Kettleshiel, Duns.
Elliot, Captain Thomas, O.B.E., Thirlestane, Lauder.
Elliot, Thomas (R. M. Henderson & Co.), 65 Albert Street, Edinburgh.
Erskine, David, Myrend Farm, Cairneyhill, by Dunfermline.
Evans, T. R., Penkiln, Garlieston, by Newton Stewart.

Fair, Alex., Duniface, Windygates.
Fairlie, Dennis W. W., Kirkton, Monikie, by Dundee.
Fairlie, John M., Kirkton, Monikie, by Dundee.
Falgate, Walter R., Pinkerton, Dunbar.
Farquharson, John, jun., Bridgend, Auchterless.
Fells, G. F. (Hurst & Son, Ltd.), 156 Copse Hill, West Wimbledon, London, S.W.20.
Ferguson, Hugh, B.Sc., Agricultural Research Division, Wad Medani, The Sudan.
Ferguson, William Crawford, Grange of Lindores, Newburgh.
Fife, John W. (Dobbie & Co., Ltd.), 52 Moira Terrace, Edinburgh.
Findlay, John S., Easter Cadder, Kirkintilloch.
Findlay, Robert, Easter Cadder, Kirkintilloch.
Finlayson, William, Harelaw, Longniddry.
Finlayson, William Watt, Marfield, Penicuik.
Firn, Roland J., F.A.L.P.A., F.V.I., Morton Mains, Edinburgh.
Fisher, A. C., Shawfair Farm, Portobello.

Fisher, John, Jellyholm Farm, Alloa.
Fleming, G. J., Greenwells, Lauder.
Fleming, John (Fisons, Ltd.), Harvest House, Berwick-on-Tweed.
Fleming, William, Cove Villa, Annan.
Fleming, William, Upper Deanpark, Balerno.
Fletcher, Captain Andrew M. Talbot, of Saltoun, Pencaitland.
Forbes, J. D. H., Jameston, Maidens, Girvan.
Forbes, Colonel Robert, D.S.O., M.C., Balglassie, Forfar.
Forrest, A. S., Balgone Barns, North Berwick.
Forrest, George, East Hermiston, Currie.
Forrest, R. L., Mersington, Greenlaw.
Forster, E. A., Mains of Benholm, Benholm, by Montrose.
Fraser, Samuel (Alex. Cross Seed Co., Ltd.), 21 Hope Street, Glasgow.
Fullarton, A. W., Tranent Mains, Tranent.
Fulton, Alex. B. (James Fulton, jun.), 118 Queen Street, Glasgow, C.1.

Garden, W. J. (R. Garden, Ltd.), 18 Bridge Street, Kirkwall.
Gardner, Andrew, 30 Melville Street, Glasgow, S.1.
Gardner, J., Stonelaws, East Linton.
Gascoyne, G. (G. Gascoyne & Co., Ltd.), Worcester.
Gebbie, Alexander (Scottish Co-operative Wholesale Society, Ltd.), Shieldhall, Govan, Glasgow.
Gibb, Lieut.-Colonel Jocelyn E., Keppoch Farm, Dundonnell, by Garve.
Gibb, John, Fliskmillan, Newburgh.
Gibson, Frank P., Drylawhill, East Linton.
Gibson, G. P., Peastonbank, Pencaitland.
Gibson, James G., Toll House, Finavon, Forfar.
Gill, Ian M. (James Gill & Sons, Ltd.), 6 Exchange Street, Aberdeen.
Gill, W. H. M., Rosskeen, Invergordon.
Glen, Alan, Mains of Errol, Errol, Perth.
Glendinning, George E., Woodhall House, Juniper Green (*last known address*).
Gordon, F. S., 11 Newbattle Road, Eskbank.
Gordon, John, Hopefield, Bonnyrigg.
Gordon, John O., Balmuchy, Fearn.
Gordon, Peter, J.P., Balcraig, Whauphill, Newton Stewart.
Graham, Andrew S., Bush Home Farm, Roslin.
Graham, John, Queenstonbank, North Berwick.
Graham, John, Walton Farm, Linlithgow.

Graham, Thomas Lang (Wotherspoon, Donald & George Graham, Ltd.), 11 Douglas Avenue, Burnside, Rutherglen, by Glasgow.

Grant, G. J., Pulrossie, Dornoch.

Grant, James (John Grant & Sons, Ltd.), Kingennie House, Kingennie, Angus.

Grant, Lieut.-Colonel J. P., Rothiemurchus Estate, Aviemore.

Grant, William (Scottish Co-operative Wholesale Society Ltd.), Chancelot Mills, Leith, Edinburgh.

Gray, G. B. R., East Fenton, Drem.

Gray, Lieut.-Colonel James, M.B.E., T.D. (James Gray & Co.), Stirling.

Gray, James, 74 Osborne Street, Glasgow.

Gray, John (James Gray & Co.), Craigs, Stirling.

Gray, W. H., South Gyle, Corstorphine, Edinburgh.

Greenshields, J., Annandale Estates Office, Moffat.

Gregor, David Clunie, Innerwick, Dunbar, East Lothian.

Gregory, H. C. (Dunn's Farm Seeds, Ltd.), Salisbury.

Hamilton, Andrew (J. & J. Cunningham (London), Ltd.), Cereal House, Mark Lane, London, E.C.3.

Hamilton, Colonel Claud L. C., Rozelle, Ayr.

Hamilton, James, jun., Old Liston, Newbridge.

Hamilton, Robert C., Kilnknowe, Galashiels.

Hamilton, W. H., W.S., O.B.E., J.P., Cairns, Kirknewton.

Hamilton, William, Phantassie, East Linton.

Hannah, George A., Drem Farm, Drem.

Hannah, John J. M., Girvan Mains, Girvan.

Hannay, Andrew (R. & A. Hannay, Ltd.), Stranraer.

Harper, Thomas, Charlotte Street, Stranraer.

Harrower, William P., Blackadder Mount, Edrom, Duns.

Harvey, W., North Elphinstone, Tranent.

Harwell, George C. M., Comiston Farm, Colinton, Edinburgh.

Hasler, W. A. (Hasler & Co., Ltd.), Dunmow.

Hector, Edwin O., Dods, Lauder.

Helm, J. C., Haltree, Heriot.

Henderson, John, Hydro Hotel, Eastbourne.

Henderson, John, Townhill Farm, Hamilton.

Henderson, J. M., Spittalrig, Haddington.

Hendrie, John, Carrington Mains, Gorebridge.

Hill, William James, 19 St Vincent Place, Glasgow, C.1.

Hogg, Robert N., Oxenfoord Mains, Dalkeith.

Hogg, Thomas (A. Cross Seed Co., Ltd.), 21 Hope Street, Glasgow.

Home, The Earl of, The Hirsel, Coldstream.
Home, James B., Westfield, by West Calder.
Home, Captain John Gavin Milne, Irvine House, Canonbie.
Home, Sir John H. Milne, D.L., J.P., Elibank, Walkerburn.
Hope, Sir Harry, Kinnettles, Forfar.
Horne, C. F., Warsetter, Sanday, Orkney.
Horne, F. R., M.A. (National Institute of Agricultural Botany), Hill Farm, Lolworth, Cambridge.
Houldsworth, Lieut.-Colonel Sir W. T. R., C.B.E., of Kirkbride, Maybole.
Howie, Alex., Ardgaith, Glencarse.
Howie, John (Storrar & Howie), Newton, Wormit, Fife.
Howie, John C., Ballinbreich, Newburgh, Fife.
Howie, Robert, Drumfork Farm, Helensburgh.
Howie, Robert, B.Sc., Grange, Kirkcaldy.
Hulme, Richard A. (Kerr & Co.), 63 Queen Street, Glasgow.
Hunter, D., Thornton, Rosewell.
Hunter, James, Cauldhall, Gorebridge.
Hunter, William, Cauldhall, Gorebridge.
Hunter, W. C., Copland, Ancrum.
Hutchison, A. (R. Hutchison & Co.), Kirkcaldy.
Hutchison, Thomas, O.B.E. (Barclay, Ross & Hutchison), 67 Green, Aberdeen.

Inch, A. W., Echline, South Queensferry.
Inch, Robert A., Hyvots Bank, Liberton, Edinburgh.
Inglis, Wm. (J. Inglis & Sons), Leith.
Innes-Smith, G. A., Whitfield, Coldingham.
Irvine, Charles, sen. (C. Irvine & Sons), 1 Market Place, Jedburgh.

Jack, A. G., Hermiston, Currie, Midlothian.
Jackson, Robert, Rosemains, Ford.
Jamieson, Lieut.-Commander G. S., 74 Quarry Hill, Tonbridge, Kent.
Jeffrey, George, Beesknowe, Dunbar.
Jeffrey, J. C., Bielgrange, Dunbar.
Johnston, W. C. (W. C. Johnston, Ltd.), Dumfries.
Johnston, W. L., Oxnam Neuk, Jedburgh.

Kay, William, 19 South St David Street, Edinburgh.
Keith, Major James, C.B.E., Pitmedden, Udny.
Kelly, P. Douglas, M.M., The Farmers' Club, 3 Whitehall Court, London, S.W.1.

Kerr, Andrew, Westfield, Winchburgh.

Kerr, H. R. (Forage Supply Co., Ltd.), Springfield Mills, Leith.

Kerr, R. Balfour, Barney Mains, Haddington.

Ketchin, W. R., Harcarsehill, Duns.

King, Alex., Wolfstar, Ormiston.

Kirkwood, Principal John, O.B.E., B.Sc., West of Scotland Agricultural College, 6 Blythswood Square, Glasgow.

Laidlaw, J. Allan, 87 Craiglockhart Road, Edinburgh.

Laing, C. T. (Thomas Bernard & Co., Ltd.), Seafield, Leith.

Lang, James, Cortachy Home Farm, Kirriemuir.

Lawson, J. Watson (Samuel Finney & Co., Ltd.), 92 Grainger Street, Newcastle.

Leitch, D. C. MacKessack, Carden, Alves, Forres.

Lindsay, Adam (Robert Inch & Son, Ltd.), 46 Timber Bush, Leith.

Linlithgow, The Marquess of, Hopetoun House, South Queensferry.

Liston, J., Abersnithalk Lodge, Monymusk.

Lithgow, Colonel Sir James, Bt., M.C., of Ormsary, Ardrishaig.

Lumsden, James R., C.B.E., Arden, Dunbartonshire.

Logan, John, Athelstaneford Mains, Drem.

Logan, Kelvin, Aikendean, Gorebridge.

Lowe, David, C.B.E., Elvingston, Gladsmuir.

Lowe, John Jamieson, B.Sc. (David Lowe & Sons, Ltd.), Monktonhall, Musselburgh.

Lowrie, James, Blegbie, Humbie.

Lyal, Thomas B., Greenknowe, Gordon.

Lyburn, R., 8-10 Germiston Street, Glasgow.

Lyon, Arthur J. (Dickson, Brown & Tait, Ltd.), 57 Cross Street, Manchester.

M'Andrew, Alex., Upper Cairnhill, Newtonhill, by Aberdeen.

M'Arthur, A. (J. & A. M'Arthur), 204 Hunter Street, Glasgow.

M'Brayne, James, West Byres, Ormiston.

M'Callum, J. W., Castlehill, Manor Valley, Peebles.

M'Cloy, J., British Sugar Corporation, Ltd., Cupar, Fife.

M'Clung, Gilbert, 22 St John's Road, Corstorphine, Edinburgh.

MacCormick, I. (Scottish Agricultural Industries, Ltd.), 39 Palmerston Place, Edinburgh.

M'Cormick, Thomas (Edward Webb & Sons (Stourbridge), Ltd.), Wordsley, Stourbridge.

M'Corquodale, A. C., Meddat, Kildary.

M'Creath, Geoffrey C. (Fisons, Ltd.), Harvest House, Berwick-on-Tweed.

M'Dowall, Anthony, Mungoswells, Drem.

M'Ewan, James, Deanston Farm, Doune.

MacFarlane, T. S., 45 Commercial Street, Leith, Edinburgh.

M'George, John (John M'George, Ltd.), 248 Milton Road East, Portobello, Edinburgh.

M'Gill, J. Becket (M'Gill & Smith, Ltd.), Ayr.

M'Gill, John F. (M'Gill & Smith, Ltd.), Ayr.

MacGillivray, Finlay, Greenhead, Pencaitland.

M'Ginness, P. R. (John Milligan (Dumfries), Ltd.), Whitesands, Dumfries.

M'Gowan, Peter, Wheatlands, Kirkliston.

MacGregor, James (James MacGregor, Ltd.), Garrion Grain Mills, Wishaw.

MacGregor, J. Sim, Garrion Grain Mills, Wishaw.

M'Kerrar, M., Addinston, Lauder.

Mackie, George Y., Ballinshoe, Kirriemuir.

Mackie, John, The Bent, Laurencekirk.

Mackie, Maitland, O.B.E., North Ythsie, Tarves.

M'Kintosh, H. J., Bughtknowe, Humbie.

M'Laren, John, Ballencrieff, Longniddry.

M'Laren, John T., Alloa Park, Alloa.

M'Leish, Allister (George Ogilvie (Montrose), Ltd.), Ferry Road, Montrose.

Maclellan, George, Redheugh, Gorebridge.

M'Nicol, J. H., Castleton, North Berwick.

Macpherson, D. J. R., B.Sc. (Scottish Agricultural Industries, Ltd.), Blaikie's Quay, Aberdeen.

Main, Alexander D. C., B.Sc., Windyedge, Perth.

Manclark, Norman M., 28 Ravelston Garden, Edinburgh.

Marshall, John, jun., Dalreoch, Dunning.

Marshall, Mark, Laverockhill Cottage, Balmore, Torrance of Campsie.

Marshall, Robert C., Burntshields, Kilbarchan.

Mather, James, Printonan, Duns.

Mather, J. C., Milne Graden, West Mains, Coldstream.

Mather, Matthew, Brackenrig, Barnton Avenue, Edinburgh.

Mather, Matthew, jun., Brackenrig, Barnton Avenue, Edinburgh.

Meikle, John P., Hoprig Mains, Macmerry.

Meikle, R. W., Hardengreen, Dalkeith.

Meikle, W. G., Bathgate.

Meiklejohn, A. K. M., B.Sc., 5 Duke Street, Edinburgh.

Meiklejohn, John A., 86 St Vincent Street, Glasgow, C.2.

Mercer, George G., C.B.E., Southfield, Dalkeith.

Messenger, W. L. (North of England Seed Growers, Ltd.), 27 Portland Square, Carlisle.
Miller, D., Coxydean, Kirknewton.
Miller, D. M., Dale, Halkirk, Caithness.
Miller, Hugh, West Fortune, Drem.
Miller, Hugh W., West Fortune, Drem.
Miller, James B., Easter Ferrygate, North Berwick.
Miller, John (W. J. Campbell & Miller), 2 Charlotte Square, Edinburgh.
Miller, J., Prora, Drem.
Miller, Colonel J. M., Brockholes, Grantshouse, Duns.
Miller, Robert, Ferrygate, North Berwick.
Milligan, John A., Yetholm Mill, Kelso.
Mills, Fred, M.C., J.P. (Roughead & Park, Ltd.), Haddington.
Miln, David L., F.L.S., Mollington Banastre, near Chester.
Miln, Thomas Edward (Gartons, Ltd.), Warrington.
Milne, Alex. S., "Timaru," Trinity, Brechin.
Milne, Alvan, Netherton of Mounie, Old Meldrum.
Milne, Frank G., M.B., Ch.B., Southesk Granaries, Montrose.
Milne, George W., Muirhead, Craigrothes, Cupar.
Mitchell, Lieut.-Colonel A., Tulliallan, Kincardine, Fife.
Mitchell, James, B.Sc., East Craigs, Corstorphine, Edinburgh.
Mitchell, James, Bonnington, North Berwick.
Mitchell, Matthew, Chesterhall, Wiston, Biggar.
Mitchell, Thomas M., Netherton, Abington, Lanarkshire.
Montgomerie, A. W., O.B.E., Dunure Mains, Dunure, Ayrshire.
Montgomery, Andrew Mitchell, Uno, Virginia, U.S.A.
Montrose, Duchess of, Brodick Castle, Isle of Arran.
Morris, John, Borlum, Reay, Thurso.
Morris, P. S. (Robert Morris & Son, Ltd.), Woodside, Coupar Angus.
Morrison, J. A. W., Wester Dalmeny, Dalmeny.
Morrison, J. G., Longniddry Farm, Longniddry.
Morrison, W. Courtenay, Kennetsidehead, Eccles, Kelso.
Morton, William, Whippielaw, Ford.
Moss, Edward C., Fountainside, Gorebridge.
Motherwell, Andrew (A. Motherwell, Ltd.), Gorbals, Glasgow.
Mowat, D. G., 12 Sinclair Terrace, Wick.
Muir, Sir A. Kay, Bt., of Blair Drummond, Perthshire.
Muir, James, Turniedykes, Pathhead.
Muir, John, Freelands, Newbridge.
Munro, J. W., Craigton, Winchburgh.
Murdie, T. Lawrie, Baggerton, Forfar.

Murray, F. R., West Memus, Forfar.
Murray, Brigadier G. D. K., M.C., O.B.E., Borgie House, Castletown.
Murray, James C., Newbattle Collieries, Newtongrange.
Murray, Joseph, N.D.A., N.D.D., Balruddery Farm, Invergowrie.
Murray, R. G., Spittal, Biggar.
Murray, T. P. Douglas, Templewood, Brechin.
Murray, W., Redden, Kelso.

Nagel, Frank S. (Peter Lawson & Son, Ltd.), 1A George IV. Bridge, Edinburgh.
Nelson, Alexander, Ph.D., D.Sc., Royal Botanic Garden, Edinburgh.
Newell, A. C., 8 Prospect Terrace, Newport.
Nimmo, Gordon, Duntarvie, Winchburgh.
Niven, John Alexander, Gloagburn, Tibbermore.

Park, R., Brunstane House, Portobello.
Pate, George, West Blanerne, Duns.
Paterson, George, Watston Farm, Doune.
Paterson, James J., Terrona, Langholm.
Paterson, Professor William G. R., Bughtrigg, Beattock, Dumfriesshire.
Patterson, H., Muirfield, Gullane.
Pattullo, I. N., Langlogie, Meigle.
Paul, Andrew (Paul & Weir), 14-16 Caithness Street, Garscube, Glasgow.
Paul, Harold D., Munlochy Mains, Munlochy, Ross-shire.
Penny, J. P., 1 Lightburn Road, Ulverston, Lancs.
Peto, Sir Michael, Bt., Dundonnell, by Garve.
Petrie, Major G. G., Inchbroom, Elgin.
Petrie, Captain W. R., Wester Manbeen, Elgin.
Picken, James, Milton, Kirkcudbright.
Pirie, John, Lennoxlea, Lennoxtown.
Playfair, J. K., Abbey Mains, Haddington.
Plumley, H., Easthorpe Green Farm, Marks Tey, Colchester.
Pollok, Mrs Gladys M., Ronachan, Clachan.
Porter, A. Gordon, West Scryne, Carnoustie.
Pratt, W. Lloyd (R. W. Green, Ltd.), 1 Old Market, Wisbech.
Prentice, W. B., Swinton Quarter, Duns.
Pringle, James, Crichton House, Ford.
Proctor, W., The Knoll, Aboyne.

Rae, John S., Linthill, Ayton.
Reid, James, Pictstonhill, Perth.
Rennie, Douglas, West Barns, Dunbar.
Rennie, James E., Greendykes, Macmerry.
Rennie, John, C.B.E., South Belton, Dunbar.
Riddel, Andrew M. (W. Drummond & Sons, Ltd.), Stirling.
Rintoul, William, Pratis, Leven.
Ritchie, Stewart, Harehead, Duns.
Roberts, Sir James Denby, Bt., Strathallan Castle, Auchterarder.
Robertson, A., 125 Willowbrae Road, Edinburgh.
Robertson, Captain Ian S., Linkwood, Elgin.
Robertson, John G., Beanston Mains, Haddington.
Robertson, Peter D., Castlecraig, Nigg.
Robertson, William, Beanston, Haddington.
Robertson, William, Gateside, Linlithgow.
Robertson, Wilson Mathieson, 30 Walker Street, Edinburgh.
Robinson, R. G. (R. G. Robinson, Ltd.), P.O. Box 4, Papanui, Christchurch, New Zealand.
Robson, Denys V. (John Milligan (Dumfries), Ltd.), Dumfries.
Robson, N. Keith (W. Smith & Son, Ltd.), 18 Market Street, Aberdeen.
Rodan, A. Martin, Mill Bank, Glenluce, Newton Stewart.
Roger, F. W., Kenley Green, St Andrews.
Rose, Oswald S., Ivanhoe, Ramsey, Huntingdon.
Rosebery, The Earl of, Dalmeny House, Edinburgh.
Ross, Andrew George, Millcraig, Alness.
Ross, C. H., Niddry Mains, Winchburgh.
Ross, R., Wester Middleton, Gorebridge.
Ross-Taylor, Sir Joshua, Chiefswood, Melrose.
Rowallan, Lord, M.C., Rowallan, Kilmarnock.
Roy, James B. (Galbraith & Roy), 82 Great King Street, Edinburgh.
Russell, John, West Mains, Haddington.
Russell, James, Muirton, Drem.

Salmon, A. B. (Barclay, Ross & Hutchison), 67 Green, Aberdeen.
Sanderson, D. H. (Scottish Agricultural Industries, Ltd.), 10 Bridge End, Berwick-on-Tweed.
Sanderson, James, Loanhead, Ford.
Sanderson, J. H., Gunsgreenhill, Ayton.
Scarlett, Robert L., O.B.E., Sweethope, Musselburgh.
Scott, D., Ferneyhill, Kelso.

Scott, G. P. (Twyford Mill, Ltd.), Park View, Newtonhill, Kincardine.

Scott, James A., Garbity, Orton.

Scott, John, Fearn House, Fearn.

Scott, R. Lyon, Loanhead.

Scott, William, J.P., 170 Mayfield Road, Edinburgh.

Seafield, The Countess of, Seafield Estates Office, Cullen.

Seaward, Richard D., Touchmeller, Stirling.

Seed, John M., Woodend, Duns.

Service, A. D. (Laing & Mather, Ltd.), Kelso.

Shackleton, J. F. (Benjamin Reid & Co.), 20 Hadden Street, Aberdeen.

Sharp, Andrew, Homebank, Coldstream.

Sharp, W. H., Langcroft, Lauder.

Shearer, A. (Macfarlan, Shearer & Co.), Greenock.

Shepherd, Thomson, Gleghornie, North Berwick.

Shields, G. Bertram, 48 Ravelston Garden, Edinburgh.

Simpson, David E. (Scottish Agricultural Industries, Ltd.), 39 Palmerston Place, Edinburgh.

Simpson, David L., Aucharroch, Kingoldrum, Kirriemuir.

Simpson, Major J., Glencarse House, Glencarse.

Simpson, Mark T., Crowhill, Innerwick, Dunbar.

Simpson, R. C., Shiel Lodge, Gullane.

Simpson, Thomas, Highfield, North Berwick.

Simpson, William D., Highfield, North Berwick.

Simpson, W. J., Castlemains, Dirleton, North Berwick.

Sinclair, David B., Abernyte Farm, Inchture.

Sinclair, Dr George H., Nottingham Mains, Latheron, Caithness.

Sinclair, Robin MacDonald, Thurso East Mains, Thurso.

Slight, Mark, North Mains, Ormiston.

Smith, John, D.Sc., Director of Agriculture and Forests, Sudan Government, Khartoum.

Smith, J. J. Elliot, Dodridge, Ford.

Smith, Stanley B., Crosston, Dunnichen, Angus.

Smith, William A., M.B.E., M.A., B.Sc., 10 South Castle Street, Edinburgh 2.

Smith, Professor Sir William Wright, Inverleith House, Arboretum Road, Edinburgh.

Snadden, W. M'Nair, M.P., The Coldoch, Blairdrummond, by Stirling.

Somerville, A., Wester Cowden, Dalkeith.

Somerville, J., Smeaton, Dalkeith.

Speirs, A. A. Hagart, of Elderslie, Houston House, Houston.
Spence, C. G., Pitcox, Dunbar.
Spence, Charles T., Tynefield, Dunbar.
Stanhope, John M. Spencer, of Glenure, Argyll.
Steel, Archibald, Spittal, Creetown.
Steel, John K., Whitehill, Dailly.
Steele, J. Norman H., B.Sc. (Agric.), A.M.I.B.A.E., 57 Harrison Road, Edinburgh.
Stephen, W. M., M.A., B.Sc., Rothills, Duffus, Elgin.
Steven, William, Craigmill, Carnoustie.
Stevenson, Allan, Luffness Mains, Aberlady.
Stevenson, A. Harvey, Saltcoats, Gullane.
Stevenson, Robert H. U., Corseclays, Ballantrae.
Stewart, John (Hutchison & M'Creath, Ltd.), Girvan.
Stewart, R. C., Edmondstone Mains, Gilmerton.
Stirling, Hugh B., Allanbank, Edrom.
Stirling, Major John, of Fairburn, Muir of Ord.
Stirling, John W., P.O. Box 245, Nairobi, Kenya.
Stobo, A. H., Fishwick, Berwick-on-Tweed.
Stodart, Charles, Leaston, Humbie.
Stodart, John A., Kingston, North Berwick.
Storrar, George A., M.C., B.Sc.(Agric.), Rossie, Auchtermuchty.
Stratton, David Thomas, Braehead House, Kilmarnock.
Sutherland, D., Tullich Farm, Fearn.
Symington, J. Struthers, B.Sc.(Agric.), N.D.A., N.D.D. (British Basic Slag, Ltd.), 27 Castle Street, Edinburgh 2.

Tait, Charles William (J. & W. Tait), Kirkwall.
Temperley, Eric (W. A. Temperley & Co., Ltd.), 2 St Nicholas Buildings, Newcastle-upon-Tyne.
Thompson, J. G., Kinpurnie Farm, Newtyle.
Thomson, Dundas, Mains Farm, North Berwick.
Thomson, Henry, Newark, St Monance.
Thomson, James (Farmers' Supply Association of Scotland, Ltd.), 9 Wellington Place, Leith, Edinburgh.
Thomson, John (Thomson Bros.), 106 Taylor Street, Glasgow.
Thomson, Moffat S., of Lambden, Greenlaw.
Thyne, James C. (Thyne & Son), 65 Trades Lane, Dundee.
Thyne, William (A. & R. Scott, Ltd.), West Mills, Colinton, Edinburgh.
Todd, J., Pinkie Mains, Musselburgh.
Tomkins, C. R., Whiston, Northampton.
Turnbull, Alan T., Smithston, Gartly.

Turnbull, Mark J., Tynemount, Ormiston.
Trent, Lord, Hambleton Hall, Oakham, Rutland.
Tweedie, A. J., Eweford, Dunbar.
Tweedie, R. R., Middlethird, Gordon.

Walker, L. J., F.L.A.S., Manor Office, Padstow, North Cornwall.
Walker, Maxwell, Springwells, Greenlaw.
Walker, Robert, Capelaw, Rosewell.
Wallace, D., Pitpointie Farm, Auchterhouse, Dundee.
Wallace, D. G., Westmains Farm, Blackshiels, Midlothian.
Wallace, James, Balmydown Farm, Dundee.
Wallace, James, Strathmartine Castle, Dundee.
Wallace, William, West Bank, Macmerry.
Warnock, James H., Garrion Farm, Wishaw.
Watherston, R. H., Crighton Mains, Ford.
Watson, Professor Sir James A. S., M.C., C.B.E., LL.D., 55 Whitehall, London.
Watson, Professor Stephen J., M.Sc., D.Sc., College of Agriculture, 13 George Square, Edinburgh 8.
Watson, Rupert, Fenton Barns, Drem.
Watt, William, Arlary, Milnathort.
Waugh, John F. (J. & A. Waugh), Windyridge, Juniper Green, Edinburgh.
Weir, Walter, B.Sc. (Scottish Agricultural Industries, Ltd.), 4 Reidhaven Street, Elgin.
Wemyss and March, The Earl of, Craigielaw House, Aberlady.
Whitburgh, Lord, Whitburgh, Ford.
White, George L., Saughland, Tynehead.
White, John, Lawfield, Dalkeith.
Wilson, Andrew R., Brightmoney, Auldearn, Nairn.
Wilson, A. Gordon, Old Crombie, Bridge of Marnoch, Huntly.
Wilson, A. Stewart B., B.Sc., Boghall, Biggar Road, Edinburgh.
Wilson, Sir George, M.A., LL.D., Carbeth Home Farm, Balfron Station.
Wilson, James F., Ham Farm, Dunnet, Caithness.
Wilson, Philip, 1 Castle Street, Duns.
Winton, Dennis, of Dalmunzie Hotel & Estates, Ltd., Glenshee, Blairgowrie.
Wither, James, Awhirk, Stranraer.
Wood, Archibald, Carlowrie, Kirkliston.
Wood, James, Dundas Home Farm, South Queensferry.
Wood, John, Milrig, Newbridge, Kirkliston.
Wright, William J., The Heugh, North Berwick.

Wyllie, James D. (John Donaldson & Co., Ltd.), 94 Thirlestane Road, Edinburgh.

Wyllie, Robert, Lochhill, Longniddry.

Wyllie, Thomas Scott, Lochhill, Longniddry.

Young, A. T., Craigie, South Queensferry.

Young, Charles, B.Sc., Shielhill, Dundee.

Young, James, Meadowfield, Corstorphine, Edinburgh.

Young, James, West Briggs, Kirkliston.

Young, James G., Cadboll, Fearn.

Young, James L. (D. & W. Croll, Ltd.), 63 Commercial Street, Dundee.

Young, Robert, West Briggs, Kirkliston.

Young, Walter, Straiton, Loanhead.

Young, William, Newton of Lathrisk, Freuchie.

Younger, H. G. (W. Younger & Co., Ltd.), Abbey Breweries, Edinburgh.

Youngson, John, Whitburgh Mains, Ford.