SCOTTISH SOCIETY FOR RESEARCH

IN PLANT-BREEDING

REPORT

BY THE

DIRECTORS

TO THE

ANNUAL GENERAL MEETING

27th July 1939

1939

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SCOTTISH SOCIETY FOR RESEARCH IN PLANT-BREEDING.

REPORT.

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

Work has continued steadily and progressively during the year on all the plant-breeding problems included in the programme of work which the Society has adopted. Many of the problems are of the long-range type, and consequently the attainment of practical results requires patient effort over a period of years. It is encouraging, therefore, to record another achievement, which is the outcome of several years' continuous work on potatoes at the Society's Plant-Breeding Station. In the potato breeding section a new seedling potato of more than usual promise has been produced. This new variety, Ref. No. 451*a* (20), now known as 'Craigs Defiance,' has successfully passed the tests conducted by the Department of Agriculture for Scotland in connection with the Department's scheme for the Registration of New Varieties of Potato, and a certificate of registration has been awarded to the Society in respect of it. One of the outstanding characters of this new variety is that it is 'field-immune' from those viruses designated by plant pathologists as 'A' and 'X'; only a very few varieties of cultivated potatoes can be included in this field-immune group. In practice, therefore, there should be little difficulty, in many parts of Scotland at least, in maintaining this new variety in a state of freedom from the above-mentioned virus diseases which entail much loss among

potato stocks in Scotland. In addition to this characteristic the new variety is also immune from wart disease, and it produces a heavy crop of tubers of good quality. As there was only a small amount of this variety available in 1938, it was decided that all the tubers should be grown for seed under the Society's control in 1939, and that arrangements would be made later this year as to putting the new variety into commerce.

Small stocks of Elder, Bell, and Early Miller oats, and of Cocksfoot (Ref. No. *Cc* 180) and Timothy (Ref. No. *Cb* 191) pasture grasses, were grown again in 1938, and the seeds from these crops were offered to members of the Society. With the exception of the Elder oats all the seeds were readily sold.

The new laboratories erected at Craigs House in 1938 were ready for occupation last August. This additional and much-needed accommodation has proved very helpful, and it will promote the progress of the experimental work at the Plant-Breeding Station.

The tenant of Ainville Farm, Kirknewton, on which the Society's Sub-Station has been located since 1926, arranged early this year to relinquish his tenancy of the farm on 28th May 1939. After the Directors of the Society were informed of this decision a Special Committee of the Board of Directors was elected to consider the position and report. The Committee visited Ainville in January 1939, and the proprietors' agents were approached with a view to finding out whether the ground which the Society at present have the use of could be leased by the Society direct from the proprietors. It was learned that the owners could not see their way to letting a small part of the farm separately. The farm was afterwards let to a new tenant, who has informed the Society that he cannot continue the sub-let after Martinmas 1939. There are prospects, however, of other suitable ground being obtained by the Society for experimental purposes at November 1939.

During the year there were several changes in the Staff.

Miss Elizabeth S. Bennett, B.Sc., resigned her appointment as Assistant for Cytological Work as from 31st May 1938, and Mr John M. Main, B.Sc., was appointed to succeed her. Mr Main attended the John Innes Horticultural Institution, London, during the months of October, November, and December 1938 for further training in cytological technique. Mr Charles A. Lyall, B.Sc., Assistant under the Virus Disease Research Scheme, was transferred as from 1st October 1938 to the Cereals Section in succession to Mr S. G. Stephens, M.A., who received an appointment with the Empire Cotton Growing Corporation, Trinidad. Mr Colin H. Cadman, B.Sc., was appointed to the post vacated by Mr Lyall.

An informal visit to the Plant-Breeding Station, Corstorphine, and to the Society's Sub-Station at Ainville, Kirknewton, was paid last October by the Right Hon. John Colville, Secretary of State for Scotland. The programmes of work in the various sections were described by members of the Staff, and material was shown in the laboratory to indicate to Mr Colville the scope and trend of the work at the Plant-Breeding Station.

Financial.

The ordinary accounts, as audited at 31st March 1939, show that the Society's funds now stand at £43,843, 19s. 1d., which is about £216 less than in the previous year. It will be noted, however, that £134 of this sum represents depreciation on temporary buildings and equipment. Attention may also be drawn to the fact that in the accounts for the two previous years (1937-38 and 1936-37) there were increases of about £91 and £95 respectively.

Income from sales shows a decrease of about £212 on that of the preceding year, when the total was £506, 11s. 8d. In the year under review prices received for all crops were much lower than they were in 1937-38. For example, wheat was sold for seed in the autumn of 1937 for 42s. 6d. per quarter

of 504 lb., whereas in the autumn of 1938 the price obtained for wheat sold as seed was 30s. per quarter. A small increase is recorded in membership subscriptions. The amount of grant received from the Department of Agriculture for Scotland was £3030, which represents an increase of £101 on that of last year.

The total ordinary expenditure is slightly higher than it was in the previous year. The increase of about £181 is accounted for by salary increases according to scale and by various other small increases in maintenance expenditure.

Capital expenditure amounted to £968, 12s., which represents the greater part of the cost of erecting the new laboratories and greenhouses, and of installing new equipment. The final instalment of the total capital expenditure will become due in the succeeding year.

"Dr Wilson" Memorial Fund.

This fund now amounts to £312, 6s. 8d. No payments were made from the fund during the year.

Auditor.

It was with deep regret that the Directors of the Society learned of the death in September last year of Mr W. Slater Brown, C.A., who had been Auditor to the Society since 1921. Mr Robert MacDonald, C.A., a partner in the late Mr Brown's firm, has been appointed Auditor.

Membership.

The Directors regret to note that in the past year six members died, and three members resigned. The names of three members who were in arrear with their subscriptions were deleted from the roll. It is pleasing to report, however, that fourteen new members were enrolled during the year

ended 31st March 1939. At 31st March the membership consisted of 144 life members and 115 annual members (25 at the 5s. rate and 90 at the 10s. rate of subscription). A list of members appears on pages 38 to 45 hereof.

Donors of £10 or 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.

Election of Directors.

In accordance with the rules of the Society, the six senior Directors retire at this time. Their names are as follows :—

James H. Elder, B.Sc., Cregganore, North Berwick.
Robert Miller, Ferrygate, North Berwick.
Fred Mills (Roughead & Park, Ltd.), Haddington.
James Paton, Kirkness, Glencraig.
Sir Joshua Ross-Taylor, Mungoswalls, Duns.
William J. Wright, The Heugh, North Berwick.

To fill the vacancies thus created, the Directors recommend the election of the following :—

William Allison, Almond Hill, Kirkliston.
T. B. B. Kerr, 63 Queen Street, Glasgow.
Ian C. Menzies, W.S., 22 Rutland Street, Edinburgh.
Frank G. Milne (John Milne & Sons), Montrose.
Professor Sir William Wright Smith, Inverleith House, Edinburgh.
James Wither, Awhirk, Stranraer.

JOHN STIRTON,
Secretary.

SEEDS FOR DISPOSAL.

It is expected that limited quantities of elite stocks of seed of Elder, Bell, and Early Miller oats, Cocksfoot (*Cc* 180), Timothy (*Cb* 191), and seed tubers of the new potato variety 'Craigs Defiance,' will be available for disposal early in 1940 to members of the Society.

ABSTRACT OF

For the year ended

INCOME.

Interest Received			£1,318 7 9
Recoverable Income Tax			298 8 9
			£1,616 16 6
Sales—			
Ordinary, including Stock on Hand	£301 7 9		
Extraordinary—			
Early Miller Oat Account	9 6 8		
	£310 14 5		
Less—			
Deficit on Elder Oat Account	£6 3 7		
Deficit on Grass Seeds Account	10 14 1		
	16 17 8		293 16 9
Subscriptions—Annual			46 0 0
Note.—Annual Subscriptions amounting to £3, 10s. are in arrear.			
Donations under £10			10 0 3
Total Ordinary Income			£1,966 13 6
Grant received from Department of Agriculture for Scotland for the year 1938-39			3,030 0 0
Capital Income—			
Donation	£10 0 0		
Interest on Donations and Life Membership Subscriptions (£1398, 0s. 4d. at 3½ per cent)	£38 2 0		
Recoverable Income Tax (estimated)	10 16 7		
	48 18 7		58 18 7
Total Income			£5,055 12 1
Funds at 1st April 1938			44,060 12 7
			£49,116 4 8

ACCOUNTS.

31st March 1939.

EXPENDITURE.

Salaries—			
Officers (including Ainville Sub-Station)			£2,740 15 11
Secretary and Office			236 13 4
			£2,977 9 3
Superannuation Contribution			255 5 0
Labour			660 8 10
National Health and Unemployment Insurances			29 3 0
Seeds and Roots			4 13 5
Manures			114 19 10
Working Expenses, including renewals of Implements and Tools			281 16 0
Laboratory Expenses			27 15 11
Library Expenses			47 18 9
Rates and Insurances			52 8 4
Office Expenses			90 0 11
Heating, Lighting, and Cleaning			57 14 11
Legal Expenses			6 7 0
Travelling Expenses			85 9 1
Property Repairs			82 6 1
Locality Trials			27 6 2
Exhibit at Highland and Agricultural Society Show			14 13 4
Ainville Sub-Station Maintenance Expenses			321 17 0
Total Ordinary Expenditure			£5,137 12 10
Depreciation on Temporary Buildings, Implements, Tools, &c.			134 12 9
Total Expenditure			£5,272 5 7
Capital Expenditure—			
New Laboratories, Greenhouse, and Equipment	£930 19 0		
Furniture and Fittings	37 13 0		
	£968 12 0		
Funds at 31st March 1939, per Balance-sheet			43,843 19 1
			£49,116 4 8

BALANCE-

As at 31st

LIABILITIES.

I.	Accounts Outstanding, due by Society	£382 11 5
II.	Subscriptions paid in advance	6 0 0
III.	Funds at 31st March 1939	43,843 19 1
		£44,232 10 6

DR WILSON MEMORIAL

Value at 31st March 1939.		
£190 10 0	Funds at 31st March 1939, consisting of—	
	£200 3½ per cent War Stock, 1929-47	£176 5 0
	Sum in Bank on Deposit Receipt	123 10 2
	Sum in Bank on Current Account	12 11 6
		£312 6 8

SHEET.

March 1939.

ASSETS.

I.	Houses and Lands, at Cost, *less* Depreciation	£8,694 2 7
II.	Implements and Tools, at Cost, *less* Depreciation	617 5 8
III.	Laboratory Apparatus, at Cost, *less* Depreciation	92 13 11
IV.	Greenhouse, Hut, and Frames at Ainville, at Cost, *less* Depreciation	133 13 8
V.	Office Fittings, at Cost, *less* Depreciation	89 8 10
VI.	Stocks on Hand, as valued by Directors	87 15 9
VII.	Accounts Outstanding, due to Society	105 19 2
VIII.	Income Tax Recoverable	309 5 4
IX.	Investments, at Cost :—	

Value at 31st March 1939.			
£13,458 16 6	1. £14,130, os. 9d. 3½ per cent War Stock, 1929-47	£12,530 0 0	
14,700 0 0	2. £14,000 4 per cent Funding Stock, 1960-90	10,045 0 0	
15,886 0 0	3. £16,900 3½ per cent Conversion Stock	11,140 3 6	
£44,044 16 6			33,715 3 6

X.	Cash Balances—		
	In Bank on Current Account	£123 11 9	
	In Bank on Deposit Receipt	250 0 0	
	On Hand	13 10 4	
			387 2 1
			£44,232 10 6

FUND ACCOUNT.

Funds at 1st April 1938	£296 16 6
Interest for year	15 10 2
	£312 6 8

VIRUS DISEASE

ABSTRACT OF

For the Year ended

INCOME.

Grant from Department of Agriculture for Scotland	£942 16 3
Sales of Produce	4 11 0
Funds at 1st April 1938	2965 11 5
	£3912 18 8

BALANCE-

As at 31st

LIABILITIES.

I. Accounts Outstanding, due by Society	£14 14 11
II. Funds at 31st March 1939	2809 9 10
	£2824 4 9

EDINBURGH, *10th May* 1939.—The undersigned, having had access to all the Accounts, and verified the same with the Accounts and Vouchers relating thereto, now

16 ALVA STREET.

RESEARCH SCHEME.

ACCOUNTS.

31st March 1939.

EXPENDITURE.

Salaries		£550 5 0
Superannuation Contribution		51 10 0
Wages		161 13 0
Maintenance Expenses—		
Craigs House	£157 17 7	
Ainville Sub-Station	42 2 9	
		200 0 4
Depreciation on Temporary Buildings, Apparatus, Tools, &c.		140 0 6
		£1103 8 10
Funds at 31st March 1939, per Balance-sheet		2809 9 10
		£3912 18 8

SHEET.

March 1939.

ASSETS.

I. Buildings, Implements, Apparatus, &c., at Cost, *less* Depreciation—	
Craigs House	£2052 4 11
Ainville Sub-Station	771 19 10
	£2824 4 9

Books and Accounts of the Society, and having examined the foregoing Statements of signs the same as found to be correct, duly vouched, and in accordance with law.

ROBERT MACDONALD, C.A., *Public Auditor.*

DISTRIBUTION OF MEMBERSHIP

As at 31st March 1939.

Aberdeen	14	Linlithgow	6
Angus	13	Midlothian	47
Argyll	6	Moray	1
Ayr	19	Nairn	—
Banff	2	Orkney	2
Berwick	12	Peebles	3
Bute	1	Perth	15
Caithness	—	Renfrew	5
Clackmannan	—	Ross and Cromarty	6
Dumbarton	4	Roxburgh	6
Dumfries	7	Selkirk	1
East Lothian	26	Stirling	4
Fife	13	Sutherland	—
Inverness	1	Wigtown	2
Kincardine	—	England	9
Kinross	1	Abroad	2
Kirkcudbright	5		259
Lanark	26		

ESTABLISHMENT FOR 1938-39.

BOARD OF DIRECTORS.

Trustees.

THE RIGHT HON. D. J. COLVILLE, M.P., H.M. Secretary of State for Scotland, Scottish Office, Whitehall, London, S.W.
DAVID BELL, 15 Coburg Street, Leith.
JOHN FINLAYSON M'GILL, Kyle Street, Ayr.
SIR JOHN H. MILNE HOME, Irvine House, Canonbie.

Ordinary Directors.

1936.

JAMES H. ELDER, B.Sc., Cregganore, North Berwick.
ROBERT MILLER, Ferrygate, North Berwick.
FRED MILLS (Roughead & Park, Ltd.), Haddington.
JAMES PATON, Kirkness, Glencraig.
Sir JOSHUA ROSS-TAYLOR, Mungoswalls, Duns.
WILLIAM J. WRIGHT, The Heugh, North Berwick.

1937.

Major R. F. BREBNER, The Leuchold, Dalmeny House, Edinburgh.
JAMES CADZOW, Duncrahill, Pencaitland.
HOWARD U. CUNNINGHAM (Scottish Agricultural Industries, Ltd.), Leith.
THOMAS HOGG, 21 Hope Street, Glasgow.
GEORGE G. MERCER, Southfield, Dalkeith.
Principal W. G. R. PATERSON, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow.

1938.

W. J. CAMPBELL, 61 Fountainhall Road, Edinburgh.
JOHN E. B. COWPER, Gogar House, Corstorphine.
ROBERT HOWIE, The Grange, Kirkcaldy.
WILLIAM KAY, 19 South St David Street, Edinburgh.
ROBERT L. SCARLETT, Sweethope, Musselburgh.
Professor ERNEST SHEARER, Agricultural Department, The University, Edinburgh.

Directors Co-opted.

WILLIAM ALLISON, Almond Hill, Kirkliston.
IAN C. MENZIES, W.S., 22 Rutland Street, Edinburgh.
Professor Sir WILLIAM WRIGHT SMITH, Inverleith House, Arboretum Road, Edinburgh.

Directors nominated by the Department of Agriculture for Scotland.

P. R. LAIRD, C.B.,
J. M. CAIE, M.A., B.L., B.Sc.,
T. ANDERSON, M.A., B.Sc., } 29 St Andrew Square, Edinburgh.
ALEXANDER M'CALLUM, M.A., LL.B., 78 Craiglea Drive, Edinburgh.

Chairman of Directors—Sir JOHN H. MILNE HOME, Irvine House, Canonbie.
Vice-Chairman—DAVID BELL, 15 Coburg Street, Leith.
Director of Research—WILLIAM ROBB, N.D.A., F.R.S.E., Craigs House, Corstorphine.
Chief Assistant—JAMES W. GREGOR, Ph.D., F.L.S., Craigs House, Corstorphine.
Assistants—V. M'M. DAVEY, B.Sc., Ph.D., CHARLES A. LYALL, B.Sc., and JOHN M. MAIN, B.Sc., Craigs House, Corstorphine.
Assistant, Potato-Breeding Sub-Station — WILLIAM BLACK, B.Sc., Ph.D., Ainville, Kirknewton.
Assistants, Virus Disease Scheme — GEORGE COCKERHAM, B.Sc., Ph.D., Craigs House, Corstorphine; and COLIN H. CADMAN, B.Sc., Ainville, Kirknewton.
Temporary Assistant—J. M. S. LANG, B.S.A., Craigs House, Corstorphine.
Secretary—JOHN STIRTON, 8 Eglinton Crescent, Edinburgh.

COMMITTEES.

RESEARCH.

Fred Mills, *Convener.*
William Allison.
T. Anderson.
Major R. F. Brebner.
James Cadzow.
W. J. Campbell.
John E. B. Cowper.
Howard U. Cunningham.
James H. Elder.
Thomas Hogg.
Sir John H. Milne Home.
Robert Howie.
William Kay.
P. R. Laird.
Alexander M'Callum.
J. F. M'Gill.
George G. Mercer.
Principal W. G. R. Paterson.
James Paton.
Robert L. Scarlett.
Professor E. Shearer.
Professor Sir William Wright Smith.
David Bell, *Vice-Chairman, ex officio.*

MANAGEMENT.

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David Bell.
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James Cadzow.
J. M. Caie.
John E. B. Cowper.
Howard U. Cunningham.
Thomas Hogg.
Sir John H. Milne Home.
Robert Howie.
Alexander M'Callum.
Ian C. Menzies.
George G. Mercer.
Robert Miller.
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Principal W. G. R. Paterson.
James Paton.
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William J. Wright.

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Sir John H. Milne Home.
P. R. Laird.
Ian C. Menzies.
George G. Mercer.
Robert Miller.
Fred Mills.
Sir Joshua Ross-Taylor.
Robert L. Scarlett.
Professor E. Shearer.
Professor Sir William Wright Smith.
William J. Wright.
David Bell, *Vice-Chairman, ex officio.*

REPORT

BY

DIRECTOR OF RESEARCH

I. Research Programme.

The main items in the programme of research work remain unchanged, and the importance of breeding for disease resistance is fully appreciated. More attention has been given to problems concerning the establishment of new strains of grasses in pasture, especially in upland areas. The isolation of new strains of grasses has created some new problems in management which require examination. The Society's staff had few facilities for dealing directly with problems relating to the establishment and maintenance of pasture before 1938, and it is hoped it will be possible to continue and extend this line of investigation in the future. An account of the year's work, which has for its object the production of improved varieties of grain crops, potatoes, pasture plants, swedes, and kales adapted to Scottish conditions, is given in these pages.

Weather conditions in 1938 were not particularly favourable for securing the best results from field experiments. The unusually long spell of dry weather in the spring hindered the regular germination of seeds, with consequent unevenness in some of the resulting crops. There was a lack of sunshine and much rain during the summer, and a continuation of the wet weather in the autumn months interfered with harvesting operations. Comparisons of plants and seeds were therefore rendered more difficult, and less importance than usual could

be attached to the results of some of the field experiments. While progress was retarded in some cases there was, however, no serious loss of experimental material.

Grain Crops.

William Robb, *Director of Research.*
S. G. Stephens, M.A. (resigned September 1938), succeeded by Charles A. Lyall, B.Sc.

Oats.

The results of the weather conditions during the summer and autumn of 1938 in Scotland emphasised the defects of many oat varieties. Lodging was prevalent, and sprouting of the grain in the stook occurred in many districts, the main exceptions being in those areas where the grain was ripe fairly early. The latest-ripening crops probably suffered worst, and it is well known that some of these were so badly damaged that they were entirely worthless. In breeding to secure improved varieties of oats adapted to Scottish conditions, resistance to lodging, earliness in ripening, resistance to sprouting in the stook, and high grain-yielding capacity are characters regarded as of first importance.

An extensive range of third-generation plants from a cross between Early Miller and Semi-dwarf oats was grown. Much scope for selection was provided, and many individual plants with comparatively short straw and bearing well-furnished panicles were retained for further breeding. If some of the best of these types can be fixed, a further stage towards improvement as regards resistance to lodging should be reached. The Elder oat, which is highly resistant to lodging, has not found favour mainly because it does not ripen early enough, and attention is therefore being given to combining a high degree of resistance to lodging with the capacity to ripen about ten to fourteen days earlier than the variety Elder.

A group of early-ripening hybrid selections, some of which may prove useful in late upland districts, underwent further trials at Corstorphine and also in other areas in Scotland, the latter trials being arranged through the co-operation of the three Scottish Agricultural College extension staffs. It was a difficult year for field trials, and the results varied

widely. It is frequently found that very early-ripening varieties are much damaged by birds, and in consequence reliable comparisons of yields from such varieties are difficult to obtain. The very early-ripening selection, Ref. No. *Aa* 684, was grown in a two-acre plot at Ainville at an elevation of about 900 feet above sea level for observation with other crops on the farm. It produced a comparatively good crop, which was the first to ripen in the immediate neighbourhood. Early-ripening oats were an asset in this district last season. The crop of *Aa* 684 was secured in fair condition, whereas much of the later-ripening crops of oats on the farm were severely damaged.

A large third-hybrid generation of oats from the cross Elder and *A. fatua* (the common wild oat) was grown in 1938 and the plants examined individually. At harvest all the wild grain and other inferior types were discarded. A portion of the grain from each selected plant was tested for germinability, and seeds from those plants showing non-germinable grain at harvest time were retained for sowing in 1939.

Pure stocks of the Society's new varieties of oats—viz., Elder, Bell, and Early Miller—were grown in 1938 for seed, and the crops of these were secured in good condition.

Barley.

Chief attention has been paid to the progeny of two crosses, Spratt Archer × Kenia and Kenia × Plumage Archer.

From both crosses early types have been selected with short straw, absence of 'neck,' and promising grain quality. The crosses are now in the third generation.

Attempts have also been made to improve the quality of Scotch Common Barley, which is widely grown by farmers in the North of Scotland. A selection from this old variety has been crossed with Plumage Archer, and, from the progeny, types are being selected which have shorter necks and improved grain quality. Several further generation hybrids are being grown in 1939.

On a smaller scale work of a more experimental nature is being carried out. The possibilities of breeding a naked malting barley are being investigated, and the malting varieties New Cross and Plumage have been crossed with a naked two-rowed form. 'Naked' segregates from the second

generation of the cross Plumage × Naked two-rowed show considerable variation in grain texture, but so far none has been found with quality equal to a good hulled malting barley. A feature of this cross is the remarkable vigour exhibited in rapidity of germination and tillering capacity.

Various hybrids are being studied which have been derived from crosses between two-rowed barleys and a six-rowed awnless barley. There is a very strong linkage between awnlessness, six-rowed character, and dwarf habit of growth, and so far no true-breeding awnless two-rowed barley has been obtained. A cross between Star (a six-rowed barley with deciduous awns) and Plumage, which is also being studied, seems to offer more possibilities.

Seven selections of Scotch Common Barley, which were selected at the Station, were further multiplied and small trial plots were also sown in Morayshire and in Aberdeenshire. On account of the wet weather reliable comparison of the plots in Morayshire was not possible, but in the Aberdeenshire trials some comparisons could be made. The results of the trials in that area were considered by the Field Trials Committee, Department of Agriculture for Scotland. It was decided that one of the selections was much better than the others, and that it should be further multiplied at the Plant-Breeding Station in 1939.

Wheat.

Work has been carried out mainly with spring wheat. At the present time there is no spring wheat well adapted to Scottish conditions which is early-ripening, resistant to lodging, and immune from Loose Smut (*Ustilago tritici*). Japhet is perhaps the most popular British spring wheat, but many of its stocks are impure, and it is very susceptible to smut.

During the last two years a collection has been made of early-ripening foreign spring wheats which show resistance to Loose Smut in their native countries, and a number of crosses has been made.

One fixed hybrid line of winter wheat, derived from a cross between Squarehead's Master × White Spelt, was multiplied in 1938. It resembles Squarehead's Master in most characters, but has shown no tendency to lodge.

Colchicine Treatment.—Grains from several varieties of oats, barley, and wheat were soaked in colchicine solution before planting, in accordance with the method developed by Blakeslee (Journ. Heredity, 1938).

It was found that an almost lethal dose was necessary to induce the malformations characteristic of tissues with unbalanced chromosome numbers. Most of the seedlings so produced died before tillering could take place, and root growth remained at a standstill.

In all cases abnormal growth resulted, but the growth-rate was not markedly checked. Later leaves produced from these shoots, however, reverted to the normal type, and no polyploid reproductive tissue was obtained.

Replicated Trial Plots.—In the original 4-block lay-out of the oat trial plots the errors due to soil differences tended to be rather high, and an attempt to reduce them was made by adopting a new lay-out of the plots incorporating five blocks instead of four. In addition to added precision obtained by introducing an extra plot per variety, the new lay-out is so constructed that account may be taken of soil variation in two directions. The new lay-out has some of the advantages of the Latin Square without making necessary the enormous reduplication of plots which would be necessary in a true Latin Square lay-out of thirty varieties.

Beans.

Experiments on a small scale were continued with field beans and also with Soya beans.

Potatoes.

William Black, B.Sc., Ph.D. (Ainville Sub-Station).

One of the main problems in potato-breeding throughout the world is the search for new economic varieties possessing a high degree of resistance to blight (*Phytophthora infestans*). Experiments with that object in view were started some years ago at this Station, and progress has been facilitated greatly by adopting a glasshouse method of testing for resistance or

susceptibility to blight. During 1938 about 1800 new seedlings were tested for their reaction to infection with spores of the fungus.

In breeding for resistance to blight, the wild hexaploid species, *S. demissum*, has not yet been superseded by any other species. About 1100 seedlings bred from it were tested and the best resistant types selected for trial in 1939. The majority of those plants were either second-generation back-crosses from the F_1 or first-generation back-crosses from the F_2. The highest proportion of promising selections was obtained from the latter group, presumably because segregation in the F_2 generation provided a resistant plant which was comparatively free from the wild and undesirable characters of *S. demissum*. The proportion of resistant seedlings obtained from these progenies covered a wide range—viz., 41.6 per cent to 76.3 per cent—no doubt due chiefly to the different genetic constitutions of the seedlings used as parents. In addition, however, the figures indicate the existence of more than one susceptible genotype among our cultivated varieties.

Some very useful types were selected from the field trials of the *S. demissum* derivatives. Yields of over 4 lb. per plant were frequent, with an occasional one exceeding 5 lb., where the average crop of good commercial varieties weighed little more than 3 lb. per plant. Several of these high-yielding seedlings possessed attractive tubers and comparatively short stolons.

Many interspecific hybridisations of South American species have been successfully made, and it is probable that a few of them possess characters of value for future breeding work and particularly for multiple hybridisation.

S. demissum × *S. andigenum*.—*S. demissum* was fairly easily crossed with *S. andigenum*, but the hybrids were partially sterile, and only a few plants were obtained in the F_2 generation. All the hybrids and a majority of the F_2 plants were resistant to blight. In these respects *S. andigenum* behaved in a manner very similar to varieties of *S. tuberosum*. Triple hybridisation was effected by crossing one of the F_2 plants with a cultivated variety of *S. tuberosum*, and a wide range of types was obtained, among which were some interesting blight-resistant seedlings.

S. Rybinii × *S. demissum*.—*S. demissum* was also crossed with the diploid species *S. Rybinii* in an endeavour to combine the blight resistance, frost resistance, and immunity from

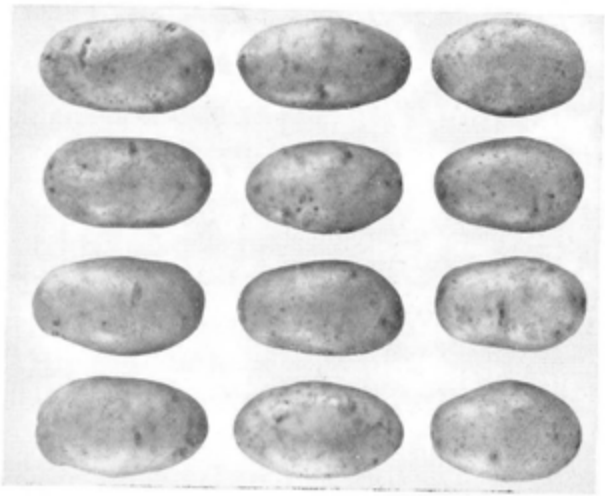

FIG. 1.
Tubers of "Craigs Defiance."

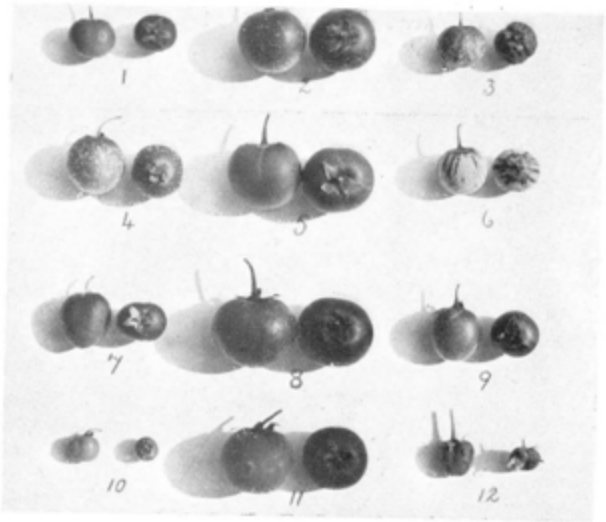

FIG. 2.
Berries of various *Solanum* species.

1. *S. maglia.*
2. *S. andigenum.*
3. *S. Fendleri.*
4. *S. chacoense.*
5. Hybrid (*S. demissum* × *S. tuberosum*).
6. *S. ajuscoense.*
7. *S. Commersonii.*
8. *S. tuberosum* (Pepo).
9. *S. demissum.*
10. *S. Jamesii.*
11. *S. tuberosum* (Kerr's Pink).
12. *S. polyadenium.*

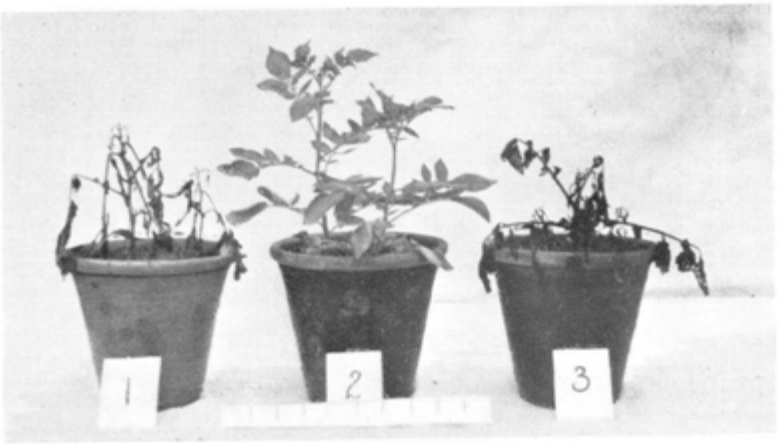

FIG. 3.

Reaction to intensive infection with blight (*Phytophthora infestans*), after eight days.

1. *S. subtilius* (susceptible) killed.
2. *S. edinense* (immune) unaffected.
3. *S. chacoense* (susceptible) killed.

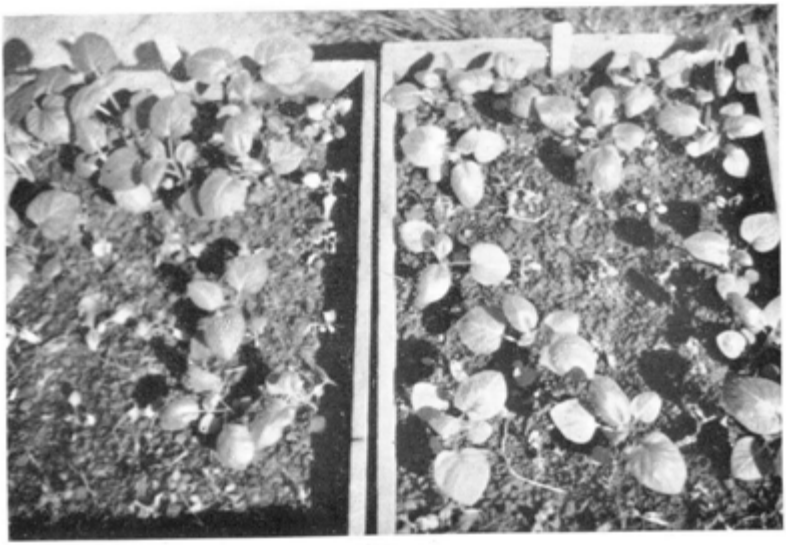

FIG. 4.

Potato seedlings undergoing test for blight resistance. The small shrivelled plants have been killed by the fungus.

wart disease of the former with the early-maturing capacity of the latter. It is also possible that, by combining a hexaploid and a diploid, a plant may be obtained which will be compatible with our tetraploid cultivated varieties. The cross (hexaploid × diploid) proved difficult to effect and very few seeds were secured. The F_1 hybrid resembled *S. demissum* more closely than it did *S. Rybinii*.

S. andigenum × *S. tuberosum*.—No difficulty was experienced in crossing *S. andigenum* with cultivated varieties. The hybrids proved to be very vigorous and heavy croppers, but were inclined to be late in maturing. The F_2 generation and the first back-crossed generation both gave a wide range of segregation of morphological characters. The majority of the plants were vigorous and highly fertile, but all were inclined to be stoloniferous with rough-shaped tubers of late maturity. Yields generally were heavy, and some fairly attractive plants were selected from the progenies.

S. Rybinii × *S. tuberosum*.—*S. Rybinii* was fairly easily crossed with cultivated varieties and the resulting hybrids, presumably triploids, were extremely vigorous. They were all self-sterile and all susceptible to blight. When back-crossed to a cultivated variety the resulting seedlings were characterised by a high degree of fertility, extreme vigour, and heavy cropping powers. One of the F_1 hybrids grown at Corstorphine produced the record yield of 18½ lb. for a single plant.

S. Fendleri × *S. polyadenium*.—Various attempts have been made to cross *S. polyadenium* (diploid) with cultivated varieties, but without success. It was, however, crossed with *S. Fendleri* (tetraploid) and a triple hybrid obtained by crossing the F_1 with a cultivated variety. The latter cross was not very productive, yielding on an average one seed per berry. *S. polyadenium* and all the F_1 hybrids are resistant to blight. It has been suggested that the unattractive odour of *S. polyadenium* may be repellent to green-fly.

By arrangement with the Imperial Bureau of Plant Genetics, Cambridge, sixty samples of potato collected by the Percy Sladen Expedition to Lake Titicaca (Bolivia-Peru) were multiplied for experimental purposes and for distribution. In addition, twenty-six samples from Peru and nineteen from Mexico were obtained during the summer of 1938, and further consignments arrived in the spring of 1939.

A number of progenies were grown in connection with the observations being made on the effects of repeated self-fertilisation of varieties followed by the hybridisation of inbred plants. This group comprised about 500 seedlings, and selections were made for further inbreeding. Over 400 seedlings obtained by crossing inbred lines were grown for comparison, and selections were made for further trial in 1939. Many of these plants were very vigorous and yielded promising crops.

Further progenies obtained by crossing the blight-resistant variety *967c* (38) with cultivated varieties were raised and tested for their reaction to blight. Over 700 seedlings were infected and fully 40 per cent survived. The proportions of resistant plants in these progenies were limited in range, the highest being 44.6 per cent and the lowest 39.7 per cent. Many promising seedings were selected for further trial. Some of the older seedlings bred from *967c* (38) showed promise of attaining commercial standard, and one of them has been included in the Potato Registration Trials for 1939.

The old-established method of breeding by inter-crossing commercial varieties has been continued, and special attention has been paid to recent discoveries in varietal reactions to virus diseases. Hybridisations have been directed towards the production of varieties which are 'field immune' to viruses 'A' and 'X' and resistant, as far as possible, to leaf-roll. An endeavour has also been made to breed varieties which mature early and varieties which possess distinctively marked tubers.

Attractive first-year seedlings were obtained from Arran Pilot × 500 (31), Catriona × The Alness, Epicure × Pepo, and Epicure × 500 (31). Seedling 500 (31) is a first-early bred from Arran Pilot × The Alness.

A large number of second-year seedlings, which were grown in trial-plots, provided good material for selection. Some very attractive tubers similar in shape and colour to the variety King Edward VII. were obtained from Gladstone × 70 (13).

Groups of the more advanced seedlings were included in the trials conducted by the Department of Agriculture for Scotland at East Craigs, Corstorphine, and by the Ministry of Agriculture and Fisheries at Ormskirk, and encouraging reports were received from both centres.

The trials at East Craigs contained nine of the Society's seedlings, five in the 1st year and four in the 2nd year. Two of the former—viz., 322 (37) and 373*a* (41)—were recommended for further trial in 1939. One of the latter, 384*a* (14), was recommended for inclusion in the 3rd-year trials in 1939, and another, 451*a* (20), was recommended for registration.

As a result of the various preliminary trials in 1938 five new seedlings—viz., 373*a* (29), 506 (8), 506 (27), 586*b* (53), and 594 (87)—have been selected for inclusion in the Registration Trials at East Craigs, and two—viz., 382*a* (66) and 450 (74)—for inclusion in the Wart Disease Immunity Trials at Ormskirk in 1939. Some details of these seedlings are given in Table I.

The Society received a Certificate of Registration from the Department of Agriculture for Scotland in respect of seedling No. 451*a* (20), which has been named "Craigs Defiance." This variety was obtained by crossing Epicure with Pepo, and it is an excellent cropper, producing attractive tubers of good table quality. Its outstanding feature, however, is its field immunity from the four viruses 'A,' 'B,' 'C,' and 'X.' The following is the official description of Craigs Defiance :—

Maturity—Early maincrop.

Tuber—Oval to long oval, flat ; skin white ; flesh white ; eyes shallow ; sprouts pink.

Foliage—Haulm medium height to tall, spreading ; stems of average strength, branching freely, mottled light pink ; wing waved ; leaf open, rigid, leaflets oval, pointed, terminal leaflet drooping, medium to dark green, dull on top but older leaflets fairly glossy ; secondaries small, not numerous.

Flower—Purple tipped white, not frequent ; anthers orange ; flower stalk often arising well down the stem ; buds pink.

The stock of Craigs Defiance was not large enough to put into commerce in 1938, and it was therefore decided that it should be increased in quantity by the Society before being put on the market.

TABLE I.

Reference Number.	Parentage.	Maturity.	Tuber.		
			Shape.	Colour.	Cooking Quality.
384*a*(14)	Kerr's Pink × The Alness	Maincrop	Kidney	White	Very Good
322(37)	966*f*(1) × Herald	Maincrop	Kidney	White	Very Good
373*a*(41)	British Queen × The Alness	1st-Early	Oval	White	Good
373*a*(29)	British Queen × The Alness	2nd-Early	Oval	White	Very Good
506(8)	Catriona × Shamrock	Early-maincrop	Kidney	White, splashed red	Very Good
506(27)	Catriona × Shamrock	Maincrop	Kidney	White, splashed purple	Very Good
586*b*(53)	Great Scot × The Alness	Maincrop	Kidney	White	Very Good
*594(87)	967*c*(38) × The Alness	Maincrop	Kidney	White	Very Good
387*b*(56)	May Queen × 188*a*(91)	1st-Early	Oval	White	Good
382*a*(66)	Immune Ash-leaf × 188*a*(91)	1st-Early	Oval	White	Very Good
450(74)	Epicure × Herald	Maincrop	Oval	White	Good

* Resistant to blight.

PASTURE PLANTS.

J. W. GREGOR, Ph.D., F.L.S.
J. M. S. LANG, B.S.A.

In last year's annual report mention was made of the acquisition of a pasture trial area at the Society's Sub-Station at Ainville, and it was at the same time pointed out that it was intended to conduct experiments relating primarily to obtaining data regarding the establishment of new strains of grasses and

to the possibilities of lowering the initial cost of reconditioning semi-derelict pastures by employing specialised herbage varieties. With this object in view appropriate trials were laid down on an area of 2¼ acres. Unexpected circumstances have, however, arisen whereby this ground will not be available for experimental purposes after November 1939, but it is hoped that arrangements may be made for the continuance of this work elsewhere.

Another economic problem is the raising of the yields per unit area on the best grasslands. This aspect of farming also suggests new and interesting possibilities regarding the establishment and maintenance of pastures and the breeding of special purpose varieties. One question which arises is whether the traditional methods of pasture management (*i.e.*, sowing relatively complex seeds mixtures for grazing more or less continuously throughout the growing season) are the methods best suited to utilise to the best advantage the properties of the new varieties ; or whether a different method could be devised whereby these varieties would be better able to fulfil a definite purpose by receiving special treatment designed to suit their particular properties. For instance, it might be beneficial to eliminate interspecific competition by sowing together only varieties of the same species, and to make adequate use of their properties by employing a system of rotational grazing.

With this possibility in view, a trial of ten varieties of timothy, each replicated five times, was laid down at Corstorphine in 1936. Each of the fifty plots was sown with only one timothy variety together with wild white clover. An analysis of last year's data from monthly cuttings showed that three of the ten varieties possess economic properties which may be of particular value. One of these (*Cb* 222) gave a heavier yield in May than any other variety, another (*Cb* 213) gave the heaviest yield in June and again in August, and the third (*Cb* 191) gave the highest yields in July and September. When expressed as percentages the values are as follows :—

Cb 222,	May	yield,	35 per cent	above	the average.
Cb 213,	June	,,	26 per cent	,,	,,
	Aug.	,,	25 per cent	,,	,,
Cb 191,	July	,,	31 per cent	,,	,,
	Sept.	,,	28 per cent	,,	,,

The yield from *Cb* 191 was lowest in May, being 45 per cent lower than *Cb* 222, and again in August, 40 per cent lower than *Cb* 213. In fact, this variety only gave a total seasonal yield equal to that of the average of all varieties. Nevertheless, when *Cb* 222, *Cb* 213, and *Cb* 191 were considered collectively, their seasonal yield was 4 per cent higher than the average. It should be possible in practice to take more advantage of such individual differences in productive dates than can be done under a system of continuous grazing. While the present trial had the advantage of eliminating inter-varietal competition, its technique has the disadvantage of submitting both early and late varieties to continuous defoliation. When the necessary data are available this latter defect could be remedied by sowing mixtures of varieties of similar growth-rhythm in separate plots, or fields, with a view to their being grazed in proper rotation. Such procedure would also ensure that the varietal balance of a mixture would be less liable to disturbance in the event of emergency hay crops being harvested.

A similar segregation might also be applied to species. For instance, the total seasonal yield from the timothy trial area mentioned above was 26,005 units, distributed as follows: May, 3006; June, 4262; July, 8094; August, 7567; and September, 3076 units. The months of July and August were therefore the most productive; this is a significant observation, since this productive peak follows the usual period of maximum production of the early varieties of cocksfoot and perennial ryegrass. Thus attempts to utilise to the full the peculiarities of specialised varieties along the lines suggested would at the same time simplify the management of pastures and bring grassland cultivation more into line with the cultivation of other arable crops.

Multiplication of New Varieties.

Timothy (*Cb* 191).—Four and a quarter acres (stock seed plot ¼ acre) were again seeded last year, and a yield of 13 cwt. of dressed seed was obtained. This variety belongs to the diploid group of timothy, and is essentially a bottom-grass pasture type reaching its annual maximum productivity about the same time as does wild white clover. Although it

is not recommended for hay mixtures, it has, when grown in pure culture, reached a yield of 3 tons per acre.

Timothy (*Cb* 213).—A rust-resistant hexaploid variety suitable for pasture but also capable of giving good yields of leafy hay. Two cwt. of seed were harvested off ¾ acre last year. This seed has been exclusively used for trial and further multiplication. Two acres of this variety have been sown for seed in East Lothian.

Timothy (*Cb* 224).—A strong stiff-strawed hexaploid variety essentially a hay type and not recommended for pasture purposes. This variety is being multiplied at Corstorphine.

Cocksfoot (*Cc* 180).—A variety with broad soft leaves. Reports from the border counties, where it makes early growth, are encouraging. Five acres of *Cc* 180 are being grown for the Society by the Essex Seed Growers' Association.

Perennial Ryegrass (*Ca* 434).—A relatively late-flowering pasture variety. Seed of this variety is now being multiplied at Corstorphine in order that more extensive grazing trials may be carried out.

The breeding programme follows the lines given in previous reports. Particular attention is being paid to early cocksfoot and perennial ryegrass varieties. Work on other pasture plants includes the study of ribgrass (*Plantago lanceolata*) in order to raise smooth (hairless) leaved, erect varieties.

Experimental Taxonomy.

Racial differentiation in wild populations and its bearing on agricultural problems has received further attention.

Root Crops.

(*Swedes and Kales.*)

V. M'M. Davey, B.Sc., Ph.D.
J. M. S. Lang, B.S.A.

The main purpose of the experiments is the examination of various methods for the selection and comparison of individual plants intended for use in breeding, with a view to obtaining varieties of improved productive capacity, of better feeding

quality, of greater uniformity of type, and of a high degree of resistance to disease. Self-fertility in the swede permits intensive inbreeding to be employed in studying this crop. In the kales, however, low self-fertility and the detrimental effects of inbreeding necessitate the elaboration of some other technique for the propagation of strains.

Kale Breeding.—The kale-breeding experiments have been in progress for three years. A number of plants selected from once-selfed lines of thousand-headed and marrow-stem kales were used for breeding. It was found that self-sterility had increased considerably as compared with the seed yields of the previous generation. One line of thousand-headed kale remained quite self-fertile, but some plants of other lines bore very few seeds indeed. Flowering commenced in April, when there was an unusual spell of warm weather. During that period the plants were bagged for self-fertilisation, and a large number of crosses was made between plants of the same and of different lines. These crosses failed completely, probably on account of subsequent night-frosts, which may also have had an adverse effect on the earlier period of self-fertilisation. Some of the crosses were repeated later in the summer, when good yields of seed were obtained; and early crosses made under glass were also successful. Three mass-multiplications of thousand-headed kale were also carried out. In one of these, plants of one line only were seeded together in isolation, but in the other two multiplications plants of two similar lines were intermingled. The single line gave a meagre yield, but the combinations of lines yielded satisfactorily.

In the first-year kale plots the progenies of various selections of thousand-headed kale line T_1 were examined. The strain is self-fertile and distinctive in habit of growth, but it is not true-breeding, and the sub-lines showed variations, some of which might be of value. In particular, one sub-line had marked activity in terminal growth of leafage in October, while others developed leafy side shoots in that month. Attempts are being made to find unrelated plants of similar appearance to line T_1, so that vigour may be re-established by outbreeding.

Swede Propagation.—The yields of swede seed from self-fertilised plants were about average, and the best plants yielded up to an ounce and a half. Few deaths occurred, and

about 200 selfed samples and thirty crosses were harvested. Three lines were mass-multiplied in natural isolation.

Swede Pedigree Breeding.—The seed available from the 1937 harvest was above the average in amount and number of samples, so that the whole available area was sown out with experimental material. The new crosses and most of the inbred lines were arranged in small plots on the flat, while the pedigree lines and hybrid strains were grown in larger plots or included in yield trials. Sowing was delayed by drought till 20th May, but growth was good. The stand of plants after singling was exceptionally regular, but finger-and-toe disease was prevalent in parts of the fields, and towards the end of the season bacterial and dry-rots seriously lowered the yields.

Swede Yield Trials.—Two yield trials of greater scope than usual were carried out with dry-matter and yield estimates. One trial contained sixteen strains in quadruplicate, the other twenty strains in quintuplicate. The results of yield trials hitherto have been somewhat invalidated by differences in numbers of plants in the plots due to gaps. Average bulb weights give more reliable comparisons than plot or acre yields, but there is a pronounced tendency for a sparse plot to have larger plants than a more crowded plot. It is now possible, by calculating covariance, to eliminate this plant number factor, and to arrange the results as though the strains had equal numbers of plants. It has been found that the dry-matter percentage is not appreciably affected, but that average bulb weight and average dry-matter content of the plant may be considerably altered, and one or two strains may be found to have changed position in the adjusted list of order of merit.

In the trials of 1938, a number of purple-top strains were compared. These strains were mostly pedigree lines, some hybrid strains and a few commercial varieties for control. Besides the above-mentioned replicated yield trials other strains were tested in groups, either unreplicated or in duplicated plots. The object was to ascertain which of the hybrid strains were worth keeping. These strains had been selfed four times since the cross, and though by no means true-breeding they were becoming sufficiently uniform for an opinion to be formed as to their value. Several were noted as promising, and two are to be multiplied for further testing.

Finger-and-Toe Disease.—Each year a plot has been employed for testing resistance to finger-and-toe disease in swedes, but the results have proved somewhat uncertain. In some years the infection has been so intense that nearly all the plants were destroyed, and none escaped the disease. In other seasons parts of the plot appeared to have been unfavourable to the disease organism, since none of the plants in these areas was seriously diseased. Nevertheless, plants which were apparently free from disease have been selected in most years, and their progenies have been grown and examined. No immunity has been found, and resistance consists of a swede plant's ability to develop a bulb, though attacked by the disease, when other plants are killed or dwarfed. This ability is found in the Danish and other resistant varieties.

The number of plants which can be grown in the infected plot is limited, so that the chances of finding the best hereditary constitutions for resistance are small. In order to increase these chances, a method of testing resistance to finger-and-toe disease in the seedling stage has been adopted. This method was devised by J. G. Gibbs in New Zealand, and consists of growing seedlings in trays of soil and infecting the soil evenly with a water extract of diseased material. During the summer of 1938 about 2800 seedlings were tested. Trays were made to hold about sixty seedlings each, and the soil was sterilised before infection. The seedlings grew for some weeks without obvious signs of disease, and then their leaves began to die and nodules were found to be abundant on the roots. The studies were of a preliminary nature, to find the most suitable times for infecting the soil and observing the disease. All the plants were badly infected in some boxes, but in others a few appeared to be free, and these were transplanted for seeding in 1939. It was found, however, that disease developed later in many of the selected plants. Infection may have been present but too slight for observation, or the organism may have been carried to the pot in the soil on the roots, though this was mostly washed off. It is proposed to attempt some form of disinfection when potting the seedlings, since it is apparent that few, if any, swedes can resist too intensive conditions.

Virus Disease Research.

Potatoes.

George Cockerham, B.Sc., Ph.D.
Charles A. Lyall, B.Sc. (from April to September).
Colin H. Cadman, B.Sc. (from October).

The possible control of potato virus diseases through some form of genetic immunity continues to provide the basic problem of investigation.

In view of the significance of virus 'X' to the seed potato industry of Scotland, considerable attention has been paid to varieties which react to artificial infection with lethal top-necrosis. Such varieties are virtually immune from infection in the field and consequently, in Scotland, are more readily maintained at high-grade standards of health than non-necrotic varieties. This fact is becoming widely recognised, and doubtless it had an influential bearing in promoting the registration of the Society's new potato 'Craigs Defiance' by the Department of Agriculture for Scotland after only two years of trial.

Genetical work on the inheritance of this valuable character has been continued through the examination of named varieties and seedlings for their reaction to virus 'X' through infection by grafting. Thirty-eight varieties have been killed with the virus, and, in consequence, are of value as parents in breeding necrotic reactors. Segregations within seedling progenies have confirmed the dominant character of the lethal necrotic reaction. The varying proportions of the segregates, however, have indicated a complexity of genetical constitution within necrotic parents. The reactions, necrotic or non-necrotic, of parents to virus 'A' have been found to have some bearing on the numbers of seedlings necrotic to virus 'X' in certain progenies. This interrelationship of reaction to viruses 'X' and 'A' in seedling progenies and the differential reactions of named varieties to viruses 'X,' 'A,' 'B,' and 'C,' each of which may produce lethal necrosis, has led to the belief that lethal top-necrosis to each of these viruses is related. The complexities found in genetical expressions may be simplified, therefore, by a study of the reactions of all four viruses on identical material. The discovery of uncontaminated strains of virus 'B' and virus 'C' during the year has enabled this work to be started. The reactions of eighteen varieties to all

four viruses have already been ascertained. In addition, the reaction of fifteen varieties to three viruses, of 142 varieties to two viruses, and of eleven varieties to one virus are now known. The analysis of progenies according to the reactions of the parents to the four necrotic viruses is not possible until this work on the named varieties has been carried further. Varieties and seedlings are at present under test.

An analysis of growing crops (1) has shown that virus ' Y,' of prime importance in England, is relatively rare in Scotland, and is of localised occurrence, mainly in the South-Western areas. Leaf-roll, on the other hand, is a significant disease in Eastern Scotland, and is at present to a minor, though not negligible, extent amongst crops in South-Western and Midland areas. The analyses show also that although certain varieties appear to be more susceptible than others to one or both viruses, none of the varieties widely grown shows any special powers of resistance.

Investigation as to the possibility of the existence of genetic immunity to these two viruses has been continued through the medium of field trials of selected progenies under conditions of natural infection. 4571 seedlings were included in these trials during 1938.

A survey of the aphis populations on potato crops at Craigs House has been conducted at weekly intervals throughout the season. Maximal infestations were found on 20th July and on 30th September. In previous years the earlier maximum has occurred slightly later in the season, and the late maximum has never received full expression.

The results of a large-scale trial to determine the effect of spraying upon insect populations and the spread of insect-borne viruses became available when fifteen plots of 360 tubers each were examined for virus content during the current year. Spraying appeared to have a temporary effect only on the size of aphis populations, and transmission of leaf-roll was unaffected. There was, however, an apparent check in the spread of virus ' Y.'

Experimental work in the greenhouse has been directed towards the development of a reliable system for the identification of viruses in virus complexes and also towards an improvement in the technique for determining reactions of seedlings to viruses ' X ' and ' A.' In this latter work the use of cuttings in place of whole plants has received greatest attention, and

a technique of considerable promise has been developed through the use of synthetic hormones to stimulate rooting.

A comprehensive trial of certain potato varieties and solanaceous plants for the positive identification of potato viruses has proved very satisfactory. Forty-six named varieties containing various complexes of virus 'A,' 'B,' 'C,' 'F,' 'G,' 'X,' and 'Y' have been examined. It is of interest to note that in one variety virus 'C' was found alone and in another variety virus 'B' alone. These two viruses have previously been recorded only in combination with other viruses.

At the request of the Edinburgh and East of Scotland College of Agriculture a number of tubers of named varieties have been examined for virus content.

The Ainville Sub-Station has been reserved for the maintenance of breeding stocks and for the raising of new seedlings. 1237 seedlings were raised during the year, of which 1007 seedlings in ten progenies were derived from parent varieties lethally necrotic to virus 'X.' Further breeding was directed mainly to an extension of material containing factors for lethal necrosis to virus 'X.' Seed has been obtained from twenty-one hybridisations, from one selfed plant amongst named varieties, and from twenty-five tested F_1 plants.

II. Publications, Lectures and Official Visits by Staff, for the Year ended 31st March 1939. Publications (P) and Lectures (L).

Director of Research :—

"Production of Oat Varieties." Galashiels Agricultural Discussion Society, 10th November 1938. (L)

J. W. Gregor, Ph.D., F.L.S. :—

"Reflections Concerning New Crop Varieties." Herbage Reviews, Vol. 6, No. 4, 1938. (P)

V. M'M. Davey, B.Sc., Ph.D. :—

"Hybridisation in *Brassicae* and the occasional contamination of Seed Stocks." The Association of Applied Biologists, 17th March 1939. (L)

George Cockerham, B.Sc., Ph.D. :—

"The Distribution and Significance of Certain Potato Viruses in Scotland." Scottish Journal of Agriculture, Vol. XXII., No. 1, January 1939. (P)

Visits.

William Black, B.Sc., Ph.D. :—

Potato Trial-Plots (Mr Donald Mackelvie's), Lamlash, Arran.

V. M'M. Davey, B.Sc., Ph.D. :—

Auchincruive Experimental Farm, Auchincruive, Ayrshire.

George Cockerham, B.Sc., Ph.D. :—

Potato Virus Research Station, Cambridge. (Annual Conference of Virus Diseases of Plants Committee and Workers.)

III. Demonstrations.

On various occasions during the year visitors were conducted round the experimental plots, and various aspects of the work were described by members of the staff.

IV. Acknowledgments.

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

Bėčius, K., B.Sc., State Plant-Breeding Station, Dotnuva, Lithuania.
Bell, David, J.P., 15 Coburg Street, Leith.
Burr, Wm. (The Banff and Moray Agricultural Co. Ltd.), 100 High Street, Elgin.
Cruickshank, James, Roselea House, Cruden Bay.
Department of Agriculture for Scotland, per T. Anderson, C. E. Foister, T. P. M'Intosh, and R. J. Scott.
Findlay, W. M., Agriculture Department, Marischal College, Aberdeen.

Gartons, Ltd., Warrington.
Lauder, A., Winnipeg, Canada.
Mackelvie, Donald, Lamlash, Arran.
Morgan, George G., Ellisland, Hillview Terrace, Corstorphine, Edinburgh.
National Institute of Agricultural Botany, Cambridge.
Nelson, Dr Alexander, Royal Botanic Garden, Edinburgh.
M'Rostie, Professor G. P., Ontario Agricultural College, Guelph, Ontario, Canada.
Paterson, Principal William G. R., West of Scotland Agricultural College, Glasgow.
Riede, Professor Wm., Botanical Institute, Agricultural College, Bonn, Germany.
Scottish Agricultural Industries, Ltd., Leith.
Temperley, W. A., & Co. Ltd., Newcastle-upon-Tyne.
Wenholz, H., Department of Agriculture, Sydney, New South Wales, Australia.

From June until the end of September 1938 valuable assistance was given by Mr K. Bėčius, B.Sc.(Agric.), of the Lithuanian Plant-Breeding Station, Dotnuva, who attended the Station as a voluntary worker.

Thanks are also due to members of the staffs of the three Scottish Agricultural Colleges who arranged and supervised the trials of certain of the Society's new varieties of oats and grasses.

WILLIAM ROBB,
Director of Research.

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