

SCOTTISH SOCIETY FOR RESEARCH
IN PLANT-BREEDING

REPORT

BY THE

DIRECTORS

TO THE

ANNUAL GENERAL MEETING

19th July 1945



1945

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-fourth Annual Report to members of the Society.

It is generally anticipated that it will be necessary for this country to make as full a contribution as possible to its own food requirements in the years immediately ahead. It is not yet clear what amount of emphasis will be placed on each of the various crop plants generally grown in Scotland, but undoubtedly there will be scope for the further improvement of most, if not all of them, particularly as regards resistance to or freedom from disease, nutritive quality, and greater adaptability to specific sets of soil and climatic conditions.

The requirements of agricultural research in this country are being examined by the Government, and an official pronouncement on the decisions reached will doubtless be made in due course. There is every reason to expect that plant-breeding will require to be continued and extended if efficiency in crop production is to be maintained and increased. Further attention is therefore being given by the Directors of the Society to devising an appropriate scheme for the extension of the Society's activities and thus accelerating progress. Proposals to conduct plant-breeding on a more extensive scale than heretofore are being reviewed, and programmes of work involved have raised the question of obtaining more land, buildings, equipment, and staff. A problem to which careful consideration is being given is whether the Plant-

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Dunfermline
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Breeding Station should be transferred to another site or whether sufficient land to meet future requirements could be obtained in the vicinity of the present Station, which is conveniently situated to the Seed-Testing and Plant Registration Stations of the Department of Agriculture for Scotland, as well as being within fairly easy reach of Edinburgh University departments and the Edinburgh and East of Scotland College of Agriculture. Before reaching a decision regarding the future location of the Plant-Breeding Station, some guidance from Government sources regarding the development of agricultural research may be available, and this should be helpful.

In anticipation of developments, arrangements have been made to extend the herbage trials, and the use of an area in Wester Ross and another area on an upland site near Balerno, Midlothian, have been obtained.

Staff.

In response to a renewed request from the Department of Agriculture for Scotland, two members of the Society's staff, Dr William Black and Dr George Cockerham, were granted leave of absence in August to assist as temporary inspectors under the Department's scheme for the inspection of growing crops of potatoes. The undertaking of this field work has provided these members of the staff with useful experience regarding the characteristics of many varieties of potatoes when grown under the usual agricultural conditions.

Financial.

The accounts as audited at 31st March 1945 show that the Society's funds now stand at £47,386, 1s. 10d. as against £47,540, 4s. 8d. at 31st March 1944.

The Society's ordinary income in 1944-45 was £206, 19s. less than that of the previous year. This decrease occurred mainly through a reduction in the amount received from sales.

of produce. There was a slight reduction in the area of commercial crops grown, and weather conditions in 1944 were unfavourable for seed production, the wheat, barley, grass, and broccoli seed crops suffering severely. There was also an appreciable reduction in the return from sugar-beet. The amount of grant received from the Department of Agriculture for Scotland was £4107.

Capital income (*i.e.*, income not taken into account in reckoning the amount of grant provided by the Department of Agriculture for Scotland) for the year amounted to £204, 15s., which sum included £100 of Life Membership subscriptions.

The total ordinary expenditure amounted to £6885, 3s., this being £88, 13s. 4d. above that of the previous year. The chief increases were for salaries, statutory wage increments, and travelling expenses. No capital expenditure was incurred during the year.

On the assets side of the balance-sheet, items I. to VI. represent fixed assets which are valued on the basis of cost, subject to allowance for depreciation each year, and they amount to a total of £11,285, 9s. 5d. Item VII., amounting to £242, 8s., represents floating assets reckoned at current market valuation. It will be noted that the Society's liquid assets (items VIII. to XI. inclusive) are substantial, amounting to £36,226, 12s. 7d., the investments in item X. being valued at cost price. The market value of these investments at 31st March 1945 showed an appreciation of £14,986, 16s. 6d. on the cost price.

" Dr Wilson " Memorial Fund.

This fund now amounts to £371, 8s. 8d. No payments were made from the fund during the year.

Membership.

The Directors regret to report that in the past year thirteen members died, four members resigned, and the name of one

member in arrear with his subscriptions was deleted from the roll. They are pleased to record, however, that twenty-five new members were elected during the year; five of these became life members. At 31st March the membership numbered 334, and consisted of 146 life members and 188 annual members (20 at the 5s. rate and 168 at the 10s. rate of subscription). A list of members appears on pages 32 to 41 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 Directors have decided that members on Military Service shall be allowed the privileges of membership without payment of subscription for the duration of hostilities, on the understanding that they resume payment after the war.

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 CADZOW, Duncrahill, Pencaitland.
 W. J. CAMPBELL, 61 Fountainhall Road, Edinburgh.
 ROBERT HOWIE, Grange, Kirkcaldy.
 ROBERT MILLER, Ferrygate, North Berwick.
 ROBERT L. SCARLETT, O.B.E., Sweethope, Musselburgh.
 WILLIAM J. WRIGHT, Heugh, North Berwick.

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

Major R. F. BREBNER, C.B.E., The Leuchold, Dalmeny House, Edinburgh.
 ROBERT N. HOGG, Oxenfoord Mains, Dalkeith.
 THOMAS HOGG, 21 Hope Street, Glasgow.
 GEORGE G. MERCER, C.B.E., Southfield, Dalkeith.
 JAMES B. MILLER, Dolphingstone, Tranent.
 Sir JAMES DENBY ROBERTS, Bt., Strathallan Castle, Auchterarder.

JOHN STIRTON,

Secretary.

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

<i>Oats</i> —		Date of Registration.
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.

Potaloes—

The Alness	} Registered by the Department of Agriculture for Scotland as new varieties.	1934
Craigs Defiance		1939

Grasses—

"Scotia" Cocksfoot, Ref. No. *Cc* 196.

Timothy, Ref. No. *Cb* 224.

Perennial Ryegrass, Ref. No. *Ca* 448.

SEEDS FOR DISPOSAL.

It is expected that limited quantities of elite stocks of seed of Early Miller and Bell oats, Scottish Iron III. wheat, Craigs Triumph barley, and several hundredweights of seed of "Scotia" Cocksfoot will be available for disposal early in 1946.

It is suggested that members who wish to obtain any of these seeds should make provisional intimation of their requirements as soon as possible to the Director of Research. It is sometimes impracticable to circularise all members of the Society regarding seeds for disposal, and it is hoped that this suggestion will be noted by interested members.

ABSTRACT OF

For the year ended

INCOME.

Interest Received	£1,050 10 11
Recoverable Income Tax	549 18 4
	£1,600 9 3
Sales—	
Ordinary, including Stocks on Hand	£863 3 11
Extraordinary—	
Cocksfoot Account	£48 6 6
Boghall Multiplication Plot (potatoes)	27 10 0
	75 16 6
Subscriptions—Annual	939 0 5
	79 0 0
<i>Note.</i> —Annual Subscriptions amounting to £5, 15s. are in arrear.	
Donations—Sums under £10	6 1 3
	Total Ordinary Income
	£2,624 10 11
Grant received from Department of Agriculture for Scotland for the year 1944-45	4,107 0 0
Capital Income—	
Life Membership Subscriptions	£100 0 0
Donation, over £10	35 0 0
Interest on Donations and Life Membership Subscriptions (£2324, 13s. 8d. at 3½ per cent, less Income Tax)	£45 7 0
Recoverable Income Tax	24 8 0
	69 15 0
	204 15 0
	Total Income
	£6,936 5 11
Funds at 1st April 1944	47,540 4 8
	£54,476 10 7

BUILDINGS AND EQUIPMENT

Balance at 1st April 1944	£226 12 8
Interest	2 5 1
	£228 17 9

ACCOUNTS.

31st March 1945.

EXPENDITURE.

Salaries—	
Officers, including Sub-Station	£3,381 4 4
Secretary and Office	356 13 11
	£3,737 18 3
Superannuation Contribution	401 1 0
Labour, including Sub-Station	1,650 7 8
National Insurance	33 18 8
Seeds and Roots	21 16 9
Manures	114 17 1
Working Expenses, including renewals of Implements and Tools	231 11 2
Laboratory Expenses	11 11 5
Library Expenses	31 6 0
Rates and Insurances	66 12 7
Printing, Telephone, Postages, and Office Supplies	132 4 0
Heating, Lighting, and Cleaning	113 6 1
Travelling Expenses	101 16 7
Property Repairs	21 10 5
Regional Trials	78 14 7
Sub-Station Maintenance Expenses	136 10 9
	Total Ordinary Expenditure
	£6,885 3 0
Depreciation on Temporary Buildings, Implements, Tools, &c.	205 5 9
	Total Expenditure
	£7,090 8 9
Funds at 31st March 1945, per Balance-sheet	47,386 1 10
	£54,476 10 7

—FIRE DAMAGE.

Replacements	£4 8 0
Sum on Deposit Receipt at 31st March 1945	224 9 9
	£228 17 9

BALANCE-

As at 31st

LIABILITIES.

I. Accounts Outstanding, due by Society	£359	3	2
II. Subscriptions paid in advance	9	5	0
III. Funds at 31st March 1945	47,386	1	10

£47,754 10 0

DR WILSON MEMORIAL

Value at 31st March 1945—	Funds at 31st March 1945—		
£210 10 0	£200 3½ per cent War Stock	£176	5 0
	Sum in Savings Bank—Deposit Account	195	3 8

£371 8 8

EDINBURGH, 11th May 1945.—The undersigned, having had access to all the Accounts, and verified the same with the Accounts and Vouchers relating thereto, now
16 ALVA STREET.

SHEET.

March 1945.

ASSETS.

I. Houses and Lands, at Cost, less Depreciation	£8,308	7	1
II. Virus Scheme Buildings, &c., at Cost, less Depreciation— Craigs House	£1,791	8	5
Boghall Sub-Station	435	9	10
	2,226	18	3
III. Greenhouses, Hut, Frames, and Equipment at Sub-Station, at Cost, less Depreciation	173	14	3
IV. Implements and Tools, at Cost, less Depreciation	442	12	1
V. Laboratory Apparatus, at Cost, less Depreciation	68	2	9
VI. Office Furniture and Fittings, at Cost, less Depreciation	65	15	0
VII. Stocks on Hand, as valued by Directors	242	8	0
VIII. Accounts Outstanding, due to Society	349	3	11
IX. Income Tax Recoverable	574	6	4
X. Investments, at Cost:—			
Value at 31st March 1945—			
£14,871 0 0	1. £14,130, os. 9d. 3½ per cent War Stock	£12,530	0 0
15,960 0 0	2. £14,000 4 per cent Funding Stock, 1960-90	10,045	0 0
17,871 0 0	3. £16,900 3½ per cent Conversion Stock	11,140	3 6
£48,702 0 0		33,715	3 6
XI. Cash Balances—			
In Bank on Current Account	£342	1	6
On Deposit Receipt	189	10	8
In Savings Bank, Deposit Account	1,054	0	2
On Hand	2	6	6
	1,587	18	10
	£47,754	10	0

FUND ACCOUNT.

Funds at 1st April 1944	£359	16	7
Interest for year		11	12 1
	£371	8	8

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 1945.

Aberdeen	12	Linlithgow	6
Angus	25	Midlothian	55
Argyll	7	Moray	2
Ayr	17	Nairn	—
Banff	2	Orkney	3
Berwick	15	Peebles	2
Bute	1	Perth	24
Caithness	2	Renfrew	5
Clackmannan	—	Ross and Cromarty	10
Dumbarton	4	Roxburgh	8
Dumfries	12	Selkirk	1
East Lothian	26	Stirling	6
Fife	24	Sutherland	2
Inverness	2	Wigtown	6
Kincardine	1	England	12
Kinross	4	Abroad	3
Kirkcudbright	3		—
Lanark	32		
			<u>334</u>

ESTABLISHMENT FOR 1944-45.

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, Irvine House, Canonbie.
ALEXANDER M'CALLUM, O.B.E., M.A., LL.B., 78 Craiglea Drive, Edinr.

Ordinary Directors.

1942.

JAMES CADZOW, Duncrahill, Pencaitland.
W. J. CAMPBELL, 61 Fountainhall Road, Edinburgh.
ROBERT HOWIE, B.Sc., The Grange, Kirkcaldy.
ROBERT MILLER, Ferrygate, North Berwick.
ROBERT L. SCARLETT, O.B.E., Sweethope, Musselburgh.
WILLIAM J. WRIGHT, The Heugh, North Berwick.

1943.

A. Y. ALLISON, Turnhouse Farm, Corstorphine.
WILLIAM ALLISON, Almond Hill, Kirkliston.

WILLIAM KAY, 19 South St David Street, Edinburgh.
IAN C. MENZIES, O.B.E., W.S., 22 Rutland Street, Edinburgh.
WILLIAM D. SIMPSON, Highfield, North Berwick.
Professor Sir WILLIAM WRIGHT SMITH, Inverleith House, Edinburgh.

1944.

DAVID BELL, 15 Coburg Street, Leith.
JAMES H. ELDER, B.Sc., Cregganore, North Berwick.
WM. HUGH HAMILTON, W.S., Cairns, Kirknewton.
FRED MILLS (Roughead & Park, Ltd.), Haddington.
JAMES PATON, Kirkness, Glencraig.
ROBERT H. U. STEVENSON, Corseclays, Ballantrae.

Directors Co-opted.

Major R. F. BREBNER, C.B.E., The Leuchold, Dalmeny House, Edinburgh.
THOMAS HOGG, 21 Hope Street, Glasgow.
GEORGE G. MERCER, C.B.E., Southfield, Dalkeith.

Directors nominated by the Department of Agriculture for Scotland.

Sir PATRICK R. LAIRD, C.B.,
J. M. CAIE, C.B., M.A., B.L., B.Sc., } St Andrew's House, Edinburgh.
T. ANDERSON, M.A., B.Sc.,
ALEXANDER M'CALLUM, O.B.E., M.A., LL.B., 78 Craiglea Drive, Edinr.

Chairman of Directors—SIR JOHN H. MILNE HOME, Irvine House, Canonbie.

Vice-Chairman—W. J. CAMPBELL, 61 Fountainhall Road, Edinburgh.

Director of Research—WILLIAM ROBB, N.D.A., F.R.S.E., Craigs House, Corstorphine.

Chief Assistant—JAMES W. GREGOR, Ph.D., D.Sc., F.I.L.S., Craigs House, Corstorphine.

Assistants—V. M'M. DAVEY, B.Sc., Ph.D., Craigs House, Corstorphine, and CHARLES A. LYALL, B.Sc. (on Military Service).

Assistant, Potato-Breeding Sub-Station—WILLIAM BLACK, B.Sc., Ph.D., Boghall.

Assistant, Virus Disease Scheme—GEORGE COCKERHAM, B.Sc., Ph.D., Craigs House, Corstorphine.

Secretary—JOHN STIRTON, 8 Eglinton Crescent, Edinburgh, 12.

ESTABLISHMENT FOR 1944-45

BOARD OF DIRECTORS
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David Bell.

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J. M. Caie.

W. J. Campbell.

James H. Elder.

Wm. Hugh Hamilton.

Thomas Hogg.

Sir John H. Milne Home.

Robert Howie.

William Kay.

Sir Patrick R. Laird.

Alexander M'Callum.

J. F. M'Gill.

Ian C. Menzies.

George G. Mercer.

Robert Miller.

James Paton.

Robert L. Scarlett.

William D. Simpson.

Professor Sir William Wright Smith.

R. H. U. Stevenson.

William J. Wright.

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David Bell.

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James Cadzow.

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Thomas Hogg.

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William Kay.

Alexander M'Callum.

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George G. Mercer.

Robert Miller.

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James Paton.

William D. Simpson.

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Sir John H. Milne Home.

Sir Patrick R. Laird.

Ian C. Menzies.

George G. Mercer.

Fred Mills.

Robert L. Scarlett.

Professor Sir William Wright Smith.

R. H. U. Stevenson.

William J. Wright.



FIG. 1.

A stiff-strawed selection of Oats.



FIG. 2.

The lethal streak diseases caused by virus Y on hypersensitive seedlings of *Solanum simplicifolium* (infected by graft).

Left, early stage of disease.

Right, later stage, plant killed.



FIG. 3.

Ryegrass Trials—Grassland Experimental Centre at Dalmahoy, Midlothian, May 1945. Late varieties in the foreground. The early varieties (where cattle are lying) are in ear.



FIG. 4.

General view of the proposed site (middle foreground) of the Dundonnell Grassland Experimental Centre, Wester Ross.

R E P O R T

BY

DIRECTOR OF RESEARCH

I. Research Programme.

GRAIN CROPS.

WILLIAM ROBB, *Director of Research.*

CHARLES A. LYALL, B.Sc., *Assistant.* (At present on Military Service.)

Oats.

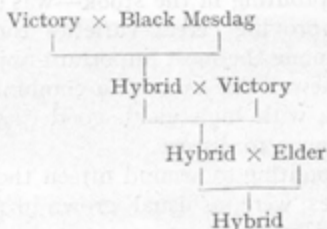
The adverse weather conditions in the late summer and the early autumn of 1944 severely tested certain capacities of cereal varieties and accentuated some of their deficiencies. In various districts of Scotland the important qualities in cereals generally—of early maturity, resistance to lodging, and resistance of the grain to sprouting in the stook—was emphasised. In the work of improving cereal varieties the characteristics referred to are among the most important objectives which are being kept in view. The aim is to combine these qualities as far as possible with high yield, good quality of grain and straw, and resistance to disease.

Unfixed hybrid oats, amounting to around fifteen thousand, representing about 500 lines, were, as usual, grown in rows as spaced plants and protected by netting to prevent damage by birds. The plants made good growth throughout the season, and the environmental conditions were helpful in differentiating those plants genetically different as regards length of straw and period of maturity. Many individual plants have been selected for further breeding, and a few groups in which the component plants showed signs of uniformity were earmarked for multiplication and field trial.

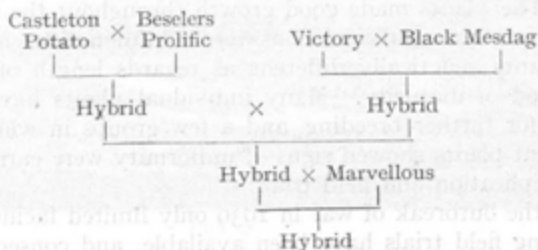
Since the outbreak of war in 1939 only limited facilities for conducting field trials have been available, and consequently

there is a considerable number of fixed hybrid oat selections awaiting trial on a field scale. There are prospects now, however, of more opportunities becoming available in the near future, and the stocks of new selections are therefore being increased in quantity with a view to having, as soon as possible, the necessary amounts of seed required for the trials in different regions. For initial replicated trial plots it is estimated that about 20 bushels of seed of each new variety will be required, and to obtain this quantity of seed each multiplication plot will require to be at least a quarter of an acre. During the first four war years only relatively small quantities of the fixed selections were grown and maintained, but in 1944 as many of them as possible were increased in quantity, and further increases are being made in 1945. Among the hybrids which have shown some promise, particularly as regards resistance to lodging (see Fig. 1), there are selections from the following crosses:—

1. Progress × Elder.
2. Elder × Early Miller.
3. Elder × Semi-Dwarf.
4. Elder × Marvellous.
5. Early Miller × Progress.
6. Early Miller × Semi Dwarf.
- 7.

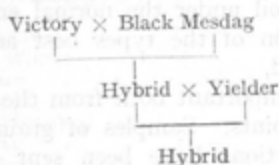


8.



Some of the promising early-maturing hybrids have been derived from—

9. Marvellous × Orion.
10. Orion × Yielder.
11. Castleton Potato × Yielder.
12. Elder × Mulga
13. Victory × Bathurst.
14. Potato × Wilga.
- 15.



Regional Trials.—Ten hybrid oat selections raised by the Society were included in field trials at Craibstone Experimental Farm, Aberdeen, in 1944, and useful reports regarding their "standing power" and time of maturity have been received from the Superintendent of Experiments, Mr W. M. Findlay. The varieties in the trials there have been graded into five groups as regards resistance to lodging, ranging from Group I., in which there was no lodging, to Group V., in which the crop was laid flat. Six of the Society's varieties were placed in Group I., two in Group III., and one in each of Groups IV. and V. As regards period of maturity, two varieties have been placed in the "very early-ripening" group, three in the "early-ripening" group, two in the "medium early" group, one in the "late" group, and two in the "very late" group. The Craibstone trials are being continued in 1945, and they will contain most of the Society's varieties which were included in 1944.

Arrangements were made early in 1945 with the National Institute of Agricultural Botany to have four of the Society's new oat selections included in some of the Institute's observation trials in various parts of England this season. If sufficient seed (10 bushels of each variety) had been available, it would have been possible to have had them more extensively and thoroughly tested this year in the Institute's larger replicated trials. It is hoped that there will be sufficient grain available for the larger-scale trials in 1946.

With a view to obtaining a better oat than the bristle-pointed oat (*Avena strigosa*) for alkaline soils such as occur in various areas on the west coast of Scotland, Mr A. G. Malcolm, County Organiser for Argyll, Oban, has kindly agreed to co-operate by arranging to have a small-scale trial of two unfixed mass selections of oats laid down on alkaline soil in Tiree this year, if possible. These oats were derived from crossing the oat named Quality (*A. sativa*) with another oat species (*A. byzantina*). It is hoped that, by growing the unfixed material on alkaline soil under the normal environmental conditions, the selection of the types best adapted to alkaline soil will be facilitated.

The quality of oat grain is important both from the nutritional and the milling standpoints. Samples of grain from several fixed hybrid oat selections have been sent to Dr Godden, Rowett Research Institute, Aberdeen, who has kindly agreed to examine them for protein and vitamin B₁ contents. Eighteen samples of seed from fixed hybrids have been submitted to a few oatmeal millers for the purpose of obtaining their advice as to the best types of grain for milling, and they have kindly indicated the types which they prefer. Important characteristics affecting the milling quality of the grain are the percentage of kernel and the proportion of small bosom grains. The percentage of kernel should be high and the proportion of small grains low.

In order to compare varieties on the basis of the proportion of kernel to husk, representative samples of oat grains, consisting of twenty-three named varieties and twenty-five hybrid varieties from the 1944 crop, were husked and the percentage kernel estimated. Acknowledgment is made of help received in this work from Dr Davey, who undertook all the weighings and made the subsequent calculations. The undernoted data have been selected to indicate the range in variation of 1000 grain weights and of the percentage kernel. The varieties are arranged in descending order of 1000 grain weight in Table I.

A few acres of Early Miller and Bell oats and Craigs Triumph barley were grown at the Plant-Breeding Station in 1944, and the bulk of the grain was sold for seed.

Over thirty named varieties of oats were grown in small plots to maintain a collection for reference purposes.

TABLE I.

Name or Reference No. of Variety.	Weight in Grammes of 1000 Grains. (Full-size Grains).	Percentage Kernel.
445(1)B(2)A(1)A	56.4	68.4
445(1)B(3)F(1)	55.7	73.0
453(10)A(1)	53.5	69.2
Record	52.7	70.4
441(a)(11)D(1)A	51.4	75.5
Yielder	51.0	66.2
495(6)C(1)A	48.1	73.6
Grey Winter	47.7	75.7
Onward	46.9	66.5
Victory	45.4	72.8
404(2)B(1)A(3)	45.3	74.6
Quality	41.1	75.5
Potato	34.0	75.5
Sandy	28.2	77.8
Small Welsh Oat	22.3	75.7

Wheat, Barley, and Rye.

Small collections of varieties of these crop plants were grown for observation and demonstration. Seeds from three lots of winter rye received from Craibstone Experimental Farm were sown at intervals of fourteen days from 10th February to 26th May in order to observe whether any wide differences in ear production occurred as a result of sowing at different times. The observations were made in compliance with a request from the Field Trials Committee of the Department of Agriculture for Scotland. From the sowings made in February the plants ripened fairly well, but from the sowings made after February the plants did not ripen and the plants in the latest sowings were still quite green about the middle of September. Only the two latest sowings of one variety showed a marked reduction in the number of ears produced; some of the plants in these lots bore no ears, while others produced a few ears very late in the season.

Beans.

Two early-ripening varieties of beans originally single-plant selections from a Russian variety and a selection from the

Scots Tick bean were included in a field trial at Auchincruive Experimental Farm, Ayrshire, in 1944. It is believed that an earlier-ripening type of field bean would be an advantage in that area. The Russian selections are reckoned to ripen about a fortnight earlier at Corstorphine than the ordinary field beans, and the trials at Auchincruive confirmed their earlier-ripening character. The other varieties in the trial ripened from nine to eighteen days later than the two Russian selections from the Plant-Breeding Station. Further trials are being made at Auchincruive in 1945. These selections, however, are not breeding as true to type as desired. Mass selection has not been effective in attaining a high degree of cultural purity, and efforts are being made to obtain pure stocks by selfing under bags.

POTATOES.

(Breeding—Boghall Sub-Station.)

WILLIAM BLACK, B.Sc., Ph.D.

In the potato-breeding work the experiments are designed with a view to producing new varieties incorporating, as far as possible, a high degree of resistance to blight, field immunity from viruses A, X, and Y, and resistance to leaf-roll, together with the various commercial and culinary qualities which are essential in any new introduction.

During 1944 about 6000 new seedlings were raised and examined for their reaction to blight. About half of them survived the test, and these were planted out and grown to maturity. The technique for eliminating blight-susceptible seedlings has been developed to form a simple routine test, and much larger numbers could readily be examined if more glass-house accommodation were available. The breeding of blight-resistant varieties is rendered more difficult by the appearance of different and more virulent strains of the fungus. Three different strains designated A, B, and C have been cultured and used for testing purposes, but on account of the difficulties of isolation it is impracticable to carry out extensive experiments with all three concurrently. Routine testing was therefore confined to the A strain, while the others

were employed at different times for a limited number of special tests.

The results of the tests have shown that the strains are specialised forms. This is apparent in the classification of blight-resistant plants, which fall into three groups, viz. :—

- (1) Immune from strains A and B, but susceptible to strain C.
- (2) Immune from strains A and C, but susceptible to strain B.
- (3) Immune from strains A, B, and C.

Group (3) has obviously greater potentialities than the others, and it is found to be most prominent in the material derived from the triple hybrid (*S. Rybinii* × *S. demissum*) × *S. tuberosum*. Many promising selections have been made from derivatives of this material, but they have not yet reached the stage for multiplication.

Tests for reactions to the more important viruses were confined to plants selected for breeding purposes and to older seedlings which showed prospects of attaining commercial standard. These tests were carried out by Dr Cockerham. Several selections which proved to be immune from all three strains of blight were also field immune from viruses A and X.

None of the commercial varieties is field immune from virus Y, but this character of immunity is a feature of certain wild species indigenous to Central and South America. Hybridisations of some of these types have been effected, and experiments are in progress to facilitate the utilisation of this valuable character.

Although breeding is largely centred on the character for blight resistance, a few progenies bred from cultivated varieties only are usually raised each year. Among the promising selections in this group is a seedling derived from *Craigs Defiance* × *Gladstone*, which has given high yields of attractive tubers, and has compared very favourably with standard varieties. It is field immune from viruses A and X.

The investigations concerning the economic potentialities of the collection of Mexican and South American potatoes and the mode of inheritance of certain characters have been continued. Progress in the utilisation of certain wild species in breeding experiments has been adversely affected by the

presence of self- and cross-incompatibility. The artificial alteration of the chromosome number appears to offer a solution to the problem in some cases, and grateful acknowledgment is made to the John Innes Horticultural Institution, London, for help and co-operation in this work.

Selections of seedlings raised in previous years were grown in trial and multiplication plots at Boghall and Craigs House in 1944. Several of them were also included in the trials held at the Midland Agricultural College, Loughborough. In addition, samples were sent for trial purposes to the Department of Agriculture for Scotland, East Craigs, Edinburgh; Craibstone Experimental Farm, Aberdeen; Auchincruive Experimental Farm, Ayrshire; and the Harper Adams Agricultural College, Newport, Shropshire. Among this material were selections possessing blight resistance, together with field immunity from viruses A and X. Favourable reports regarding them were received.

Three seedlings belonging to group (2) in the classification of blight-resistant types were included in the Lord Derby Gold Medal Trials. Although they did not receive an award they compared favourably in yield with standard commercial varieties, and were characterised by a very small proportion of waste tubers.

Trials of seedlings will again be carried out at all the above centres in 1945.

Through the kind offices of Mr W. J. Campbell, Fountainhall Road, Edinburgh, arrangements were made to grow 1 cwt. samples of seedling 653a(99) in six different localities in England and two in Scotland. Reports of the trials showed that the results were very variable, and most growers emphasised the inconclusive nature of the test owing to the abnormal weather conditions which prevailed. The variety proved to be highly resistant to blight, and one grower found that it yielded $2\frac{1}{2}$ tons per acre more than King Edward. This seedling appears to be rather late in maturing, however, and its tubers tend to grow large and hollow under wet conditions in autumn. For these reasons, multiplication of this variety has been discontinued.

Certain types of seedlings, although they may not be suitable for general cultivation in this country, may be adapted to particular environmental conditions abroad. Accordingly co-operation in the search for such types has been extended

to South Africa, Kenya, and Australia, and small samples of seedlings have been forwarded for trial. The preliminary reports regarding their prospects were favourable, and it is intended to forward further consignments as they become available.

Virus Diseases—Craigs House.

GEORGE COCKERHAM, B.Sc., Ph.D.

In the continued search for characters of resistance value most of the wild and native cultivated forms of Mexican and South American potatoes in the possession of the Station have now been examined in a preliminary manner for their reactions to each of six common potato viruses. Practically all of them have been successfully infected by graft inoculation, but there still remain a few forms which have withstood repeated attempts to infect them with one or more of these viruses. Intensive tests to ascertain the nature of the apparent resistance of these latter forms are now in progress. In a number of cases infection has been brought about by graft inoculation, but not by alternative methods of introducing the virus, such as sap inoculation or through the feeding of infective aphides. The majority of these cases relate to forms which have proved to be hypersensitive to, and hence field immune from, one or more of the viruses X, B, A, and C. In addition, a clone of the diploid species *Solanum simplicifolium*, two clones of the pentaploid species *S. Salamani*, and two clones of the hexaploid species *S. demissum* have shown every reaction characteristic of hypersensitiveness to virus Y, and they may, therefore, be field immune from this virus (see Fig. 2). There is also indication that some forms which are susceptible on graft inoculation are so distasteful to aphides that they may escape infection with aphis-borne viruses on that account. These various possibilities which have come to light in the preliminary survey are receiving the closest attention, and material for their further examination was raised during the year.

In co-operation with the commercial breeding activities a number of advanced seedlings of potential economic or breeding value were examined for their reactions to individual

viruses. Many of these seedlings are resistant to blight and are also field immune from viruses X and A. To this combination attempts are being made to add resistance to leaf-roll. With this object in view a breeding programme designed to extend the range of suitable parental material, so as to avoid close inbreeding in future, was followed with moderate success in spite of a not very favourable season.

Genetical investigations into the mode of inheritance of field immunity and leaf-roll resistance were continued, special attention being paid to the elucidation of points of detail in inheritance and to the relationships of the genetic factors concerned.

Additional investigations included the further examination of the nature and relationships of certain viruses found in the collection of South American and Mexican material, a field trial to furnish information on the extent and means of spread of virus X, and the collection of data on aphid populations in their relation to the spread of leaf-roll and virus Y.

HERBAGE PLANTS.

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

Re-seeding Investigations.—The marked influence of management on the mixed composition of grassland is well known, and one of the primary aims of current plant-breeding research is to produce specialised varieties of herbage plants which will suit different systems of management and produce the maximum amount of animal food at the proper time. As far as re-seeding is concerned there is still a tendency to envisage a standardised type of pasture which, if it is to be maintained in a productive state, must be managed in a certain manner. In other words, there is a tendency to subordinate the needs of the stock to the needs of the pasture rather than attempting to create specialised pastures to suit different systems of management.

As mentioned in a previous Report, a grassland experimental area was acquired at Dalmahoy, eight miles from Edinburgh (see Fig. 3). The trial plots there were sown on 3rd June 1943. In the previous autumn soil samples were taken from three portions of the experimental area which were subsequently

to receive different grazing treatments. The results of the analyses carried out by the East of Scotland College of Agriculture showed that all three areas were equally deficient in lime, phosphates, and potash. In the spring of this year the same three areas were again sampled with the following results: (1) the lime requirements had by now been satisfied; (2) the available phosphate content had actually been slightly reduced from the index value of 8 (low) to just a trace in Area I (which was hayed and not grazed in 1944), and to a value of 4 (very low) in the other two areas. The potash indices had not changed appreciably and were still very low. During the interval between the two samplings the following manures had been applied per acre: 1943—an initial dressing of 5 cwt. of a special manure (analysing 7 per cent N, 7 per cent sol. and 1 per cent insol. phosphoric acid, and 9 per cent potash), followed in the autumn by 2 cwt. supers and 42 lb. muriate of potash; 1944—a spring dressing of 3 cwt. supers, 42 lb. muriate of potash, and 1 cwt. sulphate of ammonia. The design of the trial area involved its use as the complement of a larger area of poor *Festuca-Nardus* rough grazing. This complementary use of cultivated and rough grazing is of interest as an example of the economic utilisation of a rough grazing which by itself supplies a very inferior diet. But such treatment implies the removal of fertility from the cultivated area to the rough grazing—hence the results of the soil analyses. It should, however, be noted that the amounts of manure applied were sufficient to maintain the pasture in a high state of production, though not enough to alter the basic level of the land fertility.

Against this general background the trials of ryegrass varieties are being conducted. The single species mixture (such as ryegrass, wild white clover mixtures) is often considered to be an unsuitable diet for grazing animals on account of its lack of plant variety. But in the present case where a rough grazing is being used to supplement the cultivated grass this objection no longer holds good. In theory the single species mixture ought to have certain practical advantages over the complex one, since by eliminating the possibilities of interspecific competition management should be simplified. Moreover, it has recently been suggested by two American workers that when certain species are sown in pure culture they are capable of giving higher yields than when grown as

a mixture. The lowering of the individual yields in the mixture is attributed to harmful root interaction—a matter of considerable practical significance. It may well be that with the introduction of specialised varieties within species and the adoption of new grassland techniques, the competition relationships of grassland components, and consequently the composition of the seeds mixtures used, will need to be re-examined.

The trials at Dalmahoy emphasise that conclusions drawn in respect of varietal performance from trials conducted in one environment may not be applicable to other environments. For instance, when Ayrshire Perennial Ryegrass and a late variety *Ca 434* are grown at Corstorphine, a productive difference of about 30 per cent is obtained in favour of Ayrshire at the time of the spring production peak. (The grass in all plots was cut dry and immediately weighed.) On the other hand, the mid-April production of Ayrshire at Dalmahoy only exceeded that of *Ca 434* by approximately 6 per cent, while *Ca 434* exceeded the Ayrshire yields by approximately 13 per cent by mid-August. The difference in relative production between these two varieties at Corstorphine and Dalmahoy is due to the Ayrshire starting active growth considerably later in the latter district. From a knowledge of the individual production cycles of distinct varieties of ryegrass it would seem reasonable to expect a levelling out of seasonal production by combining in a mixture varieties with distinctive cycles. The results indicate that under grazing conditions the levelling process is not carried to the lengths expected. Notwithstanding this somewhat disappointing result a mixture of early, mid-season, and late varieties out-yielded a pure culture of Ayrshire by 9 per cent. It is, however, possible to alter production to suit specific purposes by the choice of varieties. For example, as compared with a mixture of Ayrshire and *Ca 434*, a mixture of an early variety (raised from Cornish material supplied by Mr F. R. Horne of the National Institute of Agricultural Botany) and the same late variety as before showed an 8 per cent increase in mid-April, and a mid-August decrease of $7\frac{1}{2}$ per cent. These differences in yield are undoubtedly small by comparison with the yield increases obtained by differential manurial treatment, but after the manurial requirements of a crop have been satisfied the differences in varietal performance

still remain, and their contribution, if the objective is the highest possible returns from grassland, is by no means negligible.

Mr R. Rennie, Whelpside, Balerno, kindly offered the Society two acres of rough grazing on his farm for use as a herbage trial centre. His offer has been gladly accepted, and a series of grazing nurse crop trials are being laid down this year.

Arrangements are being made to establish a trial centre in 1946 in the north-west of Scotland at Dundonnell, Wester Ross (see Fig. 4), where conditions are markedly different from those obtaining at either Dalmahoy or Whelpside. Colonel Sir Michael Peto, Bart., has kindly granted facilities on Dundonnell Home Farm. The provision of winter as well as summer keep will be the main problem to be studied at this centre.

Multiplication of Stocks.—15 acres of Scotia Cocksfoot (*Cc 196*) were seeded for the Society in Essex by the Essex Seed Growers' Association, and 2 acres of Timothy, *Cb 224*, were seeded in Stirlingshire. 26 cwt. of Scotia Cocksfoot seed and 4 cwt. 3 qrs. of Timothy seed were sold to members of the Society. 5 acres of Perennial Ryegrass, *Ca 434*, have been sown this year in Hants. for seeding under the supervision of the National Institute of Agricultural Botany; and 1½ acres of Missouri Early Beardless Barley, which has given promise as a forage crop, is being multiplied in Midlothian. In addition, three varieties of Perennial Ryegrass and two of Timothy are being multiplied on a small scale at Corstorphine in order to supply seed for trial purposes. During the year two local American races of herbage plants have been received for trial: (1) a broad-leaved race of Birdsfoot Trefoil from New York State (per Dr Johnstone-Wallace, Cornell University), and (2) Kentucky 31 Fescue (per the National Institute of Agricultural Botany, Cambridge).

ROOT CROPS.

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

Swedes and Kales.

The present phase of the investigations with swedes is a process of eliminating the less valuable strains and of assessing

those which have shown promise. The work of testing and breeding for resistance to finger-and-toe disease is being advanced to a more prominent position in the programme.

Propagation.—Self-fertilisation of single plants in pollen-proof bags still forms the most convenient method of propagating the numerous lines, but a start has been made to increase the number of outlying isolation plots where strains of thirty or forty plants can be seeded without risk of cross-pollination from other sources.

Swede Pedigree Breeding.—The area of the trials was again limited. Groups of lines, bred from the more promising strains of 1942, were examined and compared, and the best lines were chosen for the propagation of the strains. The strain ABJ, which has a turnip ancestor, is to receive consideration as a possible economic variety.

Kales, &c.—A few strains of kale were propagated and others observed in plots. A cross between Broccoli and Thousand-headed kale attracted attention as a heavy-yielding, leafy type.

1944-45 Swede Trial.—This was an attempt, on a small scale, to devise a trial suitable for the testing of winter hardiness. The losses sustained by six strains during their growing season were noted, and the yield and health were determined on part of each plot in December. Some of the findings may be of interest. As the turnip "flea" beetle caused no trouble, singling left fairly regular stands. Taking ten inches as the normal interval left by the singler, the strain with most plants lacked 2 per cent, and that with least only $7\frac{1}{2}$ per cent of a full stand. If anything more than accident caused this difference it would be the condition of the seed. Heavier losses occurred during the forty days after singling, when deaths occurred which may sometimes have been due to damage by the hoe, but were mainly caused by cabbage root-fly. These deaths varied from $7\frac{1}{2}$ to 13 per cent. There were fewer deaths between July and December, amounting to 3 to 8 per cent. Soft-rot was then the apparent cause, though other diseases may have contributed. Finally, in the small plots left growing till February, the severe frosts killed or seriously damaged many plants.

State of the Trial in December.—There were then 72 to 89 per cent of plants surviving in the strains. The proportions affected by finger-and-toe disease ranged from 20 to 46 per

cent, and this probably indicated degrees of resistance. Maggot damage (*Phorbia floralis*) affected 10 per cent except in one strain with large, broad bulbs which showed 15, and another with exceptionally small roots which had only 5 per cent, suggesting that the larger bulbs are more susceptible to attack. Soft-rot, from which deaths had already occurred, varied from 0 to 10 per cent, being worst in the "early" types and almost absent in the harder strains. On the other hand, there were 1 to 12 per cent of plants where decay had started in cracks and hollows, and this was worst in the hard types and those strains noted as liable to split.

State of the Trial in February.—20 and 29 per cent respectively of plants of the two "hard" strains and 58 and 68 per cent respectively of plants of the two "early" type strains had completely rotted by this time. The other two strains were maincrops, and the proportions of rotted bulbs were intermediate between those of the other two groups. In each of the six strains partly rotted to nearly sound bulbs occurred in similar proportions. Since finger-and-toe and maggot had damaged the bottoms earlier, it was to be expected that many of these damaged parts would be in a decayed condition. The leaves and necks all showed frost damage and were sometimes decayed.

Results of the Trial.—Hybrid strain ADC, a somewhat late type, had a disappointing yield in December, but was outstanding as a keeper. Hybrid strain AFR, a bronze-top of Victory type, was the heaviest yielder, but succumbed to the frosts; it was also susceptible to soft-rot. Hybrid strain AFS was intermediate in both yield and resistance; it was worst affected by finger-and-toe, and also susceptible to splitting. A line, CHi, bred from Champion, had a low yield partly compensated by high dry-matter percentage, and came second for frost resistance. A line MGc, bred from Magnificent, gave a typical early-type performance, but another new line, MFg, proved a failure, the yield being too low.

Broccoli.

Variety Trials.—The 1943-44 trial was concluded after the Annual Report for 1944 went to Press. This trial was designed to test different strains of named varieties, and especially

to compare the characteristics of intra-varietal strains harvested in different localities, seeded respectively in Lancashire and Essex. Pairs of samples were obtained for *St George*, *May Blossom*, *Royal Oak*, and *Midsummer*. The most noticeable difference found in these pairs was a tendency for the Essex-grown seed to produce earlier-maturing plants. Thus the average dates of flowering were as follows: *St George*—Essex 16th April, Lancs. 19th; *May Blossom*—Essex 20th April, Lancs. 25th; *Royal Oak*—Essex 26th April, Lancs. 29th; and the Station strain 9:3, 2nd May; *Midsummer*—Essex and Lancs. both 6th June. Although this tendency did not appear in the very late variety *Midsummer*, a difference of three to five days occurred in the other varieties, suggesting that the effect of sowing in the south may be to encourage the natural selection of early-maturing types. Heavier yields were also obtained from the Essex-grown seed, as may be seen from the average curd weights. *St George*—Essex 8.8 oz., Lancs. 6.8 oz.; *May Blossom*—Essex 7.2 oz., Lancs. 6.7 oz.; *Royal Oak*—Essex 7.4 oz., Lancs. 6.4 oz.; *Midsummer*—Essex, 8.5 oz., Lancs. 8.3 oz. The winter was mild, and little frost damage was sustained by any of these varieties. No difference in winter resistance were observed between the Essex and Lancashire strains. Other varieties grown in the trial included four strains of *Late Queen* from different sources, which showed considerable differences in both winter resistance and yield.

The final results of the 1944-45 trials are not yet available. Mention may be made, however, of a trial of eight varieties which was laid down at the Station and at two centres in Inverness-shire. The winter was exceptionally severe at all three centres. At Corstorphine the plants were well grown, and the frosts damaged the leaves of every plant and killed a considerable proportion. At Meadow Croft, Roy Bridge, the plants were as large as those at Corstorphine, but there was not sufficient snow to protect the hearts during the frosts, and the crop was almost completely destroyed. At Corran Garden, Onich, on the other hand, the plants were protected by deep snow for most of the period of the frosts, and showed rather less damage than those at Corstorphine, but their growth during the previous summer had been poor and they did not yield an economic crop. Since the winter was abnorm-

ally severe, it is not possible to decide whether broccoli could be profitably grown in average seasons. It is of interest to note that the strains which stood the frosts best were *not* those which do best at Edinburgh. Thanks are due to both Mr Murdo Millen, Meadow Croft, and to Mr R. W. Paine, Corran Garden, for their active co-operation in laying out and conducting these locality trials.

The selected line of Royal Oak, derived from plants of this variety which had survived the winter of 1939-40 at Cupar, was again grown as a seed crop on about a quarter of an acre. The crop promised to be an exceptionally heavy one until shortly before harvest, when the pods became severely attacked by the fungus *Alternaria oleracea*, the well-known cause of black-spotting of Brassica leaves. As a result the little seed saved was so contaminated with *Alternaria* spores that it was totally unfit for disposal.

II. Publications and Lectures by Staff for the Year ended 31st March 1945.

Publications (P) and Lectures (L).

W. Black, B.Sc., Ph.D.

"Recent developments in the breeding and cultivation of potatoes." Royal Caledonian Horticultural Society. (L.)

"Wild species and cultivated varieties of potatoes." The Botanical Society of Edinburgh. (L.)

"Inheritance of resistance to blight (*Phytophthora infestans*) in potatoes." Joint Meeting of the Association of applied Biologists and the Genetical Society, London. (L.)

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

"Potato Virus Diseases." The Garden Guild, Leslie. (L.)

"Some Genetical Aspects of Resistance to Potato Viruses." Joint Meeting of the Association of applied Biologists and the Genetical Society, London. (L.)

V. M'M. Davey, B.Sc., Ph.D., and J. W. Gregor, Ph.D.,
D.Sc., F.L.S.

"Effects of Sowing Date on Savoy, Cabbages, and
Broccoli." *Scottish Journal of Agriculture*, Vol. 25,
No. 1, 1944. (P.)

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

"Broccoli." *Royal Caledonian Horticultural Society*. (L.)

"The selective action of environment." *Edinburgh Univer-
sity Biological Society*. (L.)

"Trends in Broccoli." *The Garden Guild, Leslie*. (L.)

"Broccoli trials." *The Garden Guild, Burntisland*. (L.)

III. Visits.

Director of Research :—

John Innes Horticultural Institution, Merton, Surrey.
Welsh Plant-Breeding Station, Aberystwyth.
Craibstone Experimental Farm, Aberdeen.

William Black, B.Sc., Ph.D., and George Cockerham, B.Sc.,
Ph.D.

Imperial Bureau of Plant-Breeding and Genetics, Cambridge.
School of Agriculture, Cambridge.
Plant Virus Research Station, Cambridge.

William Black, B.Sc., Ph.D.

Lord Derby Gold Medal Trials, Hutton Farm Institute,
Preston.

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

Sugar-Beet Demonstration near Cupar, Fife.
Broccoli trials at Meadow Croft, Roy Bridge ; and Corran
Garden, Onich.

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

Imperial Bureau of Plant-Breeding and Genetics ; School
of Agriculture ; and Plant-Breeding Institute, Cambridge.

- Craibstone Experimental Farm, Aberdeen.
 Grassland Experimental Centres of the North of Scotland
 College of Agriculture.
 Broccoli Trials at Roy Bridge and Onich.
 "Scotia" Cocksfoot, Seed Plots, Essex.

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WILLIAM ROBB,

Director of Research.

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