SCOTTISH SOCIETY FOR RESEARCH IN PLANT-BREEDING.

1923.

REPORT.

In presenting the second Annual Report to the Members of the Scottish Society for Research in Plant-Breeding, the Directors are pleased to record that the work of the Society continues to proceed in a satisfactory manner.

Full details of the work at the Research Station at East Craigs, Corstorphine, are given in the Report by the Director of Research, which follows (p. 12).

Financial.

At the end of the second financial year, 31st March 1923, the audited Accounts of the Society show an increase in the funds of over £71.

In addition to the sum of £22,363, received in 1921 from the Agriculture (Scotland) Fund through the Board of Agriculture for Scotland, a further sum of £137 was received from the same source in 1922. These sums, together, amount to £22,500, which is the maximum sum promised by the Secretary for Scotland as an equivalent grant to the sum raised from voluntary sources.

A sum of £765, 8s. 8d. was received from the Development Fund, through the Board of Agriculture for Scotland, towards the maintenance expenditure for the year ending 31st March 1922, being the Society's first financial year. This annual grant, which in no case will exceed £1100 in any one year, is an amount which, when added to the interest derived from

the grant made from the Agriculture (Scotland) Fund in aid of capital, will be equivalent to two-thirds of the maintenance expenditure of the Society during the year.

The Assets realised were £2500 5 per cent National War Bonds, and their realisation resulted in a gain of over £127 on the purchase price. The sum of £2618, 6s. was reinvested in 3½ per cent Conversion Stock.

Ordinary Income and Ordinary Expenditure are both slightly in excess of the respective figures shown in the previous year's Accounts.

Under Capital Expenditure, the main items are for additions to and reconstruction of Office and Laboratory, and for the erection of a galvanised iron shed.

Investments are valued at cost. Values of these at 1st April 1923 show very considerable appreciation since they were purchased in 1921.

Membership.

At the end of the second year, 31st March 1923, there were 172 members of the Society. Of these, 90 were life members, 28 were annual members paying an annual subscription of 10s., and 54 were annual members paying an annual subscription of £1.

Donors of £20 or over (including donations to the Preliminary Fund) are entitled to become life members without further payment. Donors of £10 or over may become life members of the Society by payment of an annual subscrip- of 10s., and others by payment of an annual subscription of £1.

As the work at the Station develops, the ordinary expenditure of the Society will increase. To meet the additional expenditure, it is hoped that the Society, as a national institution, will receive additional support from all interested in Agriculture by an increase in the membership from each of the different counties.

Board of Trustees.

During the year under review, the Right Hon. Robert Munro, K.C., M.P., on vacating the office of Secretary for Scotland, resigned from the office of Trustee of the Society. The Directors, in accepting his resignation, placed on record in the Minutes their cordial congratulations on his accession to the Bench, as Lord Alness, and their regret that this appointment had necessitated his resignation as a Trustee of the Society.

The Right Hon. Viscount Novar of Raith and Novar, the present Secretary for Scotland, has been good enough to agree to accept office as a Trustee.

Directorate.

The Directors regret to record that, during the past year, the Society has lost the services of three members of the Directorate, one through death, and two through resignation. Mr David Ferrie of Parbroath, Cupar-Fife, who had been a member of the Board since the institution of the Society, died in the end of January. He took a deep interest in the affairs of the Society, and his loss is greatly lamented. Sir Archibald Buchan Hepburn of Smeaton, Bart., and Mr Alexander B. Fulton, Glasgow, who had also been Directors since the inception of the Society, found it necessary, in the course of the year, to resign on account of other engagements. The Directors, in accepting their resignations, placed on record in the Minutes expressions of their regret and appreciation of the services which they had rendered to the Society.

Election of Directors.

A list of the eighteen Directors elected at the first General Meeting appears on page 10 of this Report. According to the Rules of the Society, six of these retire at this time, these six to be determined by ballot. As two vacancies have occurred through death and resignation, the Directors considered

that the rule would be implemented by balloting for four others who should retire at this time. This accordingly was done, and the following gentlemen fall to retire at this date:

JAMES W. DRUMMOND, Stirling.
JAMES GARDNER, South Hillington, Cardonald.
W. W. HOPE, Linton Lodge, Prestonkirk.
J. T. M'LAREN, The Leuchold, Dalmeny.

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

Sir ISAAC CONNELL, S.S.C., 18 Duke Street, Edinburgh.
JAMES HISLOP ELDER, B.Sc., Athelstaneford Mains, Drem.
CHARLES E. GREGOR, Innerwick Farm, Innerwick.
THOMAS HOGG (Messrs Alex. Cross & Sons), 19 Hope Street, Glasgow.
WILLIAM J. REID, Fordhouse of Dun, Montrose.
JOHN SPEIR, Newton Farm, Newton, Glasgow.

Year 1922-23.

ANALYSIS OF MEMBERS.

Aberdeen	5	Linlithgow	4
Argyll	2	MidLothian	20
Ayr	12	Moray	2
Banff	1	Nairn	..
Berwick	9	Orkney	2
Bute	..	Peebles	3
Caithness	..	Perth	13
Clackmannan	..	Renfrew	16
Dumbarton	2	Ross and Cromarty	5
Dumfries	10	Roxburgh	4
East Lothian	20	Selkirk	..
Fife	13	Shetland	..
Forfar	7	Stirling	1
Inverness	..	Sutherland	1
Kincardine	1	Wigtown	3
Kinross	2	England	1
Kirkcudbright	8		
Lanark	5		172

Life Members	90
Annual Members—	
£1 rate	54
10s. rate	28
	172

ABSTRACT OF ACCOUNTS.

For year ended 31st March 1923.

INCOME.

		Year to 31st Mar. 1923.
Subscriptions—		
Life	£30 0 0	
Annual	66 0 0	
	96 0 0	
Donations	41 2 3	
Interests	1,955 13 11	
Rents	20 0 0	
Income Tax Recovered	295 6 3	
Sale of Produce and Stock on Hand	177 19 5	
Discounts	4 18 3	
Total Ordinary Income		£2,591 0 1
Grants from Board of Agriculture	902 8 8	
Gain on Realisation of Investments	127 16 6	
Investments realised	£2,493 15 0	
Total Extraordinary Income		£1,030 5 2
Total Income		£3,621 5 3
Funds at 1st April 1922—		£43,025 9 7
		£46,646 14 10

EXPENDITURE.

			Year to 31st Mar. 1923.
Salaries—			
Officers		£1,519 15 6	
Secretary and Office		216 13 4	
		£1,736 8 10	
Labour		541 14 10½	
Seeds		6 12 6½	
Manures		156 10 2	
Working Expenses		256 8 10	
Laboratory Expenses		92 12 4	
Library Expenses		39 1 9	
Rates and Taxes		316 3 7	
Insurance		14 1 0	
National Health and Unemployment Insurances		6 12 4	
Office Expenses		106 1 11	
Advertising		7 4 5	
Heating, Lighting, and Cleaning		42 0 0	
Travelling Expenses		34 4 10	
Legal Expenses		5 4 6	
Property Repairs		140 7 9	
Discounts and Commissions		4 10 5	
Depreciation		43 5 5	
Total Ordinary Expenditure			£3,549 5 6
Capital Expenditure—			
Implements and Tools	£17 18 9		
Laboratory Apparatus	165 16 3		
Office Fittings	24 10 3		
Manures for Crop, 1923	114 16 3		
Improvements to House and Lands	781 16 4		
Investments made	£2,618 6 0		
Total Capital Expenditure		£1,104 17 10	
Funds at 31st March 1923, per Balance-sheet			43,097 9 4
			£46,646 14 10

BALANCE

As at 31st

LIABILITIES.

I. Accounts Outstanding		£687 13 8
II. Funds at 31st March 1923		43,097 9 4
		£43,785 3 0

DR WILSON

Funds at 31st March 1923	£191 5 0
	£191 5 0

EDINBURGH, *10th May* 1923.—I, the undersigned, having had access to all the Accounts, and verified the same with the Accounts and Vouchers relating thereto, now

45 QUEEN STREET.

SHEET.

March 1923.

ASSETS.

I. House and Lands			£7,813 16 4
II. Implements and Tools			449 7 7
III. Laboratory Apparatus			203 10 6
IV. Office Fittings			94 17 11
V. Stocks on Hand			167 15 4
VI. Accounts Outstanding			66 15 8
VII. Investments at Cost:—			
1. £14,000 5 per cent War Stock, 1929/47	£12,390 0 0		
2. £14,000 4 per cent Funding Loan, 1960/90	10,045 0 0		
3. £16,900 3½ per cent Conversion Stock	11,140 3 6		
4. £1,000 Corporation Loan	1,000 0 0		34,575 3 6
(Value at 31st March 1923)—			
1.	£14,280 0 0		
2.	12,530 0 0		
3.	13,224 5 0		
4.	1,000 0 0		
	£41,034 5 0		
VIII. Cash Balances—			
In Bank—			
On Deposit Receipt	£100 0 0		
On Current Account	298 1 10		
	£398 1 10		
On Hand	15 14 4		413 16 2
			£43,785 3 0

MEMORIAL FUND.

Value at 31st March 1923		
£204 0 0	£200 5 per cent War Stock, 1929-47—valued at date of transfer	£176 5 0
	Interest to date	15 0 0
		£191 5 0

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

W. SLATER BROWN, C.A., *Public Auditor.*

ESTABLISHMENT FOR 1922-23.

BOARD OF DIRECTORS.

Trustees.

THE RIGHT HON. VISCOUNT NOVAR OF RAITH AND NOVAR, P.C., G.C.M.G., Secretary for Scotland.
CHARLES DOUGLAS, D.Sc., C.B., of Auchlochan, Lesmahagow.
JAMES ELDER, Athelstaneford Mains, Drem.
DAVID BELL, 15 Coburg Street, Leith.
JOHN FINLAYSON M'GILL, 69 Kyle Street, Ayr.

Directors named in Rules of the Society.

D. L. BOWE (Messrs J. H. Bowe & Sons), Dunbar.
Sir JAMES CAMPBELL, LL.D., 14 Douglas Crescent, Edinburgh.
WILLIAM CUTHBERTSON, V.M.H. (Messrs Dobbie & Co.), Edinburgh.
J. INGLIS DAVIDSON, Saughton Mains, Corstorphine.
JAMES W. DRUMMOND (Messrs W. Drummond & Sons, Ltd.), Stirling.
DAVID FERRIE of Parbroath, Cupar-Fife. (*Deceased.*)
LORD FORTEVIOT, Dupplin Castle, Perth.
JAMES GARDNER, South Hillington, Cardonald.
Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Letham, Haddington. (*Resigned.*)
J. H. MILNE HOME, Irvine House, Canonbie.
W. W. HOPE, Linton Lodge, Prestonkirk.
JOHN M'CAIG of Belmont, Stranraer.
J. T. M'LAREN, The Leuchold, Dalmeny.
A. T. M'ROBERT (Aberdeen Lime Co.), Aberdeen.
G. G. MERCER, Southfield, Dalkeith.
Principal W. G. R. PATERSON, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow.
G. B. SHIELDS, Dolphingstone, Tranent.
Sir DAVID WILSON of Carbeth, Bart., Killearn.

Directors Co-opted.

Sir ISAAC CONNELL, S.S.C., 18 Duke Street, Edinburgh.
WILLIAM J. REID, Fordhouse of Dun, Montrose.

Directors nominated by the Board of Agriculture.

Sir ROBERT B. GREIG, M.C., LL.D.,
JAMES WOOD, O.B.E., M.A., B.Sc.,
T. ANDERSON, M.A., B.Sc.,
ALEXANDER M'CALLUM, M.A., LL.B.,
} York Buildings, Queen Street, Edinburgh.

Chairman of Directors—CHARLES DOUGLAS, D.Sc., C.B., of Auchlochan, Lesmahagow.
Vice-Chairman—JAMES ELDER, Athelstaneford Mains, Drem.
Director of Research—MONTAGU DRUMMOND, B.A., F.R.S.E., F.L.S., Craigs House, Corstorphine.
Secretary—JOHN STIRTON, 3 George IV. Bridge, Edinburgh.
Assistant Director and Assistant Secretary—WILLIAM ROBB, N.D.A., Craigs House, Corstorphine.

COMMITTEES.

1922-23.

RESEARCH.

G. Bertram Shields, *Convener.*
T. Anderson.
William Cuthbertson, V.M.H.
J. W. Drummond.
James Gardner.
Sir Robert B. Greig.
J. F. M'Gill.
A. T. M'Robert.
Principal W. G. R. Paterson.
William J. Reid.
Sir David Wilson, Bart., D.Sc.
Charles Douglas, D.Sc., C.B., *Chairman, ex officio.*
James Elder, *Vice-Chairman, ex officio.*

MANAGEMENT.

David Bell, *Convener.*
D. L. Bowe.
J. Inglis Davidson.
W. W. Hope.
J. T. M'Laren.
G. G. Mercer.
James Wood.
G. Bertram Shields.
J. H. Milne Home.
Charles Douglas, D.Sc., C.B., *Chairman, ex officio.*
James Elder, *Vice-Chairman, ex officio.*

FINANCE.

J. H. Milne Home, *Convener.*
David Bell.
Sir James Campbell, LL.D.
Sir Isaac Connell, S.S.C.
Lord Forteviot.
John M'Caig.
Alex. M'Callum, M.A., LL.B.
G. Bertram Shields.
Charles Douglas, D.Sc., C.B., *Chairman, ex officio.*
James Elder, *Vice-Chairman, ex officio.*

REPORT

BY

DIRECTOR OF RESEARCH.

I. Research Programme—General Outline.

THE research policy of the Society, and the methods used to put it into practice, are fully discussed in the first Annual Report (1922, pp. 12-21), where also a plan of the experiment fields will be found.

About one-half of the herbage material provisionally located in the Drive Plots has been transferred to the permanent Herbage Area (Division XIII.), and the remainder will be transplanted in the coming autumn. A small portion of the paddock (Division XIV.) has been broken up to provide accommodation for special plots which do not fit into the general scheme of the experiment fields. The results of the soil analyses, kindly carried out in 1922 by Dr A. Lauder of the Edinburgh and East of Scotland College of Agriculture, are of considerable interest. In accordance with expectation, a fairly high lime requirement is indicated throughout. Accordingly, Divisions III., IV., IX., X., and XIII. have been treated with finely-ground quicklime, at the rate of 1 ton per acre, and the remaining Divisions will be dealt with similarly each winter until the whole arable area has been limed. A marked deficiency of potash was revealed over a small portion of Field "A," the analysis thus confirming the "potash-hunger" diagnosed from the appearance of the potato-crop in that area in 1922. All the potato plots have accordingly received additional potash manure this year.

There are clear indications that both experiment fields would benefit by subsoiling. It has not been found possible

to attempt this thorough treatment for the present; but, with the sanction of the Potatoes Sub-Committee, the provisional remedies of deeper ploughing and additional cultivation have been applied to the potato breaks (Divisions I. and XI.) this spring.

II. Research Programme—Detail for 1922.

A. Cereals.

Oats.—Area, 10 acres. Divisions I. (Experimental), V., and X.-XII. (Multiplication and Commercial).

Artificial Manures :—

Small Breeding Plots—	
Superphosphates . . .	2 cwt. per acre.
Remaining Plots—	
Superphosphates . . .	2 cwt. per acre.
Muriate of Potash . .	½ ,, ,,
Sulphate of Ammonia . .	¾ ,, ,,

Experimental Plots.—Breeding work was continued on the general lines indicated in the first Annual Report, the main problem being the production of improved varieties of the Potato, Sandy and Tam Finlay types, combining heavy grain-yield with early maturity and good milling quality, and preferably thin-husked. Sample sheaves of new Sandy hybrids (not yet fixed), exhibited on the Society's Stand at the Fat Stock Show (November 1922), aroused much interest among inquirers.

The standard method of sowing adopted for Breeding Plots is in rows 9 inches apart, with 3 inches between the grains in each row. This wide spacing is necessary in order to avoid confusion between adjacent plants. It has the drawback of entailing a great deal of labour; for the current year (1923) about 25,000 oat grains have had to be sown singly by hand.

Frit-fly caused serious damage to the Breeding Plots, some being completely destroyed. It is of interest to note that some selections were much less severely attacked than others growing alongside, a result which opens up the prospect of obtaining varieties resistant to this pest. Among named

varieties, the older and more freely tillering types were in general the greatest sufferers.

Named Varieties and Pure Lines.—The formation of a representative living collection of pure lines of named varieties was continued. In Table I., which is a list of all the named varieties grown in 1922, the undoubted pure lines are marked with an asterisk.

TABLE I. OATS—LIST OF NAMED VARIETIES.

*=Pure Lines.

Name of Variety.	Station Number.	Name of Variety.	Station Number.
Algerian	Aa 62*	Crown	Aa 345
,, (Red)	,, 94	Culberson	,, 70
,, (Black)	,, 95	Dala	,, 22*
,, (Grey)	,, 96	Daubeny	,, 23*
Ascot	,, 33	1000 Dollar	,, 25*
,,	,, 44	Dun	,, 384
Aurora	,, 50	Early Champion	,, 53
A. sterilis	AaD 1	,, Hamilton	,, 12*
Banner	Aa 38	,, ,,	,, 109
Beardless Propsteier	,, 31*	Early Siberian	,, 368
Bell	,, 76*	Eighty Day	,, 21*
Beseler's Prolific	,, 27*	Fulghum	,, 52
,, ,,	,, 32	Garris	,, 104
Big Four	,, 383	Giant Yellow	,, 61*
Bjarn	,, 86	Glebe	,, 17*
,,	,, 342	,,	,, 97*
Black Mesdag	,, 77	Golden Rain	,, 65*
,, Mogul	,, 89	Gordon	,, 378
,, Tartarian	,, 93	,,	,, 379
Blainslie	,, 8	,,	,, 380
Californie	,, 49*	,,	,, 385
,,	,, 110*	Grange	,, 18*
Captain	,, 48*	,,	,, 108
Castleton Potato	,, 11*	Hamilton	,, 20*
,, Sandy	,, 381	Hardy Winter	,, 74*
Chinese Naked	AaC 1*	Hedehavre (White)	,, 19
Comewell	Aa 59	,, (Tawny)	,, 72
Crown	,, 29*	Hero	,, 40
,,	,, 344	,,	,, 39

TABLE I.—*continued.*

Name of Variety.	Station Number.	Name of Variety.	Station Number.
Huskless	Aa 1*	Richland	Aa 51
Hutcheson	,, 73	Sandy	,, 107*
Iowar	,, 58	,,	,, 6*
Joanette Hybrid	,, 75	,,	,, 3
Kent Berlie	,, 13*	,,	,, 5
Kherson	,, 63	Scots Berlie	,, 15*
Kinness	,, 26*	,,	,, 16
,,	,, 105*	Sir Douglas Haig	,, 90
Klock III.	,, 87	Sixty Day	,, 60
,,	,, 341	Sparrowbill	,, 56
Leader	,, 47*	Storm King	,, 45*
Ligowo	,, 28*	Supreme	,, 88
Lincoln	,, 377	Swedish Select	,, 35
Mansholts I.	,, 99	Tam Finlay	,, 7*
,, II.	,, 100	,,	,, 106*
,, III.	,, 101	Trifoliums	,, 103
Myrtle (*a*)	,, 91	Triumph	,, 46*
,, (*b*)	,, 92	Tyrone Tawny	,, 77
New Ascot	,, 33	Victory	,, 30*
Odal	,, 36	,,	,, 343
,,	,, 37	Waverley	,, 9
Orion	,, 340	Wexford Tawny	,, 68
Ostend's Glory	,, 57	White Horse	,, 34
Potato	,, 10*	White Russian I.	,, 54
,,	,, 111*	,, II.	,, 55
Prolific Pfeffelbacker	,, 43*	Wide Awake	,, 440
Record	,, 24*	,,	,, 441
,,	,, 41	Winter Turf	,, 69
Red Oat	,, 66*	Yellow Naesgaard	,, 64
,, Rustproof	,, 67	Yielder	,, 42

Multiplication of Standard Pure Lines.—As explained in the previous Report, considerable stocks of pure lines of Potato, Sandy and Tam Finlay, are required to serve as standards of comparison for new selections or hybrids. Sufficient seed was harvested in 1921 to sow one $\frac{1}{100}$th acre plot of each of these standard pure lines.

Crossed Oats.—Particulars regarding the various hybrid

series grown in Breeding Plots are given in Table II. Each series is represented by several selections, the number of these varying according to the generation at which the series has arrived.

TABLE II. List of Hybrid Oats Grown, 1922.

Parentage.	Generation.	Number or quantity of grains sown.
Potato × Daubeny	F_5	100
Triumph × Daubeny	F_5	40
Algerian × Leader	F_5	400
Sandy × Leader	F_5	400
Sandy × Daubeny	F_5	200
Sandy × Giant Yellow	F_5	200
Eighty Day × Beseler's Prolific	F_3	600
Sandy × Record	F_3	4040
Sandy × Victory	F_2	120
Sandy × Eighty Day	F_2	200
Tam Finlay × Giant Yellow	F_3	7270
Potato × Victory	F_2	440
Castleton Potato × Beseler's Prolific	F_3	1100
Beardless Propsteier × Eighty Day	F_3	1100
Potato × 9 (3)	F_2	480
Sandy × A. fatua	F_2	360
Sandy × Storm King	F_2	80
Sandy × Beardless Propsteier	F_2	320
Tam Finlay × Beseler's Prolific	F_2	80
Tam Finlay × Algerian	F_2	360
Golden Rain × Leader	F_5	6 oz.
Sandy × Golden Rain	F_5	4 oz.
Potato × Leader	F_5	6 oz.
Potato × Leader	F_5	2 oz.
Triumph × Daubeny	F_5	6 oz.
Triumph × Victory	F_5	2 oz.
Sandy × Leader	F_5	8 oz.

Several of the selections from hybrids are thought to be fixed, but these are being grown again in Breeding Plots for

verification and for comparison as regards yield between different selections from the same hybrid.

Notes were taken during the growing season on the more important morphological characteristics of all hybrids. It is impracticable to carry out an exhaustive analysis of the F_2 generations of several crosses simultaneously; as complete an analysis as possible was therefore made of the F_2 progeny of a Potato × Victory cross, special attention being directed to the discovery of any correlations that might be of assistance in the selection of plants of the particular type desired.

Comparative Trials.—Eight new or recently introduced varieties were grown in $\frac{1}{10}$th acre plots. The data for yield and maturity are given in Table III. The three Mansholt varieties were obtained from Holland in 1920; they resemble the Abundance type. The remainder are the property of the Society. Garris, Glebe, and Kinness were raised a few years ago by the late Dr Wilson. 3 C (3) and 3 D (4) have been selected at the Plant-Breeding Station from a cross between Potato and a black Oat. Glebe (fixed) resembles the Potato type, but the grain is slightly plumper. Kinness (fixed) and Garris are large grained, the former yellow, the latter white 3 C (3) and 3 D (4) (both fixed) approximate to the Potato type.

TABLE III. OATS—RESULTS OF $\frac{1}{10}$TH ACRE TRIAL PLOTS.

Name of variety.	Yield of grain per acre.	Yield of straw per acre.	Days to mature.
	Bushels.	Tons.	
Garris	61	2.6	165
Mansholts III. . .	60	2.3	158
Mansholts I. . . .	57	2.4	154
Glebe	54	2.7	159
3 D (4)	54	2.4	159
Mansholts II. . .	53	1.9	154
Kinness	50	2.1	154
*3 C (3)	26	1.7	151

*=Damaged by Wireworm and Frit-fly.

Special Investigations—Inheritance of Ear Type.—This investigation was started mainly with a view to obtaining data for the identification of panicle types among the progeny of crosses between parents with "open" panicles (*e.g.*, Tam Finlay) and "close" (one-sided) panicles (*e.g.*, Giant Yellow) respectively. Difficulty had been experienced in such cases in classifying the F_2 generation according to ear-type, the panicles apparently showing a complete gradation between the open and close types. The risks of error are increased by field conditions, especially if lodging occurs, when it becomes impossible to distinguish ear types with certainty. The F_2 progeny of a Tam Finlay × Giant Yellow cross grown in 1921 were provisionally classified under three ear types—viz., "open," "close," and "intermediate." In order to check this grouping, it was decided to grow on the F_3 generation in its entirety. As it is impracticable to handle so large a progeny test in a single year, half only was sown in 1922. Unfortunately this series was severely attacked by Frit-fly, so that the results obtained were very incomplete. So far as these go, they confirm the view that the three panicle types previously recognised—viz., open, close, and intermediate—are genetically distinct. The other half of the F_3 generation has been sown for investigation in the current year, when it is hoped a more definite conclusion may be reached.

Commercial Crops.—Six varieties were grown in plots varying in size according to the quantity of seed available. For the results see Table IV. Two 2-acre plots of Crown were sown at the same rates of seeding (six bushels per acre); but in one plot half the seed was drilled and half broadcasted, the seed on the control plot being drilled in one operation. The combination of drilling and broadcasting gave the higher yield. Orion was conspicuous for its early ripening, as in previous years. The poor yields of the two earliest varieties (Orion and Bjarn) are to some extent exaggerated owing to the destructive action of sparrows, which take heaviest toll from the early grain. On physiological grounds, however, an unusually early oat such as Orion can hardly be expected to yield a heavy crop of grain. That moderate earliness is not incompatible with high yield is, however, shown by the performance of Trifoliums oat, which, though ripening as early as Bjarn, was easily first in respect of yield.

TABLE IV. OATS—COMMERCIAL CROPS.

Name of variety.	Yield of Grain per acre.	Days to mature.
	Bushels.	
Trifoliums	67	151
Crown (Drilled and Broadcasted) .	59	156
Crown (Drilled only) . . .	52	160
Victory	51	160
Klock III.	47	171
Orion	42	141
Bjarn	33	150

Wheat.—Division III. (in part).

Over fifty varieties and species were sown in small breeding plots. All grew very poorly from the start, and few notes of value were obtained during the growing season. All types that matured were, however, classified in respect to ear, grain, and chaff characters during the winter (by Mr W. B. Nicoll). The whole series, together with some additional types received this year, has been resown for renewed examination in 1923; the growth up to the present is promising.

Barley.—Division III. (in part). 2 acres.

The principal feature was a comparative trial of nine named varieties in $\frac{1}{10}$th acre plots, sown at the rate of $2\frac{1}{2}$ bushels per acre. For results see Table V.

A few special types were grown in small breeding plots. In addition two $\frac{1}{8}$rd acre plots of "Gold" Barley were sown in order to test the effect of shallow ($\frac{3}{4}$-inch) as against deep (3-inch) sowing. The experiment was a failure, owing to the damage caused by birds to the shallow-sown plots. For any further experiments of this nature, it will evidently be necessary to "pickle" the grain in some unpalatable liquid.

TABLE V. BARLEY—RESULTS OF $\frac{1}{10}$TH ACRE PLOT TRIALS.

Name of variety.	Grain, bushels per acre.
Spratt Archer . . .	47
Golden Pheasant . .	46
Plumage Archer . . .	44
Smooth Goldthorpe . .	43
Plumage	42
Chevalier	42
Brewing	27
Alida	27
Primus	26

B. POTATOES.

Area, 4 acres. Divisions II. (1 acre Experimental, 1 acre Multiplication) and VI. (Multiplication).

Manures—

Dung	10 tons	per acre.
Superphosphate . . .	3 cwt.	,,
Muriate of Potash . . .	1½ ,,	,,
Sulphate of Ammonia . .	1 ,,	,,

Work was continued along the lines of the previous year (see 1922 Report). Preliminary experiments were carried out with a view to determining the cooking quality of promising new varieties, as in the absence of any industrial utilisation of the crop for farina or alcohol, high cropping power cannot be regarded as of first-rate importance unless accompanied by good table quality. Excessive lateness in ripening is an undesirable feature, and seedlings which suffer from this defect are discarded. Certain varieties seem to be specially susceptible to Common Scab, and seedlings of this type are likewise in general earmarked for elimination.

Seedlings (raised from true seed in 1922).—About 5000 seeds were sown and grown under glass in the early stages; of the seedlings about 1600 were finally planted out in the field or in boxes, representing some sixty series, each the progeny of a single plum. For details see Table VI. The percentage

germination varied from 96 per cent to zero, all the failures and most of the low percentages being found among the older seed lots (1912-1915).

TABLE VI. POTATO SEEDLINGS RAISED, 1922.

Reference Number.	Year Berry set.	Germination of Seed.	Number of plants planted out.	Number of plants retained at harvest.
		Per cent.		
3	1921	37.7	17	11
4	,,	28.8	14	3
5	,,	17.8	5	4
6	,,	59.5	105	18
7	,,	53.5	102	8
8	,,	58.5	70	5
9	,,	43.2	16	7
10	,,	86.0	82	39
11	,,	55.5	60	10
12	,,	87.2	226	208
13	,,	21.0	30	14
14	,,	47.2	22	8
15	,,	84.0	76	18
16	,,	62.9	87	39
17	,,	66.6	99	26
18	,,	85.6	151	35
681 (*b*)	1915	25.0	15	7
682	,,	12.8	11	9
690 (*a*)	,,	51.0	62	25
701	,,	48.3	48	9
704	,,	49.0	42	4
716	,,	45.7	14	3
724	,,	75.6	80	15
725	,,	56.0	21	7
962 (*c*)	1919	42.8	18	3
966 (*c*)	,,	86.6	53	4
988 (*a*)	,,	87.5	100	9
990 (*b*)	,,	61.4	31	13
993 (*d*)	,,	66.6	54	8
333	1912	4.4	4	1
367	,,	1.8	—	—
441	,,	—	—	—
470 (*a*)	,,	—	—	—
589	1914	—	—	—

TABLE VI.—*continued.*

The undernoted varieties were grown in boxes and selections of tubers made at the end of the season.

Reference Number.	Year Berry set.	Germination of seed.	Number of plants grown in boxes.	Number of tubers selected.
		Per cent.		
690 (*b*)	1915	56.6	60	7
697 (*c*)	,,	20.0	20	4
698 (*a*)	,,	14.6	21	3
(*b*)	,,	12.9	25	3
(*c*)	,,	12.7	16	—
699 (*a*)	,,	35.9	50	—
(*b*)	,,	13.8	25	—
702 (*b*)	,,	—	—	—
711	,,	16.9	22	3
712 (*a*)	,,	70.0	20	—
(*b*)	,,	59.3	19	3
(*c*)	,,	31.5	18	3
713	,,	30.8	25	6
715	,,	26.0	12	2
718	,,	—	—	—
718 (*b*)	,,	—	—	—
729	,,	—	—	—
970	1919	96.2	100	—
971 (*a*)	,,	67.5	50	—
(*b*)	,,	75.7	50	6
984	,,	3.3	5	—
985	,,	—	—	—
986 (*b*)	,,	44.64	50	6
987 (*d*)	,,	67.9	125	6
988 (*b*)	,,	22.12	50	8
989 (*a*)	,,	53.9	150	12
990 (*a*)	,,	56.8	25	—

Notes were taken on characters of the young seedlings, such as shape and number of cotyledons and coloration of the stem, in order to ascertain if these were correlated with any feature of economic value. No such correlations were discovered. Coloration of the young seedling stem is very variable, and the pigment develops at different periods in

different seedlings. Early tuber-formation in a seedling does not seem to indicate either early ripening or heavy cropping power. The progeny of early ripening varieties proved to be on the whole relatively tender; a large proportion of them died down soon after being planted out without forming tubers.

In a summary report it is obviously impossible to tabulate all the data of value recorded for many hundreds of seedlings. In order to illustrate the lines of observation pursued, and, incidentally, to show the amount of variation which may be found among the progeny of a single potato berry, the notes taken on tuber characters of a series of seedlings derived from one self-set berry (Ref. No. 10) are set forth in Table VII (p. 24). The parent plant was the product of a cross between a white-skinned variety and Edzell Blue, and had coloured tubers. Seventy-seven seedlings were grown to maturity, but only the thirty-nine retained for further study are included in the Table. In view of the very wide range of tuber-colour exhibited by the different plants, it is interesting to note that the fluctuation in colour among the tubers of any one plant was negligible. The white-tubered plants formed a natural class by themslves, but it was found impossible to establish definite colour types among the plants with pig-mented tubers, since these showed a complete gradation of colour from faint pink to deep purple or almost black. The total number of plants with coloured tubers (out of the entire series of seventy-seven) was fifty-nine as against eighteen white-tubered plants. The ratio of "coloured" to "white" plants is thus 3.3 to 1, suggesting a single-factor Mendelian difference between the two types.

Trials of Varieties raised from Seed prior to Year 1922.—Seventy-five varieties and selections were under trial, the tests being divided, as in 1921, into four classes—viz., 100-tuber tests, 50-tuber tests, 25-tuber tests, and 12-tuber tests. The 100-tuber tests were carried out in quadruplicate plots, the 50-tuber tests in duplicate. The 25-tuber and 12-tuber tests were not replicated. The latter two classes included varieties which are kept for stock, and also varieties of which there was an insufficient number of tubers available for inclusion in the larger plots. The data for yield, maturity, and wart immunity are given in Table VIII. In order to ensure a just comparison in respect of cropping power, &c., under local conditions, the following named varieties were grown in the

TABLE VII. ANALYSIS OF THE 39 PLANTS RETAINED FROM SERIES NO. 10. (See text.)

Reference Number of individual plant of No. 10 series.	Total weight of tubers.	Colour of skin (cut surface).	Colour of flesh.	Shape.
	oz.			
1	6	White, splashed purple	White, splashed purple	Round
2	16	Red	White, deeply splashed purple	Round kidney
3	9	Purple	White	Round
4	3	,,	White, deeply splashed purple	,,
5	12	White	White	,,
6	21	Red	Pale yellow	,,
7	9	,,	White	,,
8	10	,,	,,	,,
9	8	Purple	White, deeply splashed purple	,,
10	12	Red	White	,,
11	14	Purple	White, slightly tinged purple	Round kidney
12	9	Red	White	Round
13	9	,,	White, tinged red	,,
14	9	Purple	White, splashed purple	,,
15	10	,,	White	,,
16	3	Red	,,	,,
17	16	White	,,	,,
18	6	,,	,,	Oval
19	2	,,	,,	Round
20	45	,,	Pale yellow	Flat round
21	1	Black	White, tinged purple	Round
22	13	Purple	White	,,
23	32	White, slightly splashed purple	White, tinged purple	Flat round
24	6	White, splashed purple	White	Round
25	7	White	,,	,,
26	11	Red	White, tinged red	,,
27	16	Purple	White, tinged purple	,,
28	9	,,	White	,,
29	7	,,	Pale yellow	,,
30	20	White, splashed purple	White	,,
31	22	Red	White, tinged red	Flat kidney
32	6	White	White	Flat round
33	8	Purple	Pale yellow	Kidney
34	3	Red	White, tinged red	Round
35	18	Purple	White, slightly tinged purple	Flat round
36	4	,,	Pale yellow	Round
37	20	Red	,,	Flat round
38	11	White	White	,,
39	33	Red	,,	Round kidney

plots as controls—Arran Chief, Epicure, Great Scot, Kerr's Pink, King Edward, Majestic, Tinwald Perfection, Witchhill, and Midlothian Early. Each named variety was grown in at least four different plots. The stocks of these varieties had not been grown at the Station in the previous year, and consequently they may have had an advantage over those grown at the Station. In future, varieties raised at the Station will be compared as far as possible with stocks of named varieties which have also been grown here for at least one year.

To allow of selections from individual plants being made, the tubers are planted wider apart in the drills than is common in agricultural practice. To compute the yield per acre on that system of cultivation might be misleading. The method of estimating yields adopted is to determine the yield from ten consecutive plants in each plot (where possible), the figures from replicate plots being averaged.

The ripening period of a variety is expressed by one of the four numerals 1, 2, 3, and 4, "1" indicating the earliest ripening types. The ripening period cannot be determined to within a day or so, nor can it be expressed in absolute terms. An arbitrary criterion of ripening is therefore employed, a variety being noted as ripe whenever the shaws or haulms show signs of normal yellowing or withering. It is well known that there may be considerable variation from year to year in the date of ripening of a variety, consequently the classification here provisionally adopted may not agree with results obtained by other observers. Further, some of the varieties fall near the border-line of the class to which they have been assigned this season, and they may in other seasons be included in a later or an earlier class according to circumstances.

In Tables VIII. and IX.—

Ripening Period 1 comprises varieties which began to wither before 18th August 1922.

Ripening Period 2 comprises varieties which began to wither after 18th August and before 8th September.

Ripening Period 3 comprises varieties which began to wither after 8th September and before 30th September.

Ripening Period 4 comprises varieties which began to wither after 30th September.

The limiting dates were fixed with reference to the date of ripening of standard named varieties in 1922.

As regards size of tubers—

"Small" includes all tubers passing through a 1¼ inch riddle.

"Seed" includes all tubers passing over a 1¼ inch but through a 1¾ inch riddle.

"Ware" includes all tubers passing over a 1¾ inch riddle

TABLE VIII. POTATOES, 1922—100-TUBER TESTS.

I. = Immune. S. = Susceptible.

Reference Number.	Average yield per plant.	Ripening period.	Average weight per tuber in ware.	Ware.	Seed.	Small.	Immunity.
	lb.		oz.	Per cent.	Per cent.	Per cent.	
40 (2)	4.5	4	4.6	80.29	15.86	3.85	I.
142 (6)	2.2	3	5.5	78.35	16.89	4.76	I.
456 (*a*) (1)	4.4	3	5.4	86.37	11.88	1.75	I.
560 (4)	2.8	3	—	89.9	9.76	.34	I.
733 (*a*) (1)	3.1	4	6.5	81.97	15.57	2.46	I.
884 (1)	3.8	3	5.5	81.13	14.98	3.89	I.
891 (1)	3.4	2	7.6	71.11	24.0	4.89	S.
908 (1)	4.1	3	5.2	94.62	4.3	1.08	S.
916 (2)	2.5	3	5.5	81.84	15.29	2.87	I.
CONTROL VARIETIES.							
Arran Chief .	2.4	3	6.2	85.0	13.0	2.0	
Epicure . .	2.5	1	6.2	80.66	15.66	3.68	
Great Scot .	3.6	3	5.4	77.2	18.4	4.4	
Kerr's Pink .	4.4	4	4.6	75.0	20.3	4.7	
King Edward	4.1	3	5.3	73.0	24.1	2.9	
Majestic . .	3.7	3	8.0	89.0	9.0	2.0	
Midlothian Early . .	2.4	1	5.0	75.32	16.14	8.54	
Tinwald Perfection.	4.1	3	5.9	78.3	19.7	2.0	
Witchhill .	2.7	2	4.9	55.78	37.93	6.29	

TABLE VIII.—*continued.*

50-TUBER TESTS.

Reference Number.	Average yield per plant.	Ripening period.	Average weight per tuber in ware.	Ware.	Seed.	Small.	Immunity.
	lb.		oz.	Per cent.	Per cent.	Per cent.	
449 (*a*) (1)	2.4	2	5.5	57.24	32.51	10.25	I.
562 (1)	3.5	3	—	Discarded			S.
594 (*a*) (2)	3.0	2	3.7	60.61	37.71	1.68	I.
594 (*a*) (1)	2.4	3	4.7	70.91	24.24	4.85	I.
626 (*a*) (3)	3.15	4	6.4	82.79	13.12	4.09	S.
724 (2)	1.6	3	4.4	63.81	34.28	1.91	I.
878 (3)	3.6	3	4.6	71.2	24.6	4.2	I.
883 (1)	2.7	4	6.2	86.49	11.58	1.93	I.
(2)	2.0	4	5.2	82.51	15.92	1.57	I.
884 (2)	4.0	3	5.5	77.59	19.13	3.28	I.
(3)	3.1	3	5.7	82.33	15.8	1.87	I.
(5)	2.9	4	5.9	87.71	11.57	.72	I.
(11)	3.0	3	5.5	84.44	13.89	1.67	I.
908 (4)	2.15	4	—	Discarded			I.
916 (7)	2.1	3	—	Discarded			I.
941 (2)	2.8	3	5.2	67.06	27.06	5.88	I.

25-TUBER TESTS.

407 (*a*) (1)	2.3	4	5.3	95.45	3.03	1.52	I.
626 (*b*) (7)	1.4	3	6.4	90.86	8.6	.54	I.
624 (3)	3.0	4	5.9	68.63	23.53	7.84	I.
635 (1)	2.5	4	3.7	53.42	35.62	10.96	S.
653 (*a*) (4)	3.3	2	4.6	69.23	26.15	4.62	S.
680 (7)	3.6	4	6.4	82.04	14.08	3.88	I.
733 (*a*) (7)	3.4	2	4.5	87.39	9.85	2.76	I.
884 (7)	6.6	4	6.4	93.27	5.38	1.35	I.
891 (5)	2.2	2	5.9	76.28	23.72	—	S.
941 (5)	2.1	3	5.2	74.7	18.07	7.23	S.

12-TUBER TESTS.

296 (1)	1.9	3	4.3	62.44	31.22	6.34	I.
362 (3)	2.25	3	—	Discarded			S.
418 (*a*) (1)	3.5	4	5.0	63.77	34.78	1.45	S.
568 (*b*) (2)	3.9	4	6.4	84.62	10.58	4.8	S.

TABLE VIII.—*continued.*

12-TUBER TESTS—*continued.*

Reference Number.	Average yield per plant.	Ripening period.	Average weight per tuber in ware.	Ware.	Seed.	Small.	Immunity.
	lb.		oz.	Per cent.	Per cent.	Per cent.	
599 (*b*) (5)	2.7	2	3.7	69.79	28.13	2.08	I.
599 (*b*) (5) B	3.5	3	—	—	—	—	I.
608 (*b*) (1)	4.2	3	5.2	86.3	12.33	1.37	I.
610 (*a*) (4)	3.7	4	—	Discarded			S.
636 (1)	2.0	4	—	Discarded			S.
684 (1)	3.3	3	—	Discarded			S.
720 (3)	3.2	2	8.4	95.96	4.04	—	S.
724 (3)	2.3	2	—	Discarded			S.
733 (*a*) (4)	3.3	2	—	Discarded			S.
734 (*a*) (4)	2.4	3	5.5	66.0	27.0	7.0	I.
780 (*a*) (5)	2.6	2	5.2	85.11	13.83	1.06	I.
800 (2)	4.0	3	4.8	67.04	28.49	4.47	I.
806 (2)	.37	3	—	Discarded			I.
806 (6)	2.3	2	4.1	75.87	21.84	2.29	I.
853 (*a*) (3)	2.25	4	5.2	49.27	49.27	1.46	I.
853 (*b*) (3)	1.3	3	—	Discarded			I.
883 (4)	2.4	3	—	Discarded			I.
(7)	2.2	4	—	Discarded			I.
(8)	2.7	3	5.5	90.83	8.26	.91	I.
(11)	4.0	4	5.0	48.0	44.8	7.2	I.
(14)	4.2	4	5.2	82.61	15.94	1.45	I.
(15)	1.2	3	—	Discarded			I.
(19)	3.1	3	5.9	84.92	13.07	2.01	I.
(20)	2.5	2	4.6	81.77	14.06	4.17	I.
884 (8)	3.1	3	5.0	97.96	1.63	.41	I.
902 (6)	1.1	2	—	Discarded			S.
916 (4)	3.2	4	4.4	83.49	15.54	.97	S.
(5)	3.5	4	4.7	70.94	23.93	5.13	I.
(6)	3.3	3	3.3	51.49	45.54	2.97	
943 (3)	2.8	3	5.7	86.54	11.54	1.92	I.
957 (1)	5.3	4	4.3	71.43	25.0	3.57	I.
(2)	1.2	2	—	Discarded			I.
(4)	3.3	3	4.6	73.17	23.58	3.25	I.
957 (9)	4.0	3	—	Discarded			I.
(10)	3.0	3	—	Discarded			S.

Five-Tuber Tests—1921 Seedlings.—Over 130 selections were included in this test. It has been found expedient to plant as far as possible a uniform number of tubers in the second year from the seed, as is done with the older varieties. Five tubers is considered to be a sufficient quantity to give a preliminary indication of the merits of a variety. Occasionally it happens that there are fewer than five tubers from some plants, but if the selection is at all promising, a larger stock is generally available in the succeeding year. By limiting the number of tubers from each selection, a greater number of selections can be grown. Table IX. shows the results obtained from the above test.

Varieties approved by the Potatoes Sub-Committee at their visit of inspection in 1922, and of which sufficient tubers were available, have been included in the 100-tuber tests for 1923.

TABLE IX. POTATOES, 1922—5-TUBER TESTS OF 1921 SEEDLINGS.

I. = Immune. S. = Susceptible.

Reference Number.	Ripening Period.	Number of plants grown.	Ware.	Seed.	Small.	Average weight per tuber in ware.	Immunity.
			Per cent.	Per cent.	Per cent.	oz.	
1 (1)	3	4	0.0	44.0	56.0	0.0	I.
(2)	3	5	81.16	14.5	4.34	5.7	I.
(3)	3	2	—	57.15	42.85	—	S.
(6)	3	4	39.8	39.8	20.4	3.6	I.
(8)	3	3	77.31	21.85	.84	4.6	
(9)	3	5	19.23	57.69	23.08	2.5	I.
(10)	2	5	34.78	60.87	4.35	4.0	S.
(12)	2	4	37.56	59.51	2.93	3.9	I.
(13)	3	5	53.81	40.93	5.26	5.4	I.
(14)	4	5	23.0	51.44	25.56	3.0	I.
(15)	3	4	20.93	60.46	18.61	4.6	I.
(16)	2	5	11.2	44.4	44.4	4.0	I.
(17)	3	5	28.5	54.95	16.55	3.6	I.
(18)	3	5	39.89	49.74	10.37	4.7	I.
(19)	3	5	51.37	44.96	3.67	4.7	I.
(21)	4	5	84.86	12.75	2.39	4.9	I.

TABLE IX.—*continued.*

Reference Number.	Ripening Period.	Number of plants grown.	Ware.	Seed.	Small.	Average weight per tuber in ware.	Immunity.
			Per cent.	Per cent.	Per cent.	oz.	
1 (22)	3	5	42.64	41.05	16.31	4.3	I.
(23)	2	5	62.48	33.74	3.78	4.1	I.
(25)	3	5	67.89	27.53	4.58	4.1	I.
(27)	4	5	41.43	48.57	10.0	3.6	
(28)	4	5	72.06	25.0	2.94	5.5	S.
(29)	4	4	66.9	28.78	4.32	7.0	I.
(30)	3	2	62.78	35.03	2.19	4.3	I.
(31)	3	5	55.33	36.15	8.52	3.7	I.
(32)	4	5	43.86	35.09	21.05	4.2	
(33)	2	2	63.63	30.31	6.06	5.3	I.
(34)	3	5	63.64	18.18	18.18	3.6	
(35)	3	5	66.19	28.57	5.24	4.9	I.
(36)	3	5	75.32	19.62	5.06	4.9	I.
(37)	3	5	53.84	43.59	2.57	4.2	I.
(39)	3	3	95.28	4.72	—	5.3	I.
(40)	4	5	62.32	34.78	2.9	3.6	I.
(41)	2	3	55.6	33.3	11.1	3.8	
(43)	3	5	68.16	25.87	5.97	4.3	I.
2 (1)	3	3	43.3	46.7	10.0	3.3	
(7)	3	5	—	71.05	28.95	—	
(8)	4	4	1.23	59.26	39.51	—	
97 (2)	4	5	53.89	38.32	7.79	7.6	S.
414 (2)	4	5	28.0	69.3	2.7	3.9	I.
(4)	4	2	77.14	20.0	2.86	6.7	I.
(6)	4	5	85.25	6.56	8.19	5.2	I.
(7)	4	3	59.37	37.5	3.13	3.8	
(12)	4	5	80.77	15.38	3.85	4.2	
431 (*c*) (3)	2	4	69.34	30.15	.51	5.5	S.
(10)	4	5	71.08	24.79	4.13	4.9	I.
(13)	4	1	60.16	37.4	2.44	5.4	I.
480 (*a*) (1)	4	1	53.74	40.3	5.96	4.6	
(3)	4	5	87.38	12.62	—	3.8	I.
(4)	4	5	79.69	9.78	10.53	4.9	I.
(5)	4	2	84.81	11.39	3.8	6.2	I.
(6)	4	5	69.72	20.18	10.1	5.5	I.
(7)	3	5	75.95	21.37	2.68	5.5	I.
(8)	2	1	38.17	57.25	4.58	3.1	I.

TABLE IX.—*continued.*

Reference Number.	Ripening Period.	Number of plants grown.	Ware.	Seed.	Small.	Average weight per tuber in ware.	Immunity.
			Per cent.	Per cent.	Per cent.	oz.	
480 (*a*) (9)	4	5	46.79	42.2	10.11	2.5	I.
(10)	3	1	62.66	30.38	6.96	3.6	I.
(11)	4	1	66.67	21.84	11.49	3.6	S.
(13)	4	5	82.74	13.69	3.57	5.5	I.
(14)	4	5	70.23	22.83	6.94	3.5	I.
(15)	3	1	65.28	34.03	.69	7.9	
(16)	4	5	67.12	21.92	10.96	5.0	S.
(17)	4	2	67.31	24.04	8.65	4.4	I.
(18)	4	3	60.56	37.7	1.64	4.6	I.
(19)	4	4	68.37	25.51	6.12	5.5	I.
(20)	3	5	58.57	35.71	5.72	3.4	I.
(21)	4	4	87.14	8.57	4.29	5.0	S.
(23)	3	4	89.72	8.31	1.87	4.9	I.
(25)	4	4	72.86	17.86	9.28	6.4	I.
(26)	4	5	51.72	42.76	5.52	3.7	I.
(27)	3	2	65.22	26.09	8.69	4.3	I.
(35)	4	2	90.22	8.39	1.39	4.6	I.
(36)	4	5	58.91	31.05	10.04	3.6	I.
(37)	3	5	73.31	25.89	.8	4.2	I.
(38)	4	2	66.27	30.18	3.55	4.0	I.
(40)	3	5	91.34	7.88	.78	4.5	S.
(41)	3	5	63.75	31.55	4.7	4.7	I.
(42)	4	5	73.6	20.4	6.0	5.0	I.
(43)	4	3	23.29	65.75	10.96	4.2	I.
(44)	4	2	83.87	16.13	—	8.5	I.
(46)	3	1	82.24	14.95	2.81	5.5	I.
(48)	3	5	78.8	17.51	3.69	5.2	I.
(50)	3	5	92.81	7.19	—	4.2	I.
(51)	4	5	60.43	30.93	8.64	4.7	I.
(52)	3	1	79.17	18.75	2.08	4.9	I.
(53)	4	3	73.17	14.64	12.19	5.0	S.
(54)	4	5	50.0	42.11	7.89	3.8	S.
615 (3)	4	5	82.24	15.89	1.87	7.3	S.
655 (1)	2	3	51.67	40.83	7.5	5.2	I.
(2)	4	5	59.53	30.74	9.73	3.9	I.
(3)	4	5	42.86	51.79	5.35	4.0	I.
(8)	4	4	59.79	30.93	9.28	4.9	S.

TABLE IX.—*continued.*

NAMED VARIETIES (additional).								
Reference Number.	Ripening Period	Yield per plant.	Number of plants grown.	Ware.	Seed.	Small.	Average weight per tuber in ware.	Immunity.
		lb.		Per cent.	Per cent.	Per cent.	oz.	
Bell . . .	4	3.6	12	76.62	21.43	1.95	4.8	
Bishop . .	3	2.9	12	53.06	39.79	7.15	4.7	I.
Dean . . .	4	5.2	11	84.8	14.0	1.2	5.9	I.
Edzell Blue .	2	2.0	11	78.16	20.69	1.15	3.8	I.
Fortyfold .	3	2.0	12	92.68	7.32	—	3.8	S.
GoldenWonder	4	3.0	12	52.89	42.98	4.13	5.5	I.
Langworthy	4	3.0	12	63.09	33.33	3.58	5.2	I.
Lochar . .	3	3.4	12	77.13	18.31	4.56	3.9	I.
P. 8 . . .	2	3.6	12	44.28	45.8	9.92	4.9	S.
Priest . .	3	3.6	12	80.0	18.46	1.54	4.5	
Templar . .	4	5.6	13	78.29	19.38	2.33	4.7	I.

Immunity Trials of Seedlings.—One hundred and twenty-eight tubers from seedlings raised in 1921 were sent in 1922 to the Wart Immunity Trials conducted by the Board of Agriculture at Philpstoun, for single-tuber tests. Table X. (p. 33) shows the results. About 70 per cent. of the seedlings were classed as free from Wart Disease, but further trial of the most desirable types of these will be necessary before a certificate of immunity can be obtained.

Crossing.—A considerable amount of time and labour was spent last season in crossing and selfing certain varieties. The season proved very unfavourable for the setting of berries. Thus Templar, which in most seasons sets fruit fairly readily, produced no berries last season, although numerous self- and cross-pollinations were carried out both with and without bag protection. Pollen was very scarce, and, when found, was rarely in good condition.

Multiplication Plots.—Three varieties—viz., Nos. 296 (1), 362 (3), and 733 (*a*) (7), were grown in multiplication plots. The Potatoes Sub-Committee decided that as the variety

No. 362 (3) was not immune from Wart Disease, it should be discarded. The other two varieties are immune, and are to be multiplied and grown under ordinary field conditions in 1923.

TABLE X. POTATOES, 1922—IMMUNITY TRIALS.

Series Reference Number.	Number of tubers from series.	Free from wart disease.	Affected with wart disease.	Failed to grow.
1	42	30	3	9
83	4	2	2	—
97	2	—	2	—
414	12	9	—	3
431 (*c*)	5	4	1	—
480 (*a*)	54	41	11	2
615	3	—	3	—
655	6	4	2	—

C. HERBAGE PLANTS.

Work was continued on the general lines indicated in the first Annual Report (1922). Some promising types of Perennial Ryegrass and Cocksfoot were selected for vegetative multiplication and eventual seeding. The Herbage Sub-Committee has kindly agreed to inspect the grass and clover plots from time to time with a view to selection, for further investigation, of the types which appear to be most suitable for pasture, hay, or seed production. Small quantities of selfed seed were obtained from about forty different plants—representing the three " principal " grasses (see 1922 Report, pp. 29 and 30)—which had been protected against cross-pollination in various ways. These will all be sown in 1923 as a first step towards the separation of pure lines. The technique of isolation and crossing in grasses requires much further study ; one assistant will devote practically the whole of his time to this important subject during the summer of 1923. The Timothy collection is still very limited, and additional contributions of plants or seed of this grass will be much appreciated.

The experiments on inoculation of lucerne with pure cultures of nodule bacteria (see 1922 Report p. 30) gave

interesting results. The inoculated plots grew more actively from the start, and showed abundant root-nodules five weeks after sowing, at which time the non-inoculated (control) plots were very backward and quite free from nodules. Five months after sowing, sample cuts were taken from one plot of either series, and the fresh weights compared; the ratio was as 3 to 1 in favour of the inoculated plots; the difference in weights of air-dry hay was slightly smaller (ratio 2.7 to 1), but still sufficiently striking. Owing to their quicker growth, the inoculated plots kept down weeds fairly well; they also suffered less from autumn frosts than the non-inoculated controls. Two larger plots, which had to be located on previously uncleaned ground, were unfortunately spoilt by weeds, and will have to be resown. The above results were confirmed by the poor growth, accompanied by entire lack of nodules (ten months from sowing), shown by plants of several varieties of lucerne grown in the Drive Plots without inoculation, and further by pot experiments on soil from Forgandenny, Perthshire (kindly supplied by John J. Calder, Esq.)

It is not claimed that absence of the proper strain of nodule bacterium, or soil conditions which prevent effective inoculation, are the only or even the principal obstacles to lucerne culture in Scotland. The results so far obtained at the Plant-Breeding Station do, however, indicate that the bacterial condition of the soil should be examined before any attempt is made to grow lucerne on untried ground. The Danish method of inoculation, by treating the seed with a pure culture of the bacterium at the time of sowing, is the most convenient and effective, and probably also the least costly in the long run. Given a sufficient demand for such cultures, there should be no difficulty about their supply, which could be undertaken by any bacteriological institution in the country. Thousands of such cultures are sent out yearly to Danish growers from the State Agricultural Laboratory at Copenhagen, with the result that in Denmark a valuable forage crop has become widely distributed on soils naturally unsuited to its growth.

The collection of Leguminous Herbage plants has been considerably extended, chiefly by the addition of commercial strains of clovers. On the other hand, several species subjected to potentiality trials proved unsuited to the locality—

e.g., *Trifolium subterraneum*, *T. Johnstoni*, *Lotus americanus*, and *Lespedeza striata* (the last-named could not be raised beyond the seedling stage). The Subterranean Clover grew well, seeded freely, and gave rise to numerous self-sown seedlings in autumn; but almost all of these died off early, in spite of the exceptional mildness of the winter. This result might have been anticipated from the distribution of the species in the wild state in Britain, where it is confined to light soils, and does not occur north of the Humber. The Sweet Clovers (*Melilotus*), which it was thought might have possibilities for green manuring purposes, also proved disappointing. All the species and strains tested were sufficiently hardy, but not one of the hundreds of plants grown formed a single root-nodule (in the course of twelve to eighteen months), so that here bacterial conditions probably played a decisive part.

D. Swedes and Turnips.

Joint Trial with Board of Agriculture for Scotland.—Eighty-four representative varieties of Swedes and turnips were grown from seed kindly supplied by various seed firms in response to invitation. Notes were taken on the first year botanical features; one plot of each variety has been retained for observations on the second-year characters. Sample weighings—of 16 yards linear of drill, representing roughly $\frac{1}{400}$th acre, and comprising about fifty roots—were taken from every plot in November. The yield figures are to be regarded as approximate only, and are accordingly not published here. A copy of the complete yield-table was sent to each contributor of samples; the sources of samples were not indicated in these copies, except as regards the varieties that had been supplied by the recipient.

The policy of appealing to a limited number of firms for seed was adopted deliberately for the first trial, as it was realised that a general appeal would almost certainly produce an unmanageable number of samples. As it was, the number of varieties sent in was so large, that only five plots of each could be accommodated—viz., two at the Plant-Breeding Station, and three at the Plant-Registration Station. Such insufficient replication was undoubtedly one cause of the notable discrepancies between the results from different plots of the same variety found in most cases, both as regards

absolute weight, and, more particularly, in respect of the number of roots occupying the unit length of drill (16 yards). Irregularities of singling formed an even more obvious source of error. It seems very doubtful, indeed, whether accurate yield-data can be obtained at all, if singling is carried out by the comparatively rough-and-ready hoeing method at the nominal interval of 8 inches to 9 inches between roots. For these reasons, the corresponding Variety Trial in 1923 will be carried out at the Registration Station only; the 2 acres available for Swedes at the Plant-Breeding Station will be sown with a single variety for a test of singling, partly by hand and partly by hoe, at intervals ranging from 9 inches to 21 inches between roots, each type of plot being replicated at least ten times. The troubles experienced last year illustrate one of the gravest difficulties common to all quantitative comparative field trials—viz., the problem of obtaining true average samples. Apart from this question of sampling, the general conclusions which may be drawn from the Variety Trial are as follows :—

1. Whereas a few of the commercial stocks showed a satisfactory degree of uniformity, the great majority were in the nature of mixed populations. This statement does not imply that the stocks in general were not true to name, nor that they were seriously contaminated by rogues. The intention is to point out that, generally speaking, commercial stocks of Swedes and turnips are made up of a variety of genetic types, as is, indeed, inevitable in the case of a cross-pollinating (allogamous) crop bred chiefly on a basis of mass-selection.

2. The genetically mixed character of the average stock becomes most evident when it is examined in the second (seeding) year of growth. An excellent illustration of the importance of second-year features for identification and classification was furnished by two stocks of a green-top Swede included in the trial. In their first year these were confidently classed as synonymous; but, judged by second-year characters, they appeared so obviously distinct that the most inexperienced observer could not confuse them with one another. From the botanical point of view, there is nothing novel or surprising in this result; no botanist would venture to classify a group of species or varieties without having studied them in the flowering stage.

3. Fluctuation is doubtless partly responsible for the differ-

ences between plants of the same stock. But the balance of evidence points to genetic (*i.e.*, constitutional and heritable) differences as being the principal cause of diversity. Thus there is, on the whole, far less variation within the individual Swede stocks than in those of turnips. There is no evident reason why Swedes as a whole should *fluctuate* less than turnips under the same conditions of environment. But when it is realised that Swedes, though normally cross-pollinators, are also readily selfed, whereas turnips are self-sterile in a very considerable degree (see p. 38), the greater *genetic* uniformity of the average Swede stock follows as a matter of course.

4. The yield-data, approximate as they are, indicate that the commercial stocks have attained a high and (within the types recognised in practice) uniform standard of excellence, and that there is therefore little prospect of any great advance in yield being attained by further breeding. Table XI. illustrates this point for the twenty varieties of Bronze-Top Swedes included in the trial (two doubtful stocks are omitted; their inclusion would not in any case affect the result). Class I. includes all varieties with yields per acre between 25.5 and 26.5 tons; Class II. those with yields from 24.5 tons inclusive to 25.5 tons inclusive, and so forth. The average yield of all twenty varieties is twenty-five tons. Apart from the low figure given by the single representative of Class V., none of the yields differ by more than 1½ tons per acre from the group average.

TABLE XI. YIELDS OF BRONZE-TOP SWEDES, 1922.

Class.	Yield. Tons per acre (average of 5 plots).	Number of varieties in class.
I. . . .	26	11
II. . . .	25	3
III. . . .	24	5
IV. . . .	23	Nil
V. . . .	22	1
Average of all varieties . 25		Total varieties 20

The foregoing conclusions agree with those previously drawn from the study of small plots of a limited number of varieties in 1921, and justify the policy framed at the start of the work on turnips—viz., that of concentrating attention on features other than cropping power, notably quality and disease-resistance, and of attempting the isolation of strains approximating more closely to pure lines than do the existing commercial stocks. The results of the analyses and feeding experiments undertaken by the Rowett Institute during the past winter (see 1922 Report, p. 32) are not yet to hand; in any case, it will require prolonged co-operative effort (which has been put in train by the Committees for Research on Turnips organised by the Board of Agriculture for Scotland) to discover a reliable basis for work on the improvement of quality. Meanwhile there are many problems to be solved in connection with the inheritance of other characters. Some thirty small lots of seed produced by selfing—under conditions precluding cross-pollination—were obtained from single plants of twenty standard varieties in 1922. All the Swedes produced plenty of selfed seed; the turnips, on the other hand, proved to be comparatively self-sterile. These line-selections are all being sown this year as a first step towards isolation of approximate pure lines. In the early stages of such work, it is necessary to grow control plots of the parent stocks along with the line selections; as a consequence, even this modest effort involves the sowing of about 18,000 seeds singly by hand.

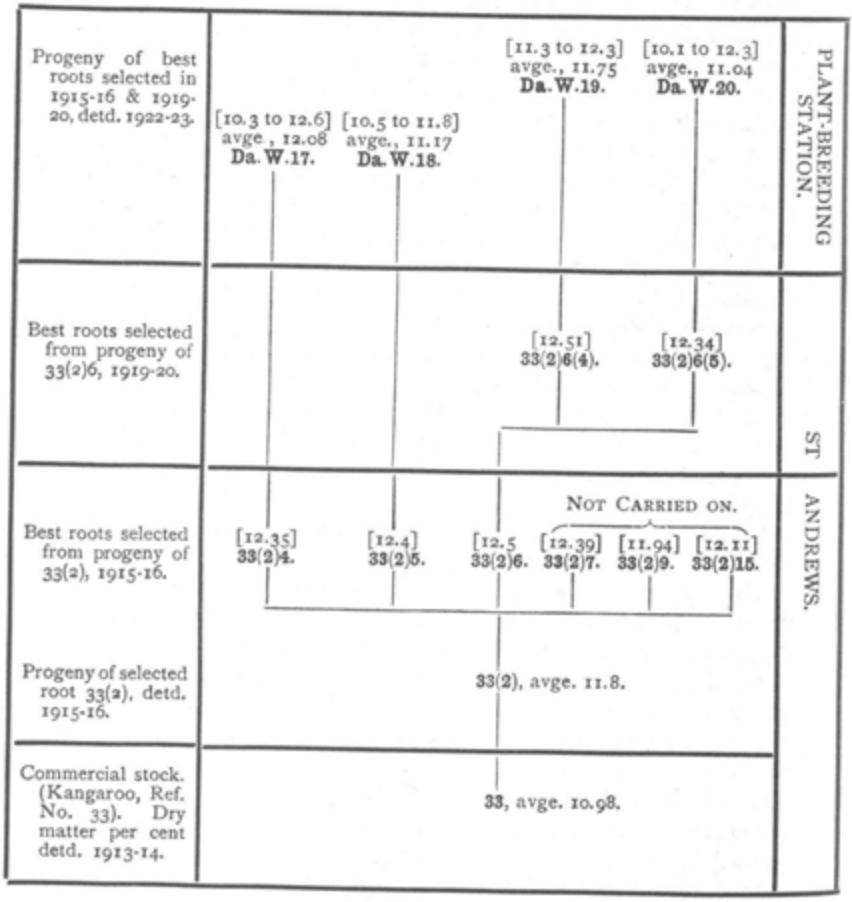
Variegation in Turnips.—Every one of the commercial turnip varieties in the Joint Trial (thirty stocks, representing all the leading types) contained a proportion of plants with parti-coloured (white and green) foliage. In the worst cases (two), the percentage of variegated individuals was as much as 35 per cent; in most instances it was much less (on the average about 5 per cent). It is not yet clear whether all the variegation is of one kind—viz., constitutional—or whether there may not also be other types, due either to local soil effects or to infection with a communicable virus, such as is generally held responsible for the Mosaic diseases of potato, tobacco, &c. The matter is receiving further attention. Whatever the cause of this variegation may be, plants with parti-coloured foliage should not be included among seeding stock, as the partial lack of chlorophyll evidently causes retarded and stunted growth in the second year, and appreciably reduces the yield of seed.

"Dr Wilson" Swedes.—About thirty small lots of seed of pedigree Swedes bred for several years by the late Dr J. H. Wilson on a basis of selection of individual roots, according to content of dry matter and sugar, were sown. Dry-matter-content determinations were carried out on all of these (by Mr F. W. Sansome). For various reasons, comparison between the results and the determinations made by Dr Wilson and his assistants in previous years (copies of Reports to the Board of Agriculture for Scotland by Messrs R. Wishart and J. C. Law were kindly supplied by Sir Robert Greig) can only be made to a limited extent. In general, only a dozen roots of each strain could be tested. Moreover, certain facts essential to the exact correlation of the two sets of data were not available. Thus, the St Andrews Reports, from 1916 onwards, give the dry-matter-content of individual selected roots only, but not the average dry-matter-content of the roots of any one generation, nor the limits of variation in this respect. Further, it is not stated during what months the determinations took place, nor under what conditions of temperature, &c., they were carried out. The change of locality must also be taken into account, and, finally, the age of the seed (six years in most cases). The effect of the last-mentioned factor was clearly shown by the braird, which was in every case poor, and in several instances practically *nil*; it is very probable that the vitality of those strains which did braird moderately well was affected, with consequent reduction in the quantity of dry matter produced.

The general result found was that the *average* dry-matter-content fell below that of the individual parent roots selected on account of their high dry-matter-content; this regression is in accordance with expectation. For a number of strains the *maximum* dry-matter value found was less than that of the parent root. Such results *may* be due to the secondary influences mentioned above; but in the absence of information regarding the range of variation of the whole preceding generation, it is impossible to arrive at any decision on this point. In other cases, the *maximum* dry-matter-content found was at least equal to (in a few strains higher than) that of the parent root. Here it is probable that the increase in dry-matter achieved by selection in previous generations has been maintained, or, more correctly, that the high dry-matter-content of the parent root selected in the previous generation was due to heritable constitutional peculiarity, and not the

result of mere fluctuation. An example of this sort is detailed in Table XII., which shows the history, so far as recorded, of a series of pedigree strains bred from the Bronze-Top variety " Kangaroo."

TABLE XII.



KANGAROO SWEDE.
DRY-MATTER CONTENT ON PEDIGREE STRAINS (WILSON).

The figures in **heavy type** indicate the selected strains or roots. All other figures refer to dry-matter content (per cent); those in square brackets pertain to individual roots.

It would seem that strains such as Da.W.19 would be worth carrying on, if it were desired to produce races with high dry-matter-content. In view of the conflict of opinion regarding the value of dry-matter-content as a criterion of feeding value, it would probably be unwise to attempt this development, which demands a considerable amount of time and space, for more than one or two selected strains.

III. Lectures and Official Visits by Staff.

LECTURES.

Director :—

Species in Theory and in Practice. Paper read to Royal Philosophical Society of Glasgow, Biological Section, February 1922.

VISITS.

Director :—

Agricultural Research Council (Ministry of Agriculture and Fisheries), Cambridge, July 1922 ; London, January 1923.

Craibstone Experimental Farm and Rowett Research Institute, Aberdeen, October 1922.

John Innes Horticultural Institution, Merton, and Rothamsted Experiment Station, Harpenden, March 1923.

Assistant-Director :—

Ormskirk Potato Trials, 1922.

IV. Demonstrations and Exhibits.

DEMONSTRATIONS TO PARTIES VISITING THE PLANT-BREEDING STATION.

Armstrong College Agriculture Students' Association, June 1922.

Glasgow University Botanical Society, June 1922.

Edinburgh University Agricultural Students, June 1922.

Edinburgh and East of Scotland College of Agriculture Students, June 1922.

EXHIBITS.

Fat Stock Show, Edinburgh, November 1922 (Joint Exhibit with Plant Registration Station, Board of Agriculture for Scotland).

V. Buildings and Equipment.

The alterations and additions to Craigs House were finished in April 1922. The provisional laboratory is now well equipped for microscopic work, and is in daily use.

A large galvanised iron drying-shed and store was erected in September 1922.

The principal items of equipment purchased during the year are as follows :—

Full-sized Zeiss Microscope and accessories.
Leitz " Student's " Microscope.
Minot Microtome.
Two Hearson Incubators (used respectively as Paraffin Embedding Bath and Drying Oven).
Torsion Balance.

VI. Acknowledgments.

Grateful acknowledgment is made to the undernoted departments, institutions, firms, and individuals for gifts of samples or other materials for experiment.

T. Alexander, Esq., Nethermuir, Bathgate.
David Bell, Esq., J.P. (Messrs David Bell, Ltd., Leith.)
The Board of Agriculture for Scotland.
John J. Calder, Esq., Calder House, Piccadilly, London.
J. A. Campbell, Esq., Arduaine, Argyll.
Wm. Cuthbertson, Esq., J.P., V.M.H. (Messrs Dobbie & Co., Ltd., Edinburgh.)
H. R. Davidson, Esq., University Farm, Cambridge.
Messrs Dickson, Brown, & Tait, Manchester.
Director, Royal Botanic Gardens, Kew.
Director, Welsh Plant-Breeding Station, Aberystwyth.

J. W. Drummond, Esq. (Messrs W. Drummond & Sons, Ltd., Stirling).
James Elder, Esq. (Messrs Wm. Dods & Son, Haddington.)
Messrs Gartons, Ltd., Warrington.
Messrs G. Gascoyne & Co., Worcester.
Messrs James Hunter, Ltd., Chester.
Messrs Charles Irvine & Sons, Jedburgh.
Messrs Kent & Brydon, Darlington.
Messrs Laing & Mather, Kelso.
Messrs Peter Lawson & Son, Ltd., Edinburgh.
T. M'Ewen, Esq., Cardenden, Fife.
J. F. M'Gill, Esq. (Messrs M'Gill & Smith, Ltd., Ayr).
J. T. M'Laren, Esq., The Leuchold, Dalmeny.
G. M'Lennan, Esq., 34 North Bridge, Edinburgh.
A. Nelson, Esq., Bardowie.
A. J. Pressland, Esq., Edinburgh Academy.
Regius Keeper, Royal Botanic Garden, Edinburgh.
Messrs Andrew Riddell & Co., Edinburgh.
Royal Geographical Society, London. (Mount Everest Committee.)
Statens Planteavls-Laboratorium, Copenhagen.
Superintendent, Craibstone Experimental Farm.
Messrs Sutton & Sons, Reading.
M. Louis de Vilmorin. (Messrs Vilmorin-Andrieux & Cie., Paris.)

Research material in exchange has been supplied to the Edinburgh and East of Scotland College of Agriculture, the Royal Botanic Garden, Edinburgh, the West of Scotland College of Agriculture, and the Welsh Plant-Breeding Station.

Thanks are also due to Messrs N. Caw, G. M'Call, T. M'Ewen, W. B. Nicoll, F. W. Sansome, J. Thomson, and A. Walton, who kindly gave their services as honorary members of the staff for varying periods, and whose assistance has been of the utmost value.

PRINTED BY WILLIAM BLACKWOOD AND SONS.