

1942

SCOTTISH SOCIETY FOR RESEARCH IN
PLANT-BREEDING.

ABRIDGED
REPORT BY THE DIRECTORS.

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

The Scottish Plant-Breeding Station has been admitted to the Register of Protected Establishments, and up to 31st March 1942 all the members of the staff, with the exception of one, Mr Charles A. Lyall, B.Sc., have continued their work at the Station. As previously reported, Mr Lyall applied for de-reservation in May 1941, and his request was granted by the Agricultural Research Council.

Certain parts of the programme of work at the Plant-Breeding Station have been curtailed, but other work dealing with the seeding of vegetables has been undertaken. The importance of seed production in the present emergency is realised, and experiments with the seeding of various species of vegetables are in progress.

Elite stocks of Early Miller and Bell oats were grown, and the grain was readily disposed of for seed. Stock-seed crops of Craigs Defiance and Alness potatoes were also grown, the former under contract at Gibston, Huntly, and the latter at the Society's substation at Boghall, Midlothian. The greater part of each lot of tubers was sold, and the small remainders were retained for planting at Boghall and at Craigs House. Small quantities of pedigree grass seeds (Perennial Ryegrass, Cocks-

foot, and Timothy) were grown, but none of these was offered to members, as it was decided that all these seeds should be used for immediate multiplication. A strain of barley selected several years ago from Scots Common barley has been giving favourable results in field trials in the North of Scotland.

The buildings at Craigs House, which were destroyed by fire in January 1941, have been completely restored, under the supervision of the Society's Architect, Mr Peter M'Laren, and they have been in use since December 1941.

Directorate.

It is with deep regret that the Directors have to record the death, which took place on 17th May 1941, of Mr David Bell, J.P., Vice-Chairman of Directors of the Society. Mr Bell was well known in agricultural circles, was a recognised expert in the seed business, and a leading authority on seed and plant production. In his death the Society has lost one of its greatest supporters. His name will always be associated with the work of the Society in the 'Bell' Oat, one of the new varieties of oats produced at the Station, which was named after him. He was a Trustee of the Society from its inauguration in 1920, and Vice-Chairman since March 1924. In all these capacities he rendered valuable services to the Society, and his death is a loss to the Society which is deeply deplored.

To fill vacancies caused by the death of Mr Bell, the Directors appointed Mr W. J. Campbell to the office of Vice-Chairman, and Mr Alexander M'Callum, M.A., LL.B., to be a Trustee of the Society.

Staff.

Miss Margaret F. Torrance, B.Sc., Assistant for Cytological Work, resigned her appointment as at 31st August 1941. It has been decided to defer filling the vacancy meantime.

In response to a 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 for four weeks to assist as Temporary Inspectors under the Department's Potato Inspection Scheme in 1941.

The Society was honoured by a visit in December 1941 from the Minister of Agriculture, the Right Hon. R. S. Hudson. He was received at the Plant-Breeding Station by the Chairman of the Board of Directors of the Society, and the work in progress at the Station was described by members of the staff.

Library.

While it has been possible to replace various publications which were destroyed in the fire which occurred at the Plant-Breeding Station last year, there are some which are known to be out of print and which we would like to acquire. A list of a few of these is subjoined, and if readers of this report have any for disposal the Director of Research would be glad to have particulars regarding them :—

Welsh Plant-Breeding Station Bulletins—

- Series H. No. 1. Preliminary investigations with herbage plants.
- No. 3. Further investigations with herbage plants.
- No. 5. The animal complex and the pasture complex.
- No. 7. Red clover investigations.

Journal of the National Institute of Agricultural Botany, Vol. I.,
No. 1. 1922.

Scottish Journal of Agriculture, Vol. 19, No. 4. 1936.

Membership.

The Directors regret to report that in the past year sixteen members died, two resigned, and the names of three who

were in arrear with their subscriptions were deleted from the roll. It is pleasing to note, however, that twenty-one new members—the largest number since 1935-36—were elected during the year ended 31st March 1942. At 31st March the membership numbered 266, and consisted of 129 life members and 137 annual members (22 at the 5s. rate and 115 at the 10s. rate of subscription). A list of members appears on pages 25 to 33 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.

JOHN STIRTON,
Secretary.

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

		Date of Registration.
<i>Oats</i> —		
Elder	} Registered by the Department of Agriculture for Scotland as new varieties.	{ 1930 1932 1934
Bell		
Early Miller		
<i>Barley</i> —		
Unnamed (as yet) selection, Ref. No. B8(8).		
<i>Potatoes</i> —		
The Alness	} Registered by the Department of Agriculture for Scotland as new varieties.	{ 1934 1939
Craigs Defiance		
<i>Grasses</i> —		
Cocksfoot—Ref. No. Cc 180.		
Timothy—Ref. No. Cb 191.		

R E P O R T

BY

DIRECTOR OF RESEARCH

I. Research Programme.

The work at the Plant-Breeding Station, Corstorphine, and at Boghall sub-station was continued without much curtailment. Small trial-plot work was reduced to some extent so as to economise in labour and to obtain additional ground for work of more immediate national importance. Efforts were made to seed several vegetable crops, and on the whole these met with a fair measure of success despite the inexperience of the staff in this class of work and the unfavourable weather at certain critical periods of the growing season.

A review of the work for the year ended 31st March 1942 follows.

GRAIN CROPS.

WILLIAM ROBB, *Director of Research.*

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

Oats.

An endeavour has been made to grow as many as possible of both the unfixed and fixed selections, but the multiplication plots of new selections were reduced considerably in size. About 16,000 unfixed hybrid oats were grown as spaced

plants. These comprised crosses in various stages of development ranging from the first generation to the seventh, and a large proportion of them consisted of types derived from selections which had been chosen for resistance to lodging and which appeared productive and to possess a good quality of grain. A few of the best types which appear to be fixed have been marked for multiplication on a small scale for comparison of straw, quality of grain, and other economic characters. The aim is to select from among these the strains most resistant to lodging and giving the highest yield of grain of good quality. In some promising short-strawed plants derived from crosses with the Semi-Dwarf oat there is too high a proportion of barren lower grains in the spikelets, while in others there is a tendency to produce too many small grains or to give too low a yield. By further selection these undesirable types may be eliminated.

The usual replicated trial-plots were not laid out, but further comparisons of a group of fixed selections were made in small plots. These included stiff-strawed types which may be adapted to fertile soil conditions, and a proportion of early-ripening strains which are intended for trial in upland areas.

The selecting of plants from crosses between the cultivated oat and the wild oat, showing resistance to prompt germination at harvest-time, was continued. A proportion of these selections now seem to be breeding true at least for resistance to prompt germination in the autumn.

About 2 acres of an elite stock of Early Miller and about $1\frac{1}{2}$ acres of an elite stock of Bell oats were grown at the Station for seed, and the produce of both these varieties was readily disposed of to members of the Society.

Single-plant selections of Early Miller oats showing a low percentage of barren grains have again been made to see if the tendency in this variety in some seasons to produce barren grains can be eliminated or substantially reduced. There are some indications that the desired improvement will be gained by the process of single-plant selection.

Barley and Wheat.

The assistant in charge has been on Military Service for a considerable part of the year, and consequently the

breeding work with these crops has been on a reduced scale. The barley from colchicine-treated material received most attention. The tetraploid seedlings obtained as a result of that treatment were grown and successfully seeded.

At the Station several years ago numerous single-plant selections were taken from Scots Common Barley, and some of these were grown-on to the small field-trial stage. Later the Field Trials Committee, Department of Agriculture for Scotland, recommended that one of them should be increased in quantity and tried out in the North of Scotland. Trials have been carried out, and the reports on these have been definitely favourable. With reference to the crop trials in the North of Scotland in 1941, quotations from three reports received are appended :—

“ It has proved to be a fairly good standing variety and produces a big yield of grain. There were only a few heads showing loose smut, a disease which was very prevalent last year. The sample is very plump and in every case over the standard bushel weight. I am confident that it is going to prove a very great asset to Morayshire. In every case the yield was over 24 cwt. per acre.”

“ Ref. your B8(8) Scots Common Barley, I sowed it at the rate of $3\frac{1}{2}$ bushels drilled on very light land. It came away freely from the beginning and threshed out at approximately 5 qrs. per acre. There was plenty of straw, but in places it was inclined to lodge. I am sowing much increased acreage of it this year. The barley itself was of very good quality.”

“ The barley, Ref. No. B8(8), has proved an unqualified success. . . . One farmer maintains that it threshed slightly over 8 qrs. per acre and that the bushel weight was over 57 lb. Two of the farmers who have grown this particular barley say it has produced the heaviest crop they have ever grown and at the same time the best sample.”

Small collections of Winter Wheat and Spring Wheat were grown to maintain stocks of these for future use. A group of spring wheats was tested for resistance to infection by loose smut.

A few lines of '*Triticale*' wheat were grown. These wheats were raised in U.S.A. and were derived from crossing wheat and rye. They may prove to be hardier than ordinary winter wheat.

Beans.

About 1 acre was grown of a selection of Scots Tick Bean which had been raised at the Station, and over 22 cwt. of cleaned beans were produced. A small quantity of these was retained for sowing and the remainder was sold for seed. Several unfixed hybrid bean selections and a collection of Russian varieties were also grown. All the available seeds of a few reputed early-ripening types of bean of Russian origin were sown to obtain increased quantities of seed of these for field trials.

Linseed.

A few Canadian and several Argentine varieties of linseed were grown in small plots for observation, and the Canadian variety '*Diadem*' again seemed to be the most promising. The stems of the Argentine varieties were short, being only about 18 inches in length.

POTATOES.

(Breeding and Genetics—Boghall Sub-Station.)

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

(Virus Diseases—Craigs House.)

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

C. H. CADMAN, B.Sc., Ph.D.

The search for new commercial varieties of potatoes possessing resistance to blight has been continued at Boghall Sub-Station, and many new seedlings bred from blight-resistant parents have been raised. Some of the resistant seedlings raised in previous years are showing considerable promise, and have compared favourably in trials with approved cultivated varieties. Several of them are being multiplied.

The blight fungus, *Phytophthora infestans*, is reputed to be

unstable and various biotypes have been isolated by other investigators. The likelihood of more virulent biotypes appearing renders it necessary to build up as high a degree of resistance as possible, and accordingly various distinct systems of breeding have been pursued. Genetical evidence so far obtained shows that, inherently, there exist several different levels of resistance, and it is the intention to build up resistance to the highest possible level compatible with essential economic qualities. The hexaploid species *S. demissum* has been used most successfully as the source from which to introduce the resistant characters or genes, but experiments are in progress with other species. During 1941 about 4000 seedlings were tested for their reaction to blight, and further evidence was obtained concerning the inheritance of resistance to disease. More progenies have been raised with a view to the production of improved types possessing field immunity from viruses A and X, and investigations on the possibility of producing leaf-roll resistant varieties are in progress. This work has been carried out in conjunction with the breeding for blight resistance with the object of combining as far as possible in economic plants the qualities of blight resistance, leaf-roll resistance, and hypersensitiveness to viruses A and X.

Several hundred cross-fertilisations have been carried out on the wild species of potato obtained from Central and South America, and a large amount of hybrid seed has been secured. Some of these species and their hybrids have been interbred with cultivated varieties to varying extents, and cytological examinations have been made on a large number of plants. Much of the work, however, has been concerned with the genetics, cytology, and intercompatibility of the diploid species, and much useful information has already accumulated. Fully 8000 seedlings were raised at Boghall in 1941.

Economic selections of seedlings raised in previous years were grown in trial- and multiplication-plots at Boghall and Craigs House, and some of them were included in the trials carried out by the Ministry of Agriculture and Fisheries at the Midland Agricultural College, Loughborough. In the latter trials some favourable reports of seedlings were received, and resistance to blight in certain high-yielding selections was confirmed. Samples of seedlings have again been forwarded for inclusion in the Ministry's trials in 1942.

About $1\frac{1}{2}$ acres of the new potato variety ' Craigs Defiance ' were grown under contract for the Society in the North of Scotland in 1941. A Stock-Seed Certificate was obtained in respect of this crop, which was offered for sale to those members of the Society who were unsuccessful in the ballot in 1941. Seed tubers, amounting to 9 tons 2 cwt., were sold, and sufficient were retained for planting about 1 acre for seed in 1942.

As mentioned in last year's report, the 25 tons of tubers available of Craigs Defiance were allocated by ballot, in lots of 1 ton each, to twenty-five of the applicants for seed. Thirteen of the growers obtained Stock-Seed Certificates, and the remaining twelve obtained T.S.(A.) Certificates in respect of their crops in 1941. Some attractive and heavy crops were obtained, and very little virus disease was evident. Growers' reports on the cooking quality of the tubers were variable, ranging from excellent to poor, but soil conditions doubtless varied also.

Trials of Craigs Defiance were carried out at two centres in England (Lincolnshire and Leicestershire) and at one centre in North Wales (Carnarvonshire). The reports from all these centres were favourable. In Lincolnshire, in trials with Scotch seed, Craigs Defiance gave a significantly higher yield of tubers than either Majestic or King Edward. At Aber, North Wales, Craigs Defiance gave the highest total yield, although the difference between it and some of the other high-yielding varieties in the trial could not be regarded as significant. It was stated that " a feature of Craigs Defiance which attracted much attention was its excellent shape and shallow eye, and none of the tubers were of the type which are too big to be marketable."

Craigs Defiance has been entered for the Lord Derby Gold Medal Trials in 1942.

A small area of the Alness was grown at Boghall in 1941. This crop gained a Stock-Seed Certificate, and all the available seed tubers were sold for seed. A similar area will be grown in 1942.

Virus Diseases.

Further genetic studies have been made at the Station at Craigs House upon the inheritance and relationships of the Na, Nb, Nc, and Nx genes controlling the hypersensitive

necrotic reactions upon which depends immunity in the field from systemic infection with viruses A, B, C, and X. Over 2000 seedlings have been graft-infected during the year, and confirmation has been obtained of strong linkage between the Na and Nx genes. In order to speed up this work and to avoid losses incurred in raising material under field conditions, a technique suited to the replication of seedlings by cuttings has been developed.

The exploration of 'wild' material for resistant characters, including hypersensitiveness, has been started. Analysis of the virus content of this material has revealed the presence of viruses A, B, C, G, X, and Y, and it is suspected that at least two unrecorded viruses are also present.

Progeny tests, completed after seven years' field trials, are now yielding preliminary information upon the inheritance of resistance to the leaf-roll virus. Data from 67 progenies derived from 28 parents have provided a basis for both determinate genetic studies and commercial breeding operations. The attempt to combine leaf-roll resistance with field immunity from viruses A, B, C, and X was carried a step further by the elimination under grafting tests of those seedlings which were not field immune from viruses A and X. The remainder were placed under conditions of intensive infection with leaf roll, and a few susceptible plants have been eliminated.

Aphis populations throughout the season have been exceedingly small. Winged migrants were first observed in small numbers in mid-June. The subsequent multiplication of apterous forms was slow, and reached a maximum in mid-September. The maximum index of 300 aphides per 100 leaves was the lowest recorded since counts were begun in July 1936.

The season was highly favourable for breeding, and a large number of berries from cross- and self-fertilisations have been secured, including a number from diploid crosses and a number which are likely to yield plants quadruplex for the Na and Nx genes. The latter would be of material advantage in commercial breeding, since the whole progeny of any cross with such a quadruplex parent would be field immune from viruses A and X.

Six seedling progenies for genetical work on field immunity and six for inclusion in the leaf-roll trials were raised during the year.

HERBAGE PLANTS.

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

The breeding work with grasses has reached a stage where it is necessary before breeding many more new strains to test the grazing value of those already raised. The testing of varieties in the initial stages of development is a part of the herbage programme which has become of increasing importance as the possibilities of different varieties are becoming more fully realised. At present all the initial trials are carried out exclusively at the Plant-Breeding Station, where, obviously, the environmental conditions may be very different from those prevailing in the localities where some of the varieties are intended ultimately to be used. The Society has therefore decided to supplement the breeding and initial trial work at Corstorphine by conducting variety investigations in an essentially grassland district. Through facilities kindly granted by Mr William Crawford, The Birches, Mid-Calder, the use of a suitable area of about two acres of a *Nardus*-bent pasture near Balerno has been obtained by the Society. The intention is to utilise these two acres for the purpose of testing the performance of grass varieties in different combinations and under different nurse crops. The objects of the investigations to be carried out at Balerno are twofold: (1) to gain information of value to the furtherance of the breeding programme as a whole, and (2) to test the reactions of incipient new varieties to different biological and cultural treatments. The existing gap between the breeding operations and the more extensive regional trials will thus be effectively bridged by the intervention of initial performance tests conducted as an integral part of the breeding programme.

Preliminary tests of possible grazing nurse crops have been continued at Corstorphine. Apart from the oats Sandy and Grey Winter, varieties which have already given satisfactory results in the field trials conducted at Ainville in 1939, certain other cereal varieties have since been examined in this connection, and this year arrangements have been made for the sowing of winter rye and small seed of Bell oats in a field trial at Bridge of Orchy, Argyll. Various varieties of spring rye and barley have given relatively poor results so far, but

the usefulness of Missouri Early Beardless barley, obtained for the Society from the United States Department of Agriculture by the Department of Agriculture for Scotland, has still to be tested. This variety is said to graze well and to be winter hardy; certainly it successfully survived last winter at Corstorphine.

Recent developments in grassland research suggest the probability of mixtures of varieties, in contrast to mixtures of species, playing an ever-increasingly important part in the country's grassland economy. The results of experiments with simple ryegrass mixtures, for instance, have been most encouraging, and indicate that, provided complementary varieties are sown, the omission of other grass species need not necessarily detract from a pasture's grazing value. This fact is worthy of attention at the present time, when there is every prospect of the ryegrasses largely being used to replace, both in hay and pasture, other species now in short supply. Since seed of the ryegrasses can be successfully obtained in this country from fields sown for hay, there is no reason why there should not be sufficient seed of the early varieties to satisfy the requirements of the short-term-grass policy of the present emergency. The seed supply of the complementary mid-late and late varieties of perennial ryegrass—*e.g.*, Kent indigenous and the late-bred strains—is, however, short, and is likely to remain so for some time to come. Accordingly an effort is being made at the Scottish Plant-Breeding Station to multiply as rapidly as possible the varieties *Ca* 434 and *Ca* 448 of perennial ryegrass, varieties which have given good pasturage in an upland locality in Midlothian when sown together with Italian ryegrass, Ayrshire perennial, and Wild White Clover.

In addition to the multiplication of these ryegrasses, the Cocksfoot variety *Cc* 180 has been re-selected, and the new stock (*Cc* 196) has been sown for seed in Essex and Ayrshire, 20 acres in the former county and 1 acre in the latter. Two varieties of hay timothy, *Cb* 213 and *Cb* 224, have also been sown for multiplication this year.

In view of the work with grasses having advanced to a stage where further extensive breeding should be deferred until the present collection has been subjected to field trial, the members of the staff engaged in herbage work have been able to spend a considerable part of their time in

other work the importance of which has been emphasised by the war. This work has consisted of comparing varieties of savoy cabbages and of broccoli, and of selecting and breeding broccoli. An account of the work undertaken on these plants is given later in this Report under the section headed "Vegetable Crops."

ROOT CROPS.

(*Swedes and Kales.*)

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

J. M. S. LANG, B.S.A.

Swede Breeding.

The main purpose of the experiments with swedes is the examination of various methods for the selection and comparison of individual plants intended for use in breeding, with a view to obtaining improved strains or varieties. Self-fertilisation in pollen-proof bags can be employed for swedes without any marked deterioration through inbreeding.

Propagation.—The storage of plants selected for seeding presents certain difficulties, though the swede survives the winter much better than the turnip or marrow-stem kale. In normal years swede plants keep best out-of-doors, planted up to the level of the base of the neck in soil. Deeper planting causes the neck to rot, while if the top of the bulb is exposed the plant may be damaged by frost. In severe winters such as have been experienced lately, however, most of the plants may be killed or seriously damaged. Swede plants stored overwinter in sheds or pits have been found to suffer badly from fungus diseases, which infected the plants from the dead petioles through the leaf scars. A better method of storing under cover was found to be in cold frames with the roots set in two or three inches of sand. This permits the plant to take in a small amount of water, while the necks can be kept free of dead leaves, and ventilation can be secured in mild weather. Duplicated sets of selections are now made, one set being planted out-of-doors and the other kept in frames. In the winter of 1940-41 nearly all the outdoor plants were killed or damaged, and it was the swedes from the frames and those in pots in the greenhouse which were seeded in

1941. About 190 samples of seed were obtained by selfing, hybridisation, or in a few cases mass multiplication. Last winter, 1941-42, the outdoor plants survived better, and both sets were available to make up the propagation plot.

Cultivation.—To conform with the war-time programme, the area under experimental crops was reduced to about an acre, and the wide spacing of the observation plots was abandoned for normal drill cultivation. Good crops were obtained, and there was relatively little mildew; there was a certain amount of finger-and-toe disease, but it was a maggot attack which caused most damage. This maggot had appeared for the first time in considerable amount in the previous year; it has been identified by the Entomological Department of Edinburgh University as that of *Phorbia* (or *Delia*) *floralis*, a close relation to the cabbage root fly, but differing essentially in its time of attack. We are informed that it appeared in Scotland in districts round Edzell some years ago, but has only recently been reported in the Lothians. The flies emerge in July or August from land which carried a swede crop in the previous year. They can fly considerable distances, attracted by smell, to growing swede crops, where they lay eggs in the soil round the young plants. Maggots hatch out and tunnel into the bottom of the bulb. They do not damage the root system like the cabbage root fly, and the plants continue to grow without showing signs of the attack; but considerable portions of the bulb are riddled, and putrefying organisms may later set up rotting. By the end of October the maggots are full grown, and they leave the bulb and pupate in the soil, remaining in their cocoons till the following summer, when they emerge as flies. There is no effective method of control on a field scale, but calomel dust or naphthalene might deter the flies from laying eggs, though they are too expensive for large areas.

The damage to a commercial crop may be considerable, though much of the tunnelled material can be cut off when the roots are lifted. For the selection of breeding plants, however, the pest has raised a problem of considerable gravity, for only bulbs which are free or have very shallow tunnels are fit to keep. In consequence it was decided to transfer the experimental crops to Boghall in 1942, where the fly has not yet been recorded, and to see whether the epidemic at Craigs House will abate in absence of first-year swedes.

Swede Pedigree Breeding.—Pedigree lines, bred by controlled self-fertilisation of single plants selected for a number of generations and originating from commercial varieties, were grown in small plots for maintenance. Large plots were grown of lines derived from varietal crosses, since it is from this material that it is hoped to obtain relatively true-breeding strains of economic value. A small yield-trial was laid out and the plots were weighed, but no dry matter or sugar estimations were undertaken this year. Strains of swede were tested for resistance to finger-and-toe disease, both in an infected field plot and as seedlings in trays of infected soil. Though strains show differences in growth and amount of infection, it has so far proved difficult to demonstrate the hereditary transmission of factors governing resistance to the disease.

Breeding of other Root Crops.

Kales.—In view of the intention to grow broccoli for seed in 1942, and to avoid contamination of the two crops, kale breeding has been reduced temporarily at the Plant-Breeding Station. Kale plants were seeded in 1941, and most of the seed has been stored, only a few small plots being sown out for observation. Observations were made on plots grown in 1941, and two strains have been kept for multiplication elsewhere. The work with thousand-headed kale has meanwhile resolved into the breeding of a strain 'T1,' which has unusual foliage characters, and may provide a useful and distinctive variety if the vigour can be improved.

Mangolds.—Strains of yellow globe and yellow intermediate were seeded in 1941, but no plots of mangold were sown out.

Species Crossing.—Hybridisation work has been carried out on a small scale each year. Since the war, however, it has been undesirable to grow hybrid plants, which may be worthless as fodder, but the possibilities of achieving crosses between certain forms of *Brassicæ* are still being investigated.

CYTOLOGICAL WORK.

MARGARET F. TORRANCE, B.Sc. (resigned 31st August 1941).

Most of the work in this section was with barley which had been treated with colchicine to induce chromosome duplica-

tion. Since Miss Torrance resigned at 31st August 1941 no further cytological work had been undertaken, and a successor is not being appointed meantime.

VEGETABLE CROPS.

Broccoli.

The main objects of the investigations were (1) to find the most suitable varieties for use in April, May, and early June, the period of greatest scarcity of vegetables—after the savoys are finished and before the early summer vegetables are ready; (2) to produce winter-hardy races of the best varieties by a process of intra-varietal selection; and (3) to examine the possibilities of seeding selected races in Scotland for local use.

Variety Trials.—The trials contained samples of the following eighteen commercial varieties: Roscoff No. 1, Roscoff No. 3, British Roscoff, Harding strain Roscoff, Blatchford's March, Clucas' June, Intermediate, Late Angers, Late Queen, Lenten Monarch, May Blossom, Methven June, Midsummer, Nichols DK7, Royal Oak, St George, Springtide, and Swan. These varieties were grown in replicated plots, and records were taken throughout the season. Winter resistance was judged by a series of grades from Grade 1, signifying practically no frost injury, to Grade 5 where the plants had been winter killed. The percentage of plants in Grades 1 and 2 was calculated and the varietal averages yielded values ranging from 100 per cent down to 0 per cent, thus giving a statistical indication of the most winter-resistant varieties.

The trials had not been concluded at the end of the period covered by this report, but full details will be available later. It may be mentioned here, however, that the earliest of the winter-hardy varieties proved to be St George. The next winter-hardy variety to follow St George was Royal Oak. No Roscoff variety could be classified as winter hardy. Roscoff No. 3 and the Harding strain, with 42 per cent and 45 per cent respectively of plants in the winter-hardy grade, were the hardiest, while the variety British Roscoff was very severely damaged by frost, no plants attaining the winter-hardy grade. It seems doubtful if any of these Roscoff varieties is likely to be of much use in Scotland.

Breeding.—An opportunity to obtain a foundation stock of apparently winter-hardy plants occurred in the winter of 1940-41, when a trial of broccoli varieties conducted by Mr J. W. Hall of the Edinburgh and East of Scotland College of Agriculture at Cupar was almost entirely destroyed by frost. By the courtesy of Mr Hall the best of the surviving plants were selected and removed to the Plant-Breeding Station, where intra-varietal crossings were made. In addition to the Cupar material, frost-resistant plants were selected for breeding purposes in 1941 from a strain of Late Queen growing at Edinburgh. The seeds obtained from the above material have been sown this spring both at Cupar and Corstorphine.

Seed Production.—The difference in hardiness and time of maturity between individual plants within a single variety greatly facilitates intra-varietal selection. Consequently the environment under which a variety is seeded is likely to influence its geographical usefulness. It is evident that an old variety like Late Queen is represented by races of differing hardiness, and it is possible that such differences are to some extent at least a result of environmental selection. This possibility raises the question of whether, when dealing with winter crops, special attention should be given to the choice of seeding localities with a view to raising regional races which would meet the specific needs of gardeners operating in different parts of the country. In order to test the value of regional seed growing a quarter of an acre of a relatively frost-susceptible race of the variety Late Queen is being seeded at Corstorphine this year. It is hoped that the average hardiness of this race will be raised as a result of the natural elimination of frost-susceptible plants from the breeding population.

Savoy Cabbage.

Variety Trials.—Eight commercial varieties—Alexander's No. 1 Late Dark Green, Green Curled, Ormskirk Early, Ormskirk Medium, Ormskirk Late Green, Ormskirk Extra Late, Perfect Gem, and Pixie Green—were grown in trial plots replicated six times. Notes were taken in December, February, and April on winter resistance, diameter of the head and its texture, and on time of maturity. The varieties Green Curled and Perfect Gem proved to be very much too

early, and were ready for use by 1st December. They succumbed completely to the first frosts of the year, and had subsequently to be left out of the trial.

The remaining varieties all formed good heads and all stood the winter reasonably well. Judged on its performance throughout the season Ormskirk Late Green was considered the most suitable to meet the needs of the average local gardener who wants a savoy to follow his cabbages and one which will stand until mid-April.

Carrots.

A small plot of St Valery carrots was grown in 1940, and about 600 typical roots were selected for seeding, off-types and coarse roots being discarded. The selected roots were carefully stored in sand, kept under cover during the winter, and planted out in the spring in an area occupying about 120 square yards. A few roots were lost probably through damage caused by maggots of the carrot-fly, but the surviving plants flowered freely, and about 25 lb. of cleaned ripe seed were secured and readily sold. The purity and the germination of the seeds were 99.3 per cent and 88 per cent respectively.

In 1941 about half an acre of Early Market (red-cored) carrot was grown, and about 1000 roots were selected for seeding in 1942. These roots were stored as described above, and they have been planted out.

Haricot Beans.

A few pounds of seed of haricot beans (variety Comtesse de Chambord) were sown in nursery plots in May. The plants grew very slowly at first, but they made more vigorous growth in August and September. Flowering took place late in the season, but some seeds were formed by the end of September. The plants were then pulled green, tied into small sheaves, and hung up on a fence to dry. When the weather became unfavourable the drying of the pods was completed in a well-ventilated shed. The seed obtained was quite well developed, but the yield was low, being at the rate of only about 2½ cwt. per acre.

Leeks.

A few thousand leek plants (variety 'Musselburgh') were kindly supplied free of charge by Mr R. L. Scarlett, Musselburgh, in the spring of 1941, and these were planted out and seeded. The plants flowered freely, but it was obvious in September that they were still far from being ripe. At the end of that month the seed heads were harvested and spread out in a well-ventilated room to promote ripening of the seed. Ripening proceeded very slowly, and the heads were not ready for threshing until about the end of January. The amount of seed obtained was small, only $2\frac{1}{2}$ lb., approximately, being secured. The percentage germination was only 51; the percentage purity 98.7.

Three thousand leek plants of the variety 'Musselburgh' were obtained in the summer of 1941 and planted where they are to be seeded in 1942.

Onions.

About a quarter of an acre of White Lisbon and about a quarter of an acre of Giant Rocca onions were grown for seeding in 1942. The White Lisbon onions were sown in a seed-bed in the spring and planted out later in the field. The Giant Rocca onions were raised under glass, pricked out into boxes, and transplanted during the summer in the field.

The White Lisbon plants formed only small bulbs, and the entire crop was allowed to remain in the ground throughout the winter. Only a small proportion of plants have died, and there is a good stand of plants for seeding. The Giant Rocca onions formed large bulbs and produced a good crop, but they never ripened-off satisfactorily. Typical bulbs were selected for seeding, and these were transplanted in the autumn in another field. A very large proportion of them, however, failed to survive the effects of the winter weather, and the small number remaining was not worth seeding.

Peas.

About an acre of the early-ripening garden pea 'Peter Pan' was grown for seed, and a good crop was produced, but the

occurrence of a spell of wet weather in August, when the plants were fully grown but not ripe, induced sprouting of the seeds within the pods. When it was observed that sprouting had commenced a quantity of pods were hand-picked and spread out on a floor to dry. It was found, however, that such a method of securing the crop was very laborious and also that the pods did not dry well. To avoid further wastage and to hasten the work of harvesting, all the plants were pulled green, made into small sheaves which were tied near the root end, and the sheaves hung up on tripods to dry. By this method of harvesting, the plants, although pulled damp, dried satisfactorily, and in due course they were in a fit condition for stacking. The peas kept well in the stacks, and were ready for threshing in December. As a considerable amount of the seed had germinated before it was harvested, the elimination of sprouted and damaged seed by hand-picking was necessary after threshing, and this greatly improved the quality of the sample. The total amount of cleaned, hand-picked seed obtained was $8\frac{1}{2}$ cwt. The purity of this seed was 95 per cent and the germination 81 per cent.

A trial plot of about an eighth of an acre was sown broadcast with a mixture of Atle spring wheat and Onward peas, at the rate per acre of 3 bushels wheat and 1 bushel peas. This spring wheat has short, stiff straw, and the experiment was to see whether the spring wheat would satisfactorily support the pea plants and keep the pods off the ground. The peas grew up well among the wheat, but they ripened rather earlier, and when ripe they began to fall to the ground. The mixed crop was harvested easily by the binder. The sheaves dried in the stook without difficulty, and the crop was ready for stacking within a fortnight. The mixed crop of wheat and peas was threshed in December, and the peas were easily separated by sieves from the wheat grain when the seed was being cleaned. The peas obtained by this method of growing were more attractive than those of the 'Peter Pan' variety grown alone. The growing of spring wheat and peas together for seed seems to have possibilities, and it is being tried again in 1942 on a larger scale.

II. Publications.

S. G. Stephens, M.A., Ph.D. :—

“Yield characters of selected oat varieties in relation to cereal-breeding technique.” *Journ. of Agric. Science*, Vol. 32, Part II., 1942.

III. Visits.

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