

SCOTTISH PLANT BREEDING STATION
PENTLANDFIELD, ROSLIN, MIDLOTHIAN

REPORT
TO THE
ANNUAL GENERAL MEETING
OF
THE SCOTTISH SOCIETY FOR RESEARCH
IN PLANT BREEDING
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BY THE
BOARD OF DIRECTORS

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REPORT BY THE DIRECTOR

General

WITH the aid of grants from the Department of Agriculture and Fisheries for Scotland good progress was made in the construction of much-needed new building. At 31st March 1967 an extension to the potato store and the installation of a new boiler had been completed; at the same time, a large new glasshouse for the maintenance of the Commonwealth Potato Collection was nearly finished and a new wing at the east end of the laboratory block was well advanced. The new wing, which should be ready for occupation in the summer of 1967, contains six working rooms on the lower floor and a large library room above. The last will allow us to convert the adjacent old library to a staff common room which will also be used for meetings and seminars. We thank the Department of Agriculture and Fisheries for Scotland not only for the provision of money for these jobs but also for the splendid assistance in design and supervision of construction given us by the Surveyor's Branch of the Department.

The laboratory site at Pentlandfield is becoming rather crowded but we believe we can see our way to providing the necessary new laboratory and glasshouse accommodation without compromising the essentially orderly layout of the place. The most urgent needs are for a new west wing to the laboratory and for more glasshouses; plans are advancing well and we hope to be able to report progress next year.

Progress 1966-67

Potato Investigations

The Official Immunity and Merit Trials conducted by the Department of Agriculture for Scotland in 1966 contained 45 of the Station's seedlings: 30 in the 1st Year, 12 in the 2nd Year and 3 in the 3rd Year of trial. The Committee recommended that 10 of the 1st Year group and 6 of the 2nd Year should be continued for further trial in 1967. Of the 3 seedlings in the 3rd Year group, 2 (3358ab(3)) and (3641a(1)) were commended. They were named Pentland Hawk and Pentland Ivory respectively and Foundation Stocks were passed to the Department of Agriculture for Scotland for distribution to specialist seed growers in Scotland. Virus-tested stocks were also distributed. Seed samples, amounting to a total of 6 cwts. of each variety, were supplied to the N.I.A.B. for regional trials in England, and half-hundredweight lots were also supplied

to the Edinburgh and East of Scotland College of Agriculture. Both varieties were granted Plant Breeders' Rights and they were exempted from statutory and other Trials under the Act.

Official descriptions of the varieties are as follows:—

PENTLAND HAWK

- Maturity* Early Maincrop.
- Tuber* Oval to long oval (kidney), occasionally slightly tapered; skin white, smooth; flesh cream; eyes shallow; sprouts pink (faint).
- Foliage* Haulm of medium height, semi-erect, fairly vigorous, open; stems strong, entirely green; nodes slightly swollen; wings waved, mainly on upper stems; leaf moderately open, broad; leaflets medium green, lobes mainly even, margins of sub-terminal leaflets slightly waved, petiolules long, green, faintly coloured in immature foliage; secondary leaflets frequent, often well-developed on petiolules of lateral leaflets and usually present on petiolules of terminal leaflets.
- Flower* Absent or rare, white; inflorescence stalks green; buds generally drop unopened.
- Remarks* Cropping: very good; cooking quality: fairly good; keeping quality: fairly good; foliage hypersensitive to the common race of blight; field-immune from viruses X and A, some field-resistance to virus Y; moderately susceptible to gangrene, moderately resistant to dry-rot as tested in the laboratory (normally similar reaction in the field), susceptible to skin spot.

PENTLAND IVORY

- Maturity* Early Maincrop.
- Tuber* Oval to long oval (pear-shape), slightly tapered at heel, uniform; skin white, smooth; flesh white to pale cream; eyes shallow; sprouts pink (faint).
- Foliage* Haulm of medium height, erect, open in the centre, later straggling; stems erect, mainly thin, green; wings waved mainly at stem apices; leaf moderately open, fairly long; leaflets dull grey-green, partially overlapping in basal foliage, lobes mainly even, terminal leaflets markedly cordate; secondary leaflets frequent, rarely borne on petiolules of lateral leaflets, usually present on petiolules of terminal leaflets.
- Flower* White, numerous; anthers orange; inflorescence stalks long, green; sepals green; buds green; berries occur.
- Remarks* Cropping; very good; cooking quality very good; keeping quality good; foliage hypersensitive to the common race of blight, some field resistance to other known races, tuber apparently blight resistant; field-immune from virus B, field-resistant to virus Y; resistant to gangrene and dry-rot, moderately susceptible to skin spot.

Plant Breeders' Rights were also granted with respect to Roslin Castle (seedling 3033(5)) and the name was added to the Index of approved varieties.

This variety has performed well in Britain and is also being tested under tropical and subtropical conditions where its resistance to blight, gangrene, dry-rot and virus Y, and its adaptation to shorter day lengths could be valuable. Several preliminary trials have given encouraging results.

In response to requests for seedlings for test in several African countries where early blight (*Alternaria solani*) and bacterial wilt (*Pseudomonas solanacearum*) are problems, over 50 samples were supplied. Results so far obtained show that resistance to both diseases is present in certain breeding lines employed originally in the late blight resistance experiments. It may therefore be possible to combine in one variety resistance to all three diseases.

Small virus tested stocks of Roslin Eburu, R. Sasumua and R. Chania were again forwarded for multiplication in Kenya, where commercial crops of these varieties are gradually deteriorating through virus infection. The demand for healthy stocks, particularly of R. Eburu, cannot be met at present but plans have been made to multiply the available virus tested units at Blythbank as rapidly as possible.

Co-operation in the work of the Central Potato Research Institute in India continued and a further consignment of single tuber samples from the greenhouse amounting to 3,209 seedlings was forwarded for trial and selection in the Simla Hills. Samples supplied in previous years have given encouraging results and some will be grown in demonstration plots in Himachal Pradesh in 1967. After these pilot tests it is hoped to release a selection for commercial cultivation in India.

With the rapidly increasing demand for varieties for processing purposes, some emphasis is being placed on the breeding and selection of seedlings suitable for crisping and canning. Crisping varieties should be acceptable for ordinary household purposes so that they will be saleable even when the crisping factories are over-supplied. Canning varieties, on the other hand, will have to be special purpose types because they must of necessity yield numerous small tubers unsuitable for the ware market. Fifteen such selections were tested as "canners" in 1966 and two of them were considered worthy of further multiplication and trial. The chief fault of the remainder was a tendency to break down when cooked. A further group of 12 selections will be tested in 1967.

Trial and multiplication plots at Blythbank in 1966 covered about 13 acres. They consisted of 10,892 single-tuber selections, 3,336 3-tuber plots, 488 8-tuber plots, 271 50-tuber plots, 32 one-fiftieth acre plots, 12 one-tenth acre plots and 4 half-acre plots. Virus-tested units of the Station's named varieties and seedlings in the Merit Trials were also grown.

Tests for field resistance to blight using race 1,2,3,4,5,7,8 were carried out on 250 of the Station's selections, and on 126 samples from the Central Potato Research Institute, India. Some of these had previously been tested at the Santa Elena Experimental Station in Mexico and, with certain exceptions due

to new R-genes, the results were similar. The inheritance of field resistance was also investigated in 32 progenies comprising some 2,500 seedlings which had been bred from field-resistant parents. The resistant survivors were grown to maturity and about 300 of the more promising types were retained for further trial. With the kind co-operation of Dr J. S. Niederhauser of the Rockefeller Foundation, 109 selections were grown in the Toluca Valley in Mexico in 1966, and scored for reaction to blight. Seventy-two seedlings were more resistant than the standard control variety Alpha and 19 were classified as grade-1 resisters.

The Commonwealth Potato Collection was received from the John Innes Institute in March 1967. Two new scientific staff to work on it took up appointment and the essential work of maintenance, together with related genetic investigations, will begin this season.

Work on blight continued during the year with some interesting results, which will be reported in appropriate scientific journals. Another case of seeming "breakdown" of field resistance was found due, as on other occasions, to the presence of an unsuspected new R-gene—the tenth to have been discovered. A detached leaflet test for field-resistance has been developed; it promises to be useful for rapid screening at a moderate level of accuracy. Several new complex races of blight were identified in experimental material and a field survey carried out in Scotland in collaboration with the Department of Agriculture for Scotland showed that a few isolates having complex specificities occur naturally here. A survey of *Andigena* Group clones which have emerged from a long-term selection experiment for cropping capacity and field-resistance was made; the results were very satisfactory for it appeared that the average blight resistance score was only 3 and many clones fell in the 1-2 category. Thus resistance is now higher than in the *Tuberosum* Group (score 4 in control samples).

Increasing attention is being paid to the various tuber diseases. Advanced breeding stocks were examined in respect of resistance to gangrene and work on common scab was continued at Archerfield. There is some resistance to scab in advanced seedlings and results were satisfactorily correlated with observations made on Merit Trial Seedlings by Mr B. C. Knight of the N.A.A.S. in Cheshire. Some observations on black scurf disease were also made.

Glasshouse assessment of the Merit Trial seedlings' reactions to viruses A,B,C, X and Y was carried out and routine measures to preserve the health of stocks at Blythbank were maintained.

In the eelworm studies two of the first-early resisters mentioned in last year's Report have gone forward to the final year Merit Trials. Both have *Andigena*-type resistance combined with high resistance to scab and gangrene. They could be very useful varieties, provided their eelworm resistance is wisely used.

The work of combining the resistance genes H_1 and H_2 on a *vernei* background was continued. This species generally behaves as though it had a polygenic ("field"-) resistance, but there is some recent evidence of strain-specific resistance in it. Despite these uncertainties there is certainly resistance there and its descendants are producing some attractive, bold, tubers—this in contrast to the experience of some other workers, who have found its derivatives to have strong stolons bearing tubers that are too numerous and small to be acceptable.

Fundamental studies of the eelworm itself have continued successfully, with the finding that pathogenicity is very probably—but not quite certainly—controlled by one locus such that AA and Aa give pathotype A and aa pathotype B. Thus no known combination at this locus attacks the potato genotype H_1H_2 ; nor is there evidence of the (hypothetical) pathotype O, which should be resisted by both H_1 and H_2 independently. Eelworms which attack H_1H_2 (pathotype E) exist and may represent genetic variation at a different locus. Resistance to E is known in *S. multidissectum* but is not yet understood; studies of it continue. There has been a suggestion that pathogenicity is "linked" with cyst colour, pathotype A showing a golden phase, pathotypes B and E passing from creamy white to brown directly. Some appropriate hybrids have been made and a field survey initiated to test the genetic nature of the relation.

The work of building up and assessing resistance to virus diseases was continued, a further 10,000 seedlings being screened for resistance to virus X and/or virus Y; a side-result of this work was the discovery of an interaction between resistance to the two viruses such that the stimulation of one resistance tended to inhibit infection by the other virus. Field exposure trials of varieties and experimental stocks were again run at Elvingston, East Lothian, and in collaboration with the Plant Breeding Institute at Cambridge. Thus 52 seedlings known to resist X were selected as being indicatively more resistant to Y and leaf-roll virus than even Pentland Crown. The excellence of Pentland Crown in this respect will be seen in the following figures; Pentland Hawk and Ivory are not so good as Pentland Crown, but both are superior to Majestic:—

	<i>Leaf roll,</i> <i>per cent infection</i>	<i>Virus Y,</i> <i>per cent infection</i>
Pentland Crown	53	2
Pentland Hawk	51	24
Pentland Ivory	76	9
Majestic-control	96	31

This sort of field resistance to viruses is a significant component of the current success of Pentland Crown, since ware growers are finding that, with good husbandry, healthy stocks can be maintained for several years.

Genetical studies of reaction to viruses were carried on with some interesting results. Evidence was obtained that N_{XB} from tetraploid *Andigena* is allelic with I_X from *Solanum acaule*, but probably not with a similar gene in *Solanum sparsipilum*. Genes controlling resistance to virus X and Y in *S. chacoense* were found to be probably linked. Further observations on *S. stoloniferum* confirmed earlier work which suggested that reactions to viruses Y and A are genetically independent—in disagreement with certain published data. A third locus also affects the reaction to virus A. The U.S. variety Saco has been thought of as a possible source of resistance to virus S; but it turns out that our entire stock is in fact S-infected, though at low virus concentration, and certain breeding anomalies are thus explained.

Several technical problems were also investigated. Thus *Chenopodium quinoa* was investigated—unsuccessfully—as an S-tester; the use of detached leaves for Y-tests was developed further; and attempts made to transmit leaf-roll virus by feeding aphids on sap extracts were—unfortunately—unsuccessful.

Forage Crops Investigations

Breeding projects with oats and barley were continued during the year. In oats the stem eelworm work continued along lines already well established and resistant selections were included in yield trials both on and off the Station. The oat-crossing programme during the year had as its main objective the production of composite cross material on a wide genetic base and, as a first step, a number of F_2 generation hybrids of earlier crosses were pollinated at random, using pollen from the oat variety museum. The hybrid grains so obtained were then grown over the winter in the greenhouse for field multiplication in 1967. Oat selection centres in Argyll and Inverness-shire were again used and a new centre for oat and barley selections was established in East Lothian on a farm near Dunbar, with more uniform soil than is available at Pentlandsfield.

We are much indebted to the Scottish Pulp and Paper Mill, Fort William, for a supply of compressed wood pulp which has proved an ideal medium for the germination of oat seedlings and which has greatly facilitated selection for resistance to the oat stem eelworm.

The trial and evaluation of advanced barley hybrids selected at Cambridge for malting quality was continued, four of the most promising selections being included in a field trial at Boghall laid out by the Edinburgh School of Agriculture. An extensive trial of other Cambridge selections was grown at the centre near Dunbar. In general the results were disappointing, the trials collectively indicating that all selections were somewhat inferior to Ymer. We plan one

further set of trials for 1967 and are reviewing the whole matter in discussion with the P.B.I., Cambridge.

For the development of our feeding barley programme composite cross material received from California was sown at Pentlandfield and at the three other centres, together with the progenies of a number of hybrids produced at Pentlandfield. Simultaneously, more hybrids produced in the glasshouse in 1966 were raised in the glasshouse over the following winter. The result will be several very widely based hybrid populations on which to found selection for high-yielding feeding types.

Discussions with the N.I.A.E. Scottish Station in the autumn of 1965 led to the development of a self-propelled seeder designed to meet our requirements for cereal plots. Although all the desired features had not been included, the essential parts of the machine were assembled in time to allow it to be used in the 1966 sowing of all the breeding and trial plots at Pentlandfield, the three selection centres and also at Archerfield. Even in its uncompleted form the use of the machine represented a great saving of time and labour in comparison with the hand-sowing methods previously used. Thus at Boat of Garten, Inverness-shire, a team of three in 1966 sowed nearly four times the area in the same time as the same team had taken by hand in previous years. By the spring of 1967 only the facility for continuous seeding from bulk hoppers remained to be completed and, subject to success in working trials and any final modifications, we believe we have the most efficient and versatile plot seeder in existence. The machine itself, together with a subsidiary device that it incorporates, has been patented by the National Research Development Corporation, under the formal name "The Scottish Plot Seeder." Our warmest thanks are due to colleagues at the N.I.A.E. for all their skilled help and encouragement.

In order to develop further our mechanisation programme, a small plot combine harvester designed by N.I.A.E., Wrest Park, Silsoe, for the P.B.I., Cambridge, was acquired in the autumn of 1966 and was tried out at Pentlandfield on some oat plots which had been kept for this purpose. The combine was unable to deal with the length of straw and has been returned to the manufacturer to be modified to suit our needs and for the incorporation of certain refinements.

Brassica work was concentrated during the year on the development of the new root-crop programme, primarily concerned with swedes (*B. napus* $2n=38$), turnips (*B. campestris*, $2n=20$), and swede \times turnip amphidiploids ($2n=58$).

Pentland Harvester, one of the highest yielding and most uniform cultivars on the market, besides being (as we noted last year) perhaps too "early" to be generally acceptable, has also given evidence of another defect—namely, internal flesh browning. Such symptoms are well known in swedes that suffer from boron deficiency, but of this there is no evidence in Pentland Harvester:

all the data we have now points to an autonomous genetic cause unconnected with mineral nutrition. The browning is unsightly and, even if it did not cause economic loss (which is uncertain), must surely militate still further against the success of the variety. Pentland Harvester is highly inbred—hence its uniformity of habit—but it is not impossible that we shall be able to select effectively against the internal browning: certainly, bulbs entirely free of symptoms were found in badly affected plots; they have been propagated as the first step in a re-selection programme.

Pentland Harvester is said to be "too early," a statement which is probably equivalent to saying that it does not store very well or is not very frost hardy. If we are to select effectively for "lateness" we must understand what we are selecting for. Accordingly, an experiment was laid down in conjunction with the Edinburgh and East of Scotland College of Agriculture to compare in field and store a number of commercial cultivars, ranging in type and dry matter content, in respect of various morphological and physiological characteristics. Meanwhile we assume that high dry matter is an important quality and have developed a rapid selection technique based on a core-flotation test.

In spring 1966 a number of crosses were carried out, mostly between Pentland Harvester and other cultivars possessing high D.M. contents. F_1 hybrids were transplanted to the field in late August to provide F_2 seed in spring 1967. These are the foundations of the general swede breeding programme.

The other two root crop projects are in a fairly early stage. Turnips of the hardy Aberdeenshire type were treated with colchicine—with results that have yet to be determined; and swede-turnip crosses were made and the F_1 hybrid seedlings treated with colchicine. The result will be a new root crop, another *napocampestris* hexaploid analogous to the leafy fodder plant mentioned below. Its agricultural potential is yet quite unpredictable. The turnip parents chosen were all resistant to club root caused by *Plasmodiophora*.

The new leafy forage plant, *B. napocampestris* ($2n=58$), derived by chromosome doubling of the hybrid *B. napus* (dwarf rape) \times *B. campestris* ssp. *nipposinica* (an oriental salad vegetable) was further studied. Observations made by the Agricultural Colleges in Scotland and by the National Institute of Agricultural Botany in England and Wales suggested that the synthetic did not compare favourably with commercial giant rape for total dry matter yield under normal agricultural conditions. There are suggestions that time of sowing, time of harvesting, etc., are important and further agronomic experiments are needed. It may be that the synthetic (or bred derivatives of it) will find its best place between the two major foliage crops, later than the rapes but earlier than the kales.

Various other *B. napocampestris* forms have been observed as spaced plants alongside their corresponding triploid hybrids and *B. napus* progenitors. The

triploids were consistently more vigorous than hexaploids but some of the latter compared favourably with commercial rape cultivars. Hybrids of which the annual *B. campestris* ssp. *pekinensis* was one parent showed a tendency to bolt but proved to have a good measure of frost resistance.

Attempts to hybridise *Raphanus* with *Brassica* (especially fodder rape \times fodder radish) continued but without much success, for the intergeneric cross is a very difficult one indeed. Selection in one fodder radish cultivar for reduced bolting was very successful.

For the grasses, 1966 was a year of preparation for the three main projects of the current programme—namely, the composite cross/diallel study of *Dactylis glomerata*, the breeding of improved cocksfoot and the production of early-growing hybrids between *Poa pratensis* and *P. ampla*. Of the cocksfoots, 509 samples with a latitudinal range of 42 to 60°N were received from foreign correspondents and 490 were sown for the composite cross. Twelve were chosen for hybridisation with Scotia Cocksfoot.

Eighty-seven samples of wild and cultivated *Poa* (mainly European members of the *pratensis* complex but including some American *P. ampla*) were received. Many came early enough to be included in a replicated field trial planted in the summer of 1966. This should provide us with a sound basis for the selection of breeding parents. In addition, over 50 samples of indigenous populations of *P. pratensis* were collected in Scotland and augmented by two batches of collections totalling 49 plants generously provided by Dr C. E. Hubbard from the South of England.

Foliage samples of all the *P. pratensis* cultivars and wild collections were dried and milled for chemical analysis and dry weights of equal numbers of plants per sample were taken to give rough estimates of productivity. The results, together with visual observations, suggested that there will prove to be large differences between strains; several Hungarian cultivars ("land races") seemed particularly productive.

What's Wrong with Plant Breeding?

Introduction

The population of the world in 1800 was about 1,000 million; it is now more than three times as great and increasing at about 2 per cent per annum. At this rate it will double in about 35 years and multiply eightfold in about 100 years. A sizeable fraction of the world's population is already hungry and food supplies are increasing much less rapidly than people. Population will, of course, come into balance with food: the alternatives before us are population control by famine, by war, by disease or by human design and surely

only the last choice is acceptable. As Sir Joseph Hutchinson said to the British Association last August: "Our greatest need is to master the threat of our own numbers."

Now these facts are coming to be generally recognised but there is a common belief that the population crisis applies to India, China and other distant countries but, somehow, not to Western Europe, least of all to us in Britain. This is wrong: Britain is already over-populated and steadily becoming more so, with an annual growth rate of about 0.7 per cent and a projected doubling time of about 100 years. Sir Joseph Hutchinson also said: "this country already carries as great a population as the environment can support without degeneration and it will call for all the knowledge and skill we can command to prevent irreparable damage before we achieve a stable population, even if we set about stabilisation without delay." The size which that stable population should be is arguable (Sir Joseph suggests 40 millions); but one thing is certain—it must be such as can be fed within our own resources, for we cannot reckon on obtaining large supplies of cheap foreign foodstuffs for many more years.

What are we to do meanwhile? One clear fact is that we shall have to grow a great deal more food rather quickly. Before the late war we produced only about one-third of our requirements; now we produce over one-half; and the need will soon be (as foreign supplies become scarce and expensive) to produce all our own basic food, and that for a swelling population from a diminishing area of land. Technically, British agriculture is rather efficient: certainly, its economic record since the war compares very favourably with that of much of the rest of British industry. But the best farming is still far ahead of the average, so there is plenty of room for advance even on the basis of established farm technology; further, agricultural science holds enormous potentialities for the future. All the same, it will take all our best efforts to feed ourselves adequately until the population stabilisation foreseen by Hutchinson becomes a reality. We shall need a great deal of excellent agricultural science—so much more important humanly than the circulation of iron-mongery in space—and a prodigious effort by the farmers themselves to use the resulting discoveries. The result will be an indefinite continuation of what the 1965-66 ARC Report called the "unspectacular inch by inch struggle on a very wide front to increase the efficiency of production"; in this struggle all phases of agricultural science will be significant and they must tend to be so closely integrated that failure in one may negate potential advances in another. A continuing critical review of what we are doing will therefore be needed to ensure that this does not happen.

The Scottish Plant Breeding Station is concerned with plant breeding, one crucially important phase of agricultural science. A review of the present state of British plant breeding seems worthwhile, and this I attempt in the following pages in the hope that it will stimulate some critical discussion.

The nature of plant breeding

There are four important points to make about plant breeding in general. The first two are simply facts; the last two are more debatable but are certainly worth closer enquiry.

(1) Plant breeding as a conscious, science-based activity is recent: it has only existed for about 150 years and has acquired a more or less coherent scientific basis only in the last 50 years.

(2) Plant breeding is extremely economical: it is a cheap activity in itself and the prime cost is nearly all. Thus a good variety costs little or no more than a poor one to cultivate and the difference in production is virtually free profit to the farmer. In this, plant breeding is unlike many other agricultural research activities in which a successful discovery demands expenditure by the farmer for its application: fertilisers, sprays and animal health measures are not cheap. As examples, I cite barley and potatoes: according to ARC figures, Proctor must have gained an average net profit of about ten million pounds per annum for ten years for British farmers; and a successful maincrop potato variety that yielded an extra ton of ware per acre and attained half the maincrop acreage would yield a net profit of about six million pounds per annum. In these terms one excellent variety of a major crop can be thought of as paying for the entire agricultural research service for several years and the costs of breeding it are infinitesimal in comparison with the profits.

(3) Plant breeding has been remarkably successful overall and has contributed enormously to the great advances in agricultural production in advanced countries during this century. But I shall argue later that it has sometimes not been as successful as it might have been, this for several reasons to be discussed.

(4) Finally, plant breeding is quasi-scientific: it is a technology not a science. Plant breeders are trying to bend Nature rather than to understand her.

The Context of British Plant Breeding

I think it is fair comment that the United Kingdom has an advanced agriculture but a backward plant breeding. If this be so, then British farmers are being poorly served in what is potentially one of the most important areas for the achievement of practical advance. In surveying the situation, I shall confine attention to the six most important crops, disregarding minor crops, vegetables, fruits and horticultural plants as being of small economic significance. The present situation may be summarised very briefly as follows. In the wheats we are dominated by foreign varieties, mostly of French origin; in the barleys, a great Cambridge variety, Proctor, has had enormous success but now shows signs of decline in the face of new continental varieties; oats are declining

anyway and, though some British-bred oats are grown, the tendency is for new Dutch varieties to dominate. In potatoes the leading maincrop varieties are some sixty years old, though an SPBS clone dominates the second early acreage and there are signs that two of our more recent maincrop varieties may yet achieve a major success. In the grasses the situation is complicated by the massive importation of foreign grass seed of variable, sometimes excellent, quality; among the rye grasses the outstanding Aberystwyth varieties still lead, but foreign material is coming on apace. In the sugar beets Britain was, until the Second World War, wholly dependent on foreign seed; there has since then been some vigorous private and official breeding, but the leading variety is still a commercial selection of the pre-war German beet, Klein E. The general tendency to foreign domination is unmistakable. Only two or three of the major varieties used in Britain since the war were actually bred in this country by one or other of the official breeding stations, and the signs are that this situation will probably get worse rather than better, as continental competition grows. Nevertheless, it must be understood that, limited as their major successes seem to have been, the official stations have overwhelmingly justified themselves, not only by the enormous profits made by the few great varieties but also because many minor successes have had by no means a negligible effect. At a reasonable guess farmers' profits from our varieties have exceeded at least thirtyfold the public cost of producing them.

Where, in all this, has commercial plant breeding fitted in? The answer is that it very nearly hasn't. Until recently British commercial plant breeding was small and almost completely ineffectual, hardly going beyond the maintenance by selection of standard varieties. These are hard words but, I think, fully justifiable. Happily there are now signs of change and, as we shall discuss later, the omens for successful commercial breeding in Britain are now good.

It is instructive to compare the situation in Britain with that which obtains in Northern Europe and North America. Both the two latter areas have agricultures which are technically comparable with that of Britain, but both are served by bigger and more vigorous plant breeding programmes. Evidence that this statement is correct is hard to put in objective concrete terms. For North America, I don't think any economic geneticist or plant breeder who has travelled widely and talked to many American colleagues would dispute the statement; I myself, from many visits to the United States, am convinced of the difference. For Europe the same consideration applies; a visit to a big continental breeding station is indeed an eye-opener to the British plant breeder; and we have, in addition, the overwhelming fact of the tendency towards domination of British agriculture by continental-bred varieties. I believe that socio-economic factors are responsible for the difference. On the continent and in America it is, I think, understood that plant breeding is a technology not a science; that success is profitable; and that success (hence profit) is

proportional to the resources put into the job. The outcome is a situation that has never developed in this country—viz., the building up of a large scale, intensely practical plant breeding effort, strictly directed towards immediate economic gains. This situation has been achieved in different ways in different countries. In Sweden and (for some crops) in the U.S.A. large State breeding organisations have been developed, organisations which differ in structure as between the two countries but which are, nevertheless, devoted to limited practical objectives. In other countries (for example Germany, France and Holland) plant breeding has been made profitable by legislation, so that it has been economically worthwhile for commercial seed firms to go in for plant breeding on the grand scale. Commercial plant breeding has also been highly successful in the United States in certain crops, in particular those (such as maize) in which the breeder has a built-in commercial control of his product. The result has been a tacit but perfectly workable division between commercial and State breeding, the latter carrying on those crops which the commercial breeders feel they cannot economically undertake.

All this is in marked contrast to the situation in Britain. Here we have never really understood, I think, that plant breeding is a technology and the results have been: small scale of operation; swamping by foreign varieties in several crops; the absence (or near absence) of serious commercial effort; and, consequently, poor service to the British farmer. Furthermore there has been a tendency to divide the effort of the three official breeding Stations between practical plant breeding and associated scientific studies. We have really had three half-stations and the surprising thing is not that they have not had more success, but that they have been as successful as the record shows.

Continental breeding is, I believe, no "better" than British breeding: it is just much larger, in a field in which success goes to the big battalions—hence the French wheats, the continental barleys, the Dutch oats and the German beets. In theory, at least, locally bred varieties ought to have a built-in advantage in comparison with foreign varieties so that it is not mere chauvinism to deplore foreign successes in Britain; we *ought* to be able to do even better.

But there is an obverse to this rather gloomy situation. The three official stations have done, as well as some good plant breeding, much good science; for example, genetic studies of wheat, grasses, brassicas and potatoes which have been developed over the past fifteen years or so all bid fair to have profoundly important economic results on breeding programmes in the longer term. These studies are as good as or better than any of their kind in the world. But who will benefit? As things are, so far as these researches are ripe for immediate practical applications, the likelihood is that it would be the continental or American breeders who would profit rather than ourselves. We could then—since we are signatories of the 1961 Paris Convention—find ourselves paying foreign royalties on the products of our own inventions. At

least the time is coming when, if these fundamental studies are to be put to use, a large, sustained, applied effort will be required. Science, in fact, must be translated into technology. Have we not heard this story before? Is this not just another example of the strong science—weak technology situation which seems to be endemic in our economy?

The immediate future

If the foregoing analysis be accepted as at least broadly correct it follows that many and drastic changes will be required if British plant breeding is to serve British agriculture up to the limit which the undoubted technical competence of that agriculture deserves. In this connection it cannot be too strongly emphasised that plant breeding is the most economical means known to us of improving agricultural productivity.

The crucial recent event was the passing of the Seeds Act (1964), followed by the introduction under the Act of Schemes relating to the various crops. Essentially the Act makes it possible for the breeder to levy royalties on his varieties in commercial cultivation. The Act is commonly referred to as providing for the application of "patents" to plant varieties but this is not correct: a patent in this country can only be applied to a concept or idea susceptible of practical application. What the Act does, rather, is to provide for the rigorous identification of varieties and then allows the breeder to charge cultivators a fee for growing the identified variety under its registered name. The outcome *should* be that commercial plant breeding in Britain will soon become profitable; if this does not happen then the Act will have failed because it has no useful function except to stimulate a commercial breeding effort. If the Act is fully successful then we may reasonably hope to see commercial plant breeding in Britain rapidly established on the same scale as that to which several continental countries have long been accustomed. If this does not happen then we shall need to know the cause of failure and what to do about it in order to stimulate commercial breeding. If that too were to fail then the situation would undoubtedly demand a great expansion of official breeding, whether at the existing stations or in a new State Breeding Corporation, constructed along the lines which have been very successful in Sweden. This is a matter upon which, it seems to me, those responsible for agricultural policy in this country will need to be deeply interested. Plant breeding is, for British agriculture, far too important a matter to be left to chance.

Meanwhile most of the new varieties being produced in this country at the present time come from the official stations. Some of those recently released and the majority of those going out in the near future are, or will be, subject to plant breeders' rights. That is, they will be eligible to attract royalties under the Seeds Act. It was recognised officially some years ago that the collecting

of royalties would be a complex administrative task, unsuitable to (and unwanted by) a research station. An organisation backed by Government but constructed along commercial lines was therefore set up to carry out the task of promoting and profiting from varieties bred at the official stations. This body, the National Seed Development Organisation (N.S.D.O.), acquired corporate status in March 1967 and is expected to begin work in the summer of this year; it should perform a useful public function, besides relieving the stations themselves of a lot of unwanted paper-work. There will be conflicts inherent in this situation. Commercial firms setting up in plant breeding may feel that they are being subjected to unfair competition from the official stations and the N.S.D.O., bodies which are supported, or at least largely backed, out of public money. This argument may have some merit but I suspect that, in the longer run, a little unfair competition of this kind would probably do good rather than harm, by serving as a stimulus to greater competition from the private sector. Further, in the longer run still, a really big and vigorous commercial plant breeding effort could so outweigh the rather small official breeding effort that the competition ceased to be of any significance at all. But this is a long way off yet.

The more distant future

We must now ask: where will the official stations stand in all this? I assume for the present purpose that commercial breeding will, in fact, develop strongly. I think, then, that the tendency will be for the official stations to be pressed in two directions: partly towards the fundamental studies on which the long term health of plant breeding depends and partly towards breeding those crops which, for one reason or another, were not attractive economically to the commercial operators, thus bringing about a situation not unlike that which obtains in the U.S.A.

This course of events would surely be felt within the official stations to be in some measure an unhappy one. Many workers like to be able to feel that they are free to move from the fundamental to the practical, carrying on an idea from its inception to its final incorporation in the construction of a new variety. Against this is the argument that few individuals have the range of scientific and practical talents demanded by such an approach. Even if a team of workers encompasses the necessary range of talents it could be held that it is difficult to combine both the right kind of scientific investigation and the vigorous commercial-type drive that is required for successful plant breeding in the one group. On this argument, the long term needs of plant breeding would best be met by orientating the official stations towards basic studies and separating from them the rather different kinds of men and facilities required for practical plant breeding. The very real dangers of such a division would

have to be recognised. Fundamental studies are a necessary provision for long-term advance, but they need to be translated into technology; there would be, in fact, a vital need for effective communication between the two wings of plant breeding and, if the official stations were in practice to become rather more fundamentally orientated, we should have to be very careful indeed to ensure a really free flow of materials and ideas from them to the commercial breeders and *vice versa*. If this analysis is correct, there should be no grounds for jealousy between scientists and breeders, for both would be contributing elements essential to the health of the whole operation—namely, a lively and productive plant breeding, adequately serving both the long- and short-term needs of British agriculture.

One final point: the suggestion that the official stations will probably be pressed towards more basic rather than practical activities means that they would tend to move in the direction in which they are already strongest, as examples given above will, I think, have shown. It might be argued that fundamental studies would be better adapted to the universities than to agricultural research institutes. This, I think, is wrong because: first, such studies demand facilities in the way of continuity, land, glasshouses and assistants, which are rarely or never achievable in British universities, but are in the research stations; and, second, though such studies can be called "fundamental" in the context of plant breeding, they are, I think, basically economic in orientation and would commonly be regarded as rather "impure" in university circles. They lie, in fact, in the vitally important middle area of work between the commercial and the academic extremes. This is the area in which tomorrow's technology is born and it is, it seems to me, the natural preserve of the research stations. It can be plausibly argued that this kind of division between the universities and research stations is intrinsically bad, leading to academic remoteness on the one hand and insularity on the other. There is surely something in this argument. But the division is a present reality; we must try to break it down, but meanwhile it is there and the responsibility of the research stations to carry on the long-term fundamental-economic studies is clear.

VARIETIES BRED BY THE STATION

Distribution of elite stocks of Scottish Plant Breeding Station products is in the hands of the following:—

<i>Oats</i>	BELL	Messrs Macfarlan, Shearer & Co., Greenock.
<i>Grasses</i>	SCOTIA COCKSFOOT SCOTIA TIMOTHY SCOTIA PERENNIAL RYEGRASS	National Institute of Agricultural Botany, Cambridge.
<i>Swede</i>	PENTLAND HARVESTER	
		National Institute of Agricultural Botany, Cambridge.

Other Scottish Plant Breeding Station products on the market are:—

<i>Oats</i>	CRAIGS AFTERLEA ALBYN DONSIDE ALBYN EMPRESS	EARLY MILLER ALBYN BARD SHEARER
<i>Barley</i>	CRAIGS TRIUMPH	
<i>Bean</i>	ALBYN TICK	
<i>Potatoes</i>	CRAIGS DEFIANCE CRAIGS ALLIANCE PENTLAND BEAUTY PENTLAND DELL PENTLAND FALCON* PENTLAND HAWK* ROSLIN CASTLE*	CRAIGS ROYAL PENTLAND ACE PENTLAND CROWN PENTLAND ENVOY PENTLAND GLORY* PENTLAND IVORY*

Plant Breeders' Rights have been granted in these varieties* and licences to reproduce and sell stocks have been issued to growers and merchants.

Applications for licences to grow and sell protected varieties of plants bred by the Society should be sent to the Secretary, Scottish Plant Breeding Station, Pentlandfield, Roslin, Midlothian.

Growers wishing to raise virus-tested stocks of potatoes bred by the Society should make application to the Secretary for virus-tested units. The Department will continue to distribute the Society's stocks of new varieties of potatoes; applications should be sent to the Director, Scientific Services, East Craigs, Edinburgh, 12.

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EXPERIMENTAL CENTRES

In addition to Pentlandfield, the following experimental centres were in use during the year:—

Potatoes:—

Animal Breeding Research Organisation Farm, Blythbank, Peeblesshire.
Centre for potato seedling selection and multiplication of virus-free stocks.

Plant Breeding Institute, Cambridge. Centre for virus resistance trials.

Elvingston, East Lothian. Centre for leaf-roll resistance trials.

Archerfield, East Lothian. Trial centre for resistance to common scab.

Cereals:—

Tullochgorum, Boat of Garten, Inverness-shire. Environmental selection centre.

South Ledaig, Benderloch, Argyll. Environmental selection centre.

Archerfield, East Lothian. Centre for selection for resistance to manganese deficiency.

Hedderwick Hill, Dunbar. Environmental selection and trial centre.

The Society is indebted to officers of the three Agricultural Colleges, respectively at Aberdeen, Glasgow and Edinburgh, for assistance in connection with the testing of plant material; to the Animal Breeding Research Organisation, Edinburgh and the Plant Breeding Institute, Cambridge, for facilities at respectively Blythbank and Cambridge; to the National Institute of Agricultural Botany, the National Agricultural Advisory Service and the Scientific Services of the Department of Agriculture and Fisheries for Scotland; and to the many farmers and land-owners who have co-operated in the work of the Station.

STAFF LIST

(in post at 31st March 1967)

Director: N. W. Simmonds, Sc.D., A.I.C.T.A., F.I.Biol.
Deputy Director: W. Black, Ph.D., D.Sc., F.R.S.E.

Forage Crops

D. Cameron, B.Sc.
I. H. McNaughton, M.A., D.Phil.
J. T. Walker, B.Sc., Ph.D., A.K.C.
Miss P. J. Watson, M.A., Ph.D.

Miss E. Bennett, B.Sc.
F. J. W. England, B.Sc., Ph.D.
Miss J. Hartridge, B.Sc.
Miss A. R. Hutchison, B.Sc.
Miss I. K. Munro, B.Sc.
D. W. Speed, B.Sc.
G. R. White, B.Sc.

Technical Assistants: Miss E. M. C. Baillie
Miss M. D. Black
I. Cowe
Miss A. T. Patterson
A. Young
Miss H. K. Young

Potatoes

W. Black, Ph.D., D.Sc., F.R.S.E.
C. P. Carroll, M.Sc.
G. Cockerham, B.Sc., Ph.D.
J. M. Dunnett, B.Sc., Ph.D.
D. R. Glendinning, B.Sc.
D. A. Govier, B.Sc., Ph.D.
Miss J. F. Malcolmson, B.Sc., Ph.D.

T. M. W. Davidson, B.Sc., Ph.D., N.D.A.
A. W. Macarthur, B.Sc.
Miss M. Turner

Graduate Student: A. Bedi, M.Sc.

Technical Assistants: Miss C. Brydon
G. Duncan
A. McFarlane
Mrs J. Spence
Miss A. Spencer

Administration

Secretary: R. J. L. Gallie, F.C.C.S.
Assistant Secretary: Miss E. A. Piggott
Clerical Officer: Miss A. G. Dunnett
Director's Secretary: Miss R. Pendrich
Clerical Assistant: Miss D. Teasdale
Shorthand Typist: Miss R. Jackson

BOARD OF DIRECTORS, 1966-7

Trustees

H.M. SECRETARY OF STATE FOR SCOTLAND, Scottish Office, St Andrew's House, Edinburgh.

DAVID BELL, 15 Coburg Street, Leith, Edinburgh.

Sir JAMES DENBY ROBERTS, Bt., O.B.E., M.A., J.P., Strathallan Castle, Auchterarder.

ROBERT L. SCARLETT, C.B.E., C.D.A., S.H.M., V.M.H., Sweethope, Musselburgh.

Chairman of Directors

Sir JAMES DENBY ROBERTS, Bt., O.B.E., M.A., J.P., Strathallan Castle, Auchterarder.

Vice-Chairman

W. ANDREW BIGGAR, O.B.E., M.C., B.Sc., Magdalene Hall, St Boswells.

Ordinary Directors

1964

W. A. BUCKPITT, B.Sc., The Rowans, Duns.

H. F. D. ELDER (Messrs William Dods & Son), Haddington.

A. HOWIE, B.Sc.(Agric.), N.D.A., N.D.D. (North of Scotland College of Agriculture), 41½ Union Street, Aberdeen.

PETER MACDUFF (Messrs Macfarlan, Shearer & Co.), Greenock.

A. D. C. MAIN, O.B.E., B.Sc., J.P., Windyedge, Perth.

R. H. WATHERSTON, C.B.E., Crichton Mains, Ford.

1965

JOHN ARBUCKLE, Logie, Newburgh.

W. ANDREW BIGGAR, O.B.E., M.C., B.Sc., Magdalene Hall, St Boswells.

GEORGE CLAPPERTON, Sheriffhall Mains, Dalkeith.

J. W. GRANT, B.Sc. (North of Scotland College of Agriculture), Drummondhill, Stratherrick Road, Inverness.

F. R. HORNE, C.B.E., M.A., N.D.A., N.D.D., Hill Farm, Lolworth, Cambridge.

IAN JENNINGS, Nether Cleuch, Dalry.

1966

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

J. LESLIE DAWSON, B.Sc. (S.A.I. Ltd.), West Mains of Ingliston, Newbridge, Midlothian.

J. F. FALGATE, Pinkerton, Dunbar.

JAMES GRAY, M.B.E., T.D. (James Gray & Co (Stirling) Ltd.), Stirling.

G. A. STORRAR, M.C., B.Sc., J.P., Rossie, Auchtermuchty.

D. THOMSON, Cessford, Kelso.

Directors Co-opted

ROBERT ALLISON, Turnhouse, Corstorphine, Edinburgh, 12.

G. B. R. GRAY, Smeaton, East Linton.

JOHN MARSHALL, C.B.E., Dalreoch, Dunning.

Directors nominated by the Secretary of State for Scotland

- D. W. WILLIAMS, M.Sc., Ph.D., Scientific Services, East Craigs, Corstorphine, Edinburgh.
ALEXANDER NELSON, Ph.D., D.Sc., N.D.A., F.R.S.E., 86 Great King Street, Edinburgh.
M. A. H. TINCKER, M.A., D.Sc., F.L.S., F.R.S.E., Arbedie House, 44 Station Road,
Banchory.
C. M. YONGE, C.B.E., Ph.D., D.Sc., F.R.S., 13 Cumin Place, Edinburgh, 9.

Standing Committee—Finance

- | | |
|---|-------------------------------------|
| Sir JAMES DENBY ROBERTS, Bt.,
<i>Convener.</i> | A. D. C. MAIN. |
| R. ALLISON. | ALEXANDER NELSON. |
| JOHN ARBUCKLE. | ROBERT L. SCARLETT. |
| H. F. D. ELDER. | D. THOMSON. |
| G. B. R. GRAY. | M. A. H. TINCKER. |
| | W. A. BIGGAR (<i>ex-officio</i>). |

Research Committees

Forage Crops

- | | |
|----------------------------------|---|
| H. F. D. ELDER, <i>Convener.</i> | A. HOWIE. |
| W. A. BUCKPITT. | I. JENNINGS. |
| G. CLAPPERTON. | P. MACDUFF. |
| J. L. DAWSON. | D. THOMSON. |
| J. W. GRANT. | R. H. WATHERSTON. |
| G. B. R. GRAY. | W. A. BIGGAR (<i>ex-officio</i>). |
| JAMES GRAY. | Sir JAMES DENBY ROBERTS, Bt. (<i>ex-officio</i>). |
| F. R. HORNE. | |

Potatoes

- | | |
|-------------------------------|---|
| J. ARBUCKLE, <i>Convener.</i> | G. A. STORRAR. |
| R. ALLISON. | D. THOMSON. |
| A. MANTON BAXTER. | D. W. WILLIAMS. |
| J. F. FALGATE. | W. A. BIGGAR (<i>ex-officio</i>). |
| A. D. C. MAIN. | Sir JAMES DENBY ROBERTS, Bt. (<i>ex-officio</i>). |
| J. MARSHALL. | |

ELECTION OF DIRECTORS

In accordance with the rules of the Society the following Directors retire from the Board at this time:—

- W. A. BUCKPITT, The Rowans, Duns.
- H. F. D. ELDER (William Dods & Son), Haddington.
- A. HOWIE, North of Scotland College of Agriculture, Aberdeen.
- PETER MACDUFF (McFarlan Shearer & Co.), Greenock.
- A. D. C. MAIN, O.B.E., Windyedge, Perth.
- R. H. WATHERSTON, C.B.E., Crichton Mains, Ford.

To fill these vacancies the Board of Directors recommends election of the following:—

- ROBERT ALLISON, Turnhouse, Corstorphine, Edinburgh, 12.
- W. LOGAN FORREST, B.Sc. (Mersington Farms Ltd.), Greenlaw.
- G. B. R. GRAY, Smeaton, East Linton.
- JOHN MARSHALL, C.B.E., Dalreoch, Dunning.
- P. P. WADE, Whitegates, Bardon Mill, Hexham, Northumberland.
- JOHN WATSON (McGill & Smith Ltd.), Ayr.

MEETINGS

The Board of Directors met four times: on 28th July 1966; 17th November 1966; 5th April 1967; and 1st June 1967.

The Finance Committee met on 1st June 1967.

Research Committee Meetings were held as follows: Potatoes on 12th January 1967; Forage Crops on 20th October 1966.

ADMINISTRATION

Finance

The abstract of the audited accounts set out on pages 30-36 reveals the Society's financial position at 31st March 1967. Maintenance expenditure for the year amounted to £97,021, 16s. 2d., assuming a refund of £1,615, 17s. 0d., in respect of recoverable Selective Employment Tax, against which the Department of Agriculture and Fisheries for Scotland provided a grant of £97,500 while income from other sources was £912, 14s. 0d.

The Department also made a capital grant of £18,057, 12s. 3d. for erecting an east wing to the main laboratory block and a glasshouse for the Commonwealth Potato Collection.

The Directors thank the Department of Agriculture and Fisheries for Scotland for grants received and firms, organisations and individuals who contributed to the funds of the Society.

Membership

At 31st March 1967, the total membership was 353, comprising 174 life members and 179 annual members. Nine new members were elected during the year while 9 members died or resigned.

Distribution of Membership as at 31st March 1967

Aberdeen	10	Fife	21	Renfrew	2
Angus	22	Inverness	5	Ross and Cromarty	9
Argyll	3	Kincardine	2	Roxburgh	11
Ayr	11	Kinross	1	Selkirk	3
Banff	1	Kirkcubright	2	Stirling	5
Berwick	20	Lanark	22	Sutherland	..
Bute	..	Midlothian	64	West Lothian	7
Caithness	4	Moray	6	Wigtown	3
Clackmannan	1	Nairn	1	England	27
Dumfries	6	Orkney	3	Ireland	1
Dunbarton	4	Peebles	1	Wales	..
East Lothian	50	Perth	21	Abroad	4

Board of Directors

Mr A. Manton Baxter, Peterborough, was welcomed on his election for the first time to the Board of Directors.

Staff

The following new appointments were made during the year:—

<i>Scientific</i>	Mr C. P. Carroll, M.Sc. (Potatoes). Mr D. R. Glendinning, B.Sc. (Potatoes). Dr J. T. Walker, B.Sc., Ph.D., A.K.C. (Forages).
<i>Experimental</i>	Miss M. Turner (Potatoes).
<i>Scientific Assistants</i>	Miss E. M. C. Baillie (Forages). Mr G. Duncan (Potatoes). Miss A. T. Patterson (Forages). Miss A. Spencer (Potatoes). Miss H. K. Young (Forages).
<i>Administration</i>	Miss R. Pendrich. Miss A. Piggott. Miss D. Teasdale.

The following resignations were received:—

Miss L. Callan.
Miss A. Malcolm.
Dr D. Ratcliffe.
Dr A. Smith.

Miss Callan moved to a new appointment in Glasgow. Miss Malcolm retired after nearly forty years of devoted service to the Station. Drs Ratcliffe and Smith moved to new appointments in the Agricultural Research Service, in the Hill Farming Research Organisation and the Grassland Research Station respectively. Our best wishes go with them all.

Two members of staff attended the Third Triennial Conference of the European Association for Potato Research in Zurich, 4th-8th September 1966: Dr T. M. W. Davidson and Dr J. F. Malcolmson. Dr Malcolmson presented, with Dr E. G. Gray, a paper entitled "Gangrene of Potatoes in Northern Scotland." Miss E. Bennett spent six months in the summer of 1966 at the Crop Research and Introduction Centre at Izmir, Turkey, under invitation from F.A.O. Members of staff also attended various scientific meetings in the United Kingdom during the year.

The Director was appointed Honorary Senior Lecturer in Botany in the University of Edinburgh and gave a course of eleven lectures to the fourth year class entitled "Topics in Economic Genetics." He also gave eight lectures in various universities and research stations in the U.K. and a talk on the B.B.C. Third Programme entitled "The Lost Genes." In November-December 1966 he visited Cornell University, gave a seminar, and then attended the annual meeting of the West Indies Sugar Association Technical Committee in Barbados.

The Station received many visitors during the year, including parties of students and farmers, as well as many individual scientists from home and abroad. We were pleased to see them.

Mr F. J. W. England was awarded the degree of Ph.D. in the University of Edinburgh.

Acknowledgments

Acknowledgment of financial assistance from the Department of Agriculture and Fisheries for Scotland and of practical help in various forms from Universities, Colleges, Institutes, Companies and individuals has been made elsewhere in this Report. To all who have thus supported the work of the Station we offer our warmest thanks.

ABSTRACT OF ACCOUNTS

For year ended 31st March, 1967

1965-66		INCOME	
£241		Interest received	£235 16 1
154		Recoverable Income Tax	125 9 5
	<u>£395</u>		
	414	Sales of Produce and Stock on Hand	£361 5 6
	3	Sale of Equipment	437 11 6
	86	Subscriptions—Annual	85 5 0
		Note.—Annual Subscriptions amounting to £11 are in arrear.	
	29	Rent of Cottage	28 12 0
	<u>£927</u>	<i>Total Ordinary Income</i>	<u>£912 14 0</u>
		Grant received from the Department of Agriculture and Fisheries for Scotland:—	
	91,000	Maintenance for year 1966-67	£97,500 0 0
	<u>£91,927</u>	<i>Total Income</i>	<u>£98,412 14 0</u>
		Balance at 1st April 1966:—	
	4,449	Department of Agriculture and Fisheries for Scotland—Main- tenance Grant	5,064 13 4

£96,376

£103,477 7 4

EXPENDITURE

1965-66

Salaries:—			
£50,552	Scientific and Technical Staff	£51,738	5 6
5,446	Administrative and Clerical Staff	5,772	18 9
725	Pension Supplementation	1,111	8 11
<u>£56,723</u>		<u>£58,622</u>	<u>13 2</u>
5,268	Superannuation Contribution	5,391	1 6
10,688	Wages	10,804	10 11
2,344	National Insurance and Graduated Contributions	2,468	7 1
2,895	Sundry Working Expenses	3,509	0 6
712	New Vehicle
782	Maintenance of Vehicles	977	17 8
2,017	New Equipment and Renewals of Implements and Tools	3,824	16 9
136	Furniture	90	9 6
383	Library Expenses	336	15 2
1,238	Rates, Taxes and Insurances	1,347	9 7
161	Audit Fee and Legal Expenses	201	5 0
1,367	Printing	609	1 8
835	Stationery, Postages, Telephone and Office Expenses	939	18 3
3,189	Power, Light and Heat	3,781	1 9
908	Travelling and Subsistence Expenses	1,466	2 0
698	Property Repairs and Upkeep	470	18 10
40	Regional Trials	70	0 0
80	Advertising Vacancies	325	11 0
847	Edinburgh Centre of Rural Economy—Contribution towards upkeep	919	0 0
..	Land Improvements	865	15 10
<u>£91,311</u>	<i>Total Ordinary Expenditure</i>	<u>£97,021</u>	<u>16 2</u>
Balance at 31st March 1967:—			
5,065	Department of Agriculture and Fisheries—Maintenance Grant	6,455	11 2
<u>£96,376</u>		<u>£103,477</u>	<u>7 4</u>

BALANCE SHEET

as at 31st March, 1967

I Funds at 31st March 1967

Balance as at 31st March 1966	£163,455	4	0	
Gain on 'realisation' of 4 per cent Funding Stock	975	3	4	
Dept. of Agriculture and Fisheries for Scotland Capital Grant	18,057	12	3	
				<u>£182,487 19 7</u>

II Current Liabilities:—

Accounts outstanding due by Society	£538	2	0	
Subscriptions paid in advance	1	10	0	
Dept. of Agriculture and Fisheries for Scotland Maintenance Grant ²	6,455	11	2	
				<u>6,995 3 2</u>

£189,483 2 9

I Fixed Assets:—

	Cost	Amounts charged to Revenue	Net
Heritable Property	£174,978 17 1	...	£174,978 17 1
Implements and Tools	11,151 13 0	£11,151 13 0	...
Vehicles	2,498 16 6	2,498 16 6	...
Laboratory Apparatus	11,544 11 1	11,544 11 1	...
Furniture and Fittings	5,234 0 5	5,234 0 5	...
Library Books	4,079 0 0	4,079 0 0	...
	<u>£209,486 18 1</u>	<u>£34,508 1 0</u>	<u>£174,978 17 1</u>

II Current Assets:—

Stocks on Hand as valued by Directors	£30	0	0	
Accounts Outstanding, due to Society	1,797	11	0	
Income Tax Recoverable	125	9	5	
Investments (see Appendix), at cost	6,936	7	8	
Cash and Bank Balances	5,614	17	7	
				<u>14,504 5 8</u>
				<u>£189,483 2 9</u>

Edinburgh, 18th May 1967.—The undersigned, having had access to all the Books and Accounts of the Society, and having examined the foregoing Statement of Accounts and verified the same with the Accounts and Vouchers relating thereto, now sign the statement to be correct, duly vouched, and in accordance with law.

16 Alva Street.

R. L. MACDONALD, *Approved Auditor.*

J. D. ROBERTS, *Convener, Finance Committee.*

LIFE MEMBERSHIP SUBSCRIPTIONS AND DONATIONS ACCOUNT

Interest received	£254 3 9
Recoverable Income Tax	93 11 10
	<hr/>
	£347 15 7
Life Subscription	50 0 0
Donations	100 0 0
Gain on realisation of Investments	118 11 0
Balance at 1st April 1966	7,045 5 7
	<hr/>
	<u>£7,661 12 2</u>

W. J. REID AND JAMES MUNRO BEQUESTS

Interest received	£80 16 1
Recoverable Income Tax	0 6 11
	<hr/>
	£81 3 0
Gain on realisation of Investments	16 16 0
Balance at 1st April 1966	1,792 13 9
	<hr/>
	<u>£1,890 12 9</u>

DR. WILSON MEMORIAL FUND

Interest received	£13 14 6
Recoverable Income Tax	0 18 7
	<hr/>
	£14 13 1
Gain on realisation of Investments	6 6 0
Balance at 1st April 1966	448 15 3
	<hr/>
	<u>£469 14 4</u>

Balance at 31st March 1967, consisting of:—

Investments (see Appendix), at cost.	£6,368	4	5	
Recoverable Income Tax.		93	11	10
Sum in Bank of Scotland Savings Account.		872	19	2
Sum in Bank of Scotland Current Account		326	16	9
				<u>7,661 12 2</u>

£7,661 12 2

Grant to Reading University College				£20	0	0
„ for retiral gift				50	0	0
„ „ hospitality				53	12	0

Balance at 31st March 1967, consisting of:—

Investments (see Appendix), at cost.	£1,581	3	1	
Recoverable Income Tax.		0	6	11
Sum in Bank of Scotland Savings Account.		21	9	11
Sum in Bank of Scotland Current Account		164	0	10
				<u>1,767 0 9</u>

£1,890 12 9

Balance at 31st March 1967, consisting of:—

Investments (see Appendix), at cost.	£368	17	6	
Recoverable Income Tax.		0	18	7
Sum in Bank of Scotland Savings Account.		50	18	0
Sum in Bank of Scotland Current Account		49	0	3
				<u>£469 14 4</u>

£469 14 4

APPENDIX

LIST OF INVESTMENTS

General Account

Nominal Value			Market Value at 31/3/67
£375	0 0	Courage, Barclay & Simonds 750 Ordinary 10s. Shares	825
225	0 0	National Commercial Bank of Scotland 450 Ordinary 10s. Shares	574
160	0 0	Royal Exchange Assurance Co. Capital £1 Stock	532
525	0 0	Imperial Chemical Industries Ordinary £1 Stock Units	978
325	0 0	Electric & Musical Industries 650 Ordinary 10s. Stock Units.	886
2,846	5 7	6½ per cent Exchequer Stock 1971	£2,867
<u>£4,456</u>	<u>5 7</u>		<u>£6,662</u>

Life Membership Subscriptions and Donations Fund

£416	8 1	Funding 6½ per cent Stock 1985-1987	£406
360	0 0	City of Birmingham 6½ per cent Redeemable Stock 1972-1973	353
247	10 0	National Commercial Bank of Scotland 495 Ordinary 10s. Shares	631
120	0 0	Royal Exchange Assurance Co. Capital £1 Stock	399
240	0 0	Courage, Barclay & Simonds 480 Ordinary 10s. Shares	528
345	0 0	Imperial Chemical Industries Ordinary £1 Stock Units	643
220	0 0	Electric & Musical Industries 440 Ordinary 10s. Stock Units	599
500	0 0	Defence 5 per cent Bonds, 2nd Issue	500
1,983	10 6	6½ per cent Exchequer Stock 1971	1,998
<u>£4,432</u>	<u>8 7</u>		<u>£6,057</u>

W. J. Reid and James Munro Bequests

£67	0 0	Imperial Chemical Industries Ordinary £1 Stock Units	£125
735	0 0	Defence 5 per cent Bonds, 1st Issue	735
150	0 0	Defence 5 per cent Bonds, 2nd Issue	150
583	10 7	Funding 6½ per cent Stock 1985-1987	568
<u>£1,535</u>	<u>10 7</u>		<u>£1,578</u>

Dr Wilson Memorial Fund

£30	0 0	Royal Exchange Assurance Co. Capital £1 Stock	£100
217	12 8	Funding 6½ per cent Stock 1985-1987	213
<u>£247</u>	<u>12 8</u>		<u>£313</u>

LIST OF MEMBERS

The following information is the latest known to the Society. It would be appreciated if alterations requiring to be made could be intimated to the Secretary.

Aberdeen

Chisholm, Miss E. M. Gibston, Huntly.
Durno, James, C.B.E., Uppermill, Tarves.
Ellis, John, Crookmore, Alford.
Gill, A. J. (James Gill & Sons, Ltd.), 6 Exchange Street, Aberdeen.
Howie, Andrew, B.Sc.(Agric.), N.D.A., N.D.D. (North of Scotland College of Agriculture),
41½ Union Street, Aberdeen.
Lee, E. M., Haddo, Methlick.
Mackie, Maitland, O.B.E., LL.D., North Ythsie, Tarves.
Salmon, A. B., 20 Harlaw Road, Aberdeen.
Shackleton, J. F. (Benjamin Reid & Co.), 20 Hadden Street, Aberdeen.
Turnbull, A. T., Smithston, Gartley.

Angus

Adam, Robert M., Newhouse of Glamis, Glamis.
Archie, Alex. R., South Leckaway, Forfar.
Barr, John M. (Pattullo, Barr & Co. Ltd.), West Dock Street, Dundee.
Barron, J. R., Findowrie Farm, Brechin.
Batchelor, D. Hill, 4 Baltic Street, Montrose.
Black, David, 16 Railway Road, Montrose.
Braes, Robert, West Ballochry, Montrose.
Fairlie, Dennis W. W., Kirkton, Monikie, Dundee.
Forster, E. A., Mains of Benholm, Benholm, Montrose.
McLeish, Allister (Geo. Ogilvie (Montrose) Ltd.), Panmure Buildings, Ferry Road, Montrose.
Mackie, George Y., Ballinshoe, Kirriemuir.
Milne, Alex. S., Timaru, Trinity, Brechin.
Murray, Joseph, N.D.A., N.D.D., Balruddery Farm, Invergowrie (*last known address*).
Murdie, T. Laurie, Birkenbush, Forfar.
Murray, T. P. Douglas, 26 Swan Street, Brechin.
Porter, A. Gordon, C.D.A., Scryne, Carnoustie.
Rankin, G. M., Westdrums, Brechin.
Smith, Stanley B., Crosston, Dunnichen.
Steven, William, Craigmill, Carnoustie.
Thyne, J. C., 65 Trades Lane, Dundee.
Thomson, J. G., Kinpurnie Farm, Newtyle.
Wallace, D. Pitpointie, Auchterhouse, Dundee.
Young, Charles, B.Sc., Shielhill, Dundee.

Argyll

Campbell, Sir George I., Bt., of Succouth, Crarae Lodge, Inveraray.
Ferguson, Hugh, B.Sc., Beach Hill, Campbeltown.
Pollak, Mrs Gladys M., Ronachan, Clachan.

Ayrshire

Archibald, Robert, Viewpoint, Ashgrove Road, Kilwinning.
Atkinson, James, 37 St Andrew Street, Kilmarnock.
Borland, T. W. (James Borland & Sons Ltd.), 9 St Marnock Street, Kilmarnock.
Crawford, Robert, Drumbeg, Turnberry.
Duncan, John, Castlehill, Maybole.
Forbes, J. D. H., "St. Brelades," Drumdown Road, Turnberry, Ayr.
Hannah, John J. M., C.B.E., Girvan Mains, Girvan.
Harvey, N. P., Oakvilla, Dalrymple, Ayr.
McGill, J. Becket F. (McGill & Smith Ltd.), Kyle Street, Ayr.
Rowallan, Lord, M.C., Rowallan, Kilmarnock.
Stevenson, Robert H. U., Corseclays, Ballantrae, Girvan.
Stewart, John (Hutchison & McCreath Ltd.), Girvan.
Watson, John (McGill & Smith Ltd.), Kyle Street, Ayr.

Banff

Currie, William, Greenhill, Deskford, Cullen.

Berwick

Calder, Adam, Marigold, Duns.

Cochrane, J. A. (Scottish Agricultural Industries Ltd.), 10 Bridge End, Berwick-on-Tweed.

Davidson, J. M. (R. Carmichael & Son), 64 High Street, Coldstream.

Dykes, Thomas S., Redheugh, Cockburnspath.

Elliot, A. D., Kettleshiel, Duns.

Fleming, G. J., Greenwells, Lauder.

Fleming, John (J. Fleming & Co. Ltd.), 10-12 Hyde Hill, Berwick.

Forrest, R. L. (Mersington Farms Ltd.), Mersington, Greenlaw.

Forrest, W. Logan, B.Sc. (Mersington Farms Ltd.), Mersington, Greenlaw.

Hamilton, James, Hoprig, Cockburnspath.

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

McCreath, Geoffrey C. (H. G. McCreath & Co.), 44-48 Hyde Hill, Berwick.

McKerrow, M., Addinston, Lauder.

Mather, James, Printonan, Duns.

Pate, George, West Blanterne, Duns.

Stobo, A. H., Fishwick, Berwick.

Veitch, Mrs J. D., Gungreenhill, Ayton.

Walker, Maxwell, Springwells, Greenlaw.

Caithness

Bruce, James S., 26 Union Street, Wick

Campbell, A. D., Sibster, Halkirk.

Morris, John, Borlum, Reay, Thurso.

Sinclair, Hon. Robin McDonald, Thurso, East Mains, Thurso.

Clackmannan

Fisher, John, Jellyholm, Alloa.

Dumfries

Barbour, Robert C., 60 High Street, Annan.

Blackley, John L., Berscar, Closeburn, Thornhill.

Buccleuch and Queensberry, The Duke of, Drumlanrig Castle, Thornhill.

Dobie, K. L., Loreburn Street, Dumfries.

Home, Captain J. Gavin Milne, Irvine House, Canonbie.

McAlister, A. A. W. (A. W. McAlister & Son), St Mary's Station, Dumfries.

Dunbarton

Calderwood, W. H., Clachan, Rosneath.

Findlay, John S., Easter Cadder, Kirkintilloch.

Findlay, Robert, Easter Cadder, Kirkintilloch.

Lumsden, Sir James R., C.B.E., of Arden, Dunbarton.

East Lothian

Baxter, William, Templehall, Ormiston.

Beveridge, Hugh V., Elphinstone Tower, Tranent.

Cochran, John M., Knowes, Dunbar.

Crawford, Lieut.-Commander W. H., Ugston, Haddington.

Dale, John R., Auldham, North Berwick.

Davidson, George, Sunnyside, Haddington.

Dawson, W. M., Whitelaw, Haddington.

Dykes, Robert, The Myles Farm, Tranent.

Elder, Hugh, Stevenson Mains, Haddington.

Elder, H. F. D. (William Dods & Son), Haddington.

Elder, James, Cregganore, North Berwick.

Falgate, J. F., Pinkerton, Dunbar.
 Forrest, A. S., Balgone Barns, North Berwick.
 Fullerton, A. W., Tranent Mains, Tranent.
 Gibson, Frank P., Drylawhill, East Linton.
 Graham, John, Queenstonbank, North Berwick.
 Gray, G. B. R., Smeaton, East Linton.
 Hamilton, William, Phantassie, East Linton.
 Hannah, George A., Drem Farm, North Berwick.
 Harvey, Malcolm M., North Elphinstone, Tranent.
 Henderson, J. M., Spittalrig, Haddington.
 Hogg, R. N., 2 Bowmont, Dunbar.
 Kerr, R. Balfour, Barney Mains, Haddington.
 King, Alex. Wolfstar, Ormiston.
 Lowe, Sir David, C.B.E., Elvingston, Gladsmuir.
 McDowall, Anthony, Mungoswells, Drem, North Berwick.
 MacKintosh, H. J., Bughtknowe, Humble.
 McLaren, John, Ballencrieff, Longniddry.
 Mills, Fred, M.B.E., M.C., J.P. (Roughead & Park Ltd.), Haddington.
 Miller, Hugh, West Fortune, North Berwick.
 Miller, Hugh W., West Fortune, North Berwick.
 Miller, James B., Ferrygate, North Berwick.
 Miller, J. Prora, North Berwick.
 Morrison, J. G., Longniddry Farm, Longniddry.
 Playfair, J. K., Abbey Mains, Haddington.
 Rennie, Douglas V., South Belton, Dunbar.
 Rennie, James E., C.B.E., Greendykes, Macmerry.
 Russell, John, West Mains, Haddington.
 Simpson, Thomas, Highfield, North Berwick.
 Slight, Mark, North Mains, Ormiston.
 Spence, C. G., Biel, Dunbar.
 Steven, John, Under Bolton, Haddington.
 Stoddart, J. A., M.P., Lorrimers, North Berwick.
 Tweedie, A. J., Eweford, Dunbar.
 Watson, Rupert, Fenton Barns, North Berwick.
 Wemyss and March, The Earl of, Estates Office, Longniddry.
 Wright, W. J., C.B.E., Heugh, North Berwick.

Fife

Adams, J. W., Woodrifle Farm, Newburgh.
 Arbuckle, John, Logie, Newburgh.
 Balfour, D. B. (Laird & Smith, Ltd.), Cupar.
 Ballantyne, John, Balkaithly, St Andrews.
 Berwick, D. F. G., Ardross, Elie.
 Ferguson, Wm. Crawford, Grange of Lindores, Newburgh.
 Forrester, Robert, Broombrae, Auchtermuchty.
 Gibb, John, Fliskmillan, Newburgh.
 Howie, John, Newton, Wormit.
 Howie, John C., Ballinbreich, Newburgh.
 Hutchison, A. (R. Hutchison & Co.), Kirkcaldy.
 Lang, J. G., Hilton of Carslogie, Cupar.
 Melville, Harry W., Balmullo House, Leuchars.
 Milne, George W., Kinaldy, St Andrews.
 Mitchell, Lieut.-Colonel A., Tulliallan, Kincardine (*last known address*).
 Morgan, T. R., B.Sc. (Miln & Co. Ltd.), 6 Hill Street, Strathmiglo.
 Noble, James, Balhelvie, Newburgh (*last known address*).
 Roger, F. W., O.B.E., J.P., Kenly Green, St Andrews.
 Storrar, G. A., M.C., B.Sc., J.P., Rossie, Auchtermuchty.
 Sutton, F. W., N.D.A. (British Sugar Corporation), Cupar.
 Thomson, Henry, Newark, St Monance.

Inverness

Coghill, R. A., Wester Lovat, Beauly.

Dods, A., "Carrington," Kincaig, Kingussie.

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

Grant, J. W., B.Sc. (North of Scotland College of Agriculture), Drummondhill, Stratherrick Road, Inverness.

Young, A. Douglas (North of Scotland College of Agriculture), Drummondhill, Stratherrick Road, Inverness.

Kincardine

Mackie, John, The Bent, Laurencekirk.

Tincker, M. A. H., M.A., D.Sc., F.L.S., F.R.S.E., Arbeadie House, 44 Station Road, Banchory.

Kinross

Blackwood, Adam, Balleave, Kinross.

Kirkcudbright

Crawford, Hugh B., Craigley, Castle Douglas.

Jennings, Ian, Nether Cleugh, Dalry.

Lanark

Bankier, William, Gartloch, Gartcosh, Glasgow (*last known address*).

Bannatyne, John, Drumalbin, Biggar.

Barr, William, Harelaw, Lanark.

Boyd, Robert (James MacGregor Ltd.), Wishaw.

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

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

Gardner, Andrew, 30 Melville Street, Glasgow (*last known address*).

Graham, Thomas Lang (Wotherspoon, Donald & George Graham Ltd.), 11 Douglas Avenue, Burnside, Glasgow (*last known address*).

Henderson, John, Townhill Farm, Hamilton.

Hill, W. J., 19 St Vincent Place, Glasgow.

Hulme, Richard A. (Kerr & Co.), 63 Queen Street, Glasgow.

Kirkwood, Professor John, O.B.E., B.Sc., Mansefield, 20 Wheatland Drive, Lanark.

Lyburn, R., 8 Germiston Street, Glasgow.

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

Martin, J. (W. B. Martin & Co. (Glasgow) Ltd.), 136 Kennedy Street, Glasgow.

Meiklejohn, J. A., 86 St Vincent Street, Glasgow (*last known address*).

Motherwell, A. (A. Motherwell Ltd.), Gorbals, Glasgow.

Thomson, John, 106 Taylor Street, Glasgow (*last known address*).

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

Warnock, James H., M.B.E., S.H.M., Garrion Farm, Wishaw.

Watson, Alex., Intock House Farm, Lanark.

Midlothian

Adam, Robert, South Gilmerton, Edinburgh.

Allison, Robert, Turnhouse Farm, Corstorphine, Edinburgh.

Anderson, R. Brewis, 9 Dean Park Terrace, Edinburgh.

Bell, David, 15 Coburg Street, Leith.

Blakebell, G. R., 17 Barnton Park View, Edinburgh, 4.

Braes, Robert, St Clements Wells, Inveresk, Musselburgh.

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

Clapperton, George, Sheriffhall Mains, Dalkeith.

Crozier, J., B.Sc. (Scottish Agricultural Industries Ltd.), 39 Palmerston Place, Edinburgh.

Cruikshank, G. A., M.A., B.Sc. (Scottish Agricultural Industries Ltd.), 39 Palmerston Place, Edinburgh.

Davey, V. E. McM., B.Sc., Ph.D., Hillview, Gogarbank, Edinburgh, 12.

Dawson, J. Leslie, B.Sc. (Scottish Agricultural Industries Ltd.), West Mains of Ingliston, Newbridge.

Dobie, James Buchan, Easter Middleton, Gorebridge.
 Dobson, J. H., 20 East Mayfield, Edinburgh.
 Douglas, A. (A. & W. Douglas), Dalkeith Mills, Dalkeith.
 Durie, John, 20 Cluny Drive, Edinburgh.
 Easton, A. L., West Mills, Mid Calder (*last known address*).
 Fleming, J. K. (A. & R. Scott, Ltd.), West Mills, Colinton.
 Fife, John W. (Dobbie & Co. Ltd.), Melville Nurseries, Eskbank.
 Finn, Roland J., F.A.L.P.A., F.V.I., Morton Mains, Edinburgh.
 Glendinning, G. E., Woodhall House, Juniper Green, Edinburgh (*last known address*).
 Grant, William (Weston Biscuit Co. Ltd.), Slateford Road, Edinburgh.
 Gray, W. H., South Gyle, Corstorphine, Edinburgh.
 Gregor, J. W., C.B.E., Ph.D., D.Sc., F.R.S.E., Old Mill House, Balerno, Midlothian.
 Helm, J. C., Haltree, Heriot.
 Howie, Robert, B.Sc., Spittal Farm, Ninemileburn, Penicuik.
 Inglis, William (J. Inglis & Sons), Leith, Edinburgh (*last known address*).
 Kay, W. G. M., 19 South St David Street, Edinburgh.
 Kerr, H. R., Springfield Mills, Leith (*last known address*).
 Laing, C. T. (Thomas Bernard & Co. Ltd.), Seafield, Leith.
 Lemmon, R. M., O.B.E., B.L., 8 Eglinton Crescent, Edinburgh.
 Lindsay, Adam (Robert Inch & Son, Ltd.), 46 Timber Bush, Leith.
 Logan, Kelvin, Aikendeane, Gorebridge.
 Lowe, John J., B.Sc. (David Lowe & Sons, Ltd.), St Michael's, Inveresk, Musselburgh.
 McClung, Gilbert, 22 St John's Road, Corstorphine, Edinburgh.
 McFarlane, Malcolm, 22 Fort Place, Leith.
 MacGillivray, Finlay, 29 Heriot Row, Edinburgh.
 McNair, W. K., 41 Hamilton Drive, Edinburgh, 15.
 Mather, Matthew, Brackenrig, Barnton Avenue, Edinburgh.
 Meiklejohn, A. K. M., B.Sc., School of Agriculture, West Mains Road, Edinburgh.
 Meikle, R. W., Hardengreen, Dalkeith.
 Muir, James, Turnidykes, Pathhead.
 Muir, John, Freeland, Newbridge, Ratho.
 Murray, J. C., Newbattle Collieries, Newtongrange.
 Nelson, Alexander, Ph.D., D.Sc., F.R.S.E., University Department of Botany, Royal Botanic Garden, Edinburgh.
 Rankine, R. D. (R. Edgar & Co. Ltd.), 41 Mitchell Street, Leith.
 Robb, William, N.D.A., F.R.S.E., 24 Downie Terrace, Edinburgh.
 Rosebery, The Earl of, Dalmeny House, Edinburgh.
 Scarlett, Robert L., C.B.E., C.D.A., S.H.M., V.M.H., Sweethope, Musselburgh.
 Scott, R. Lyon, Loanhead.
 Sharp, Andrew, N.D.A., J.P., Heriot Mill, Heriot.
 Shaw, David (St Cuthbert's Co-operative Association Ltd.), 92 Fountainbridge, Edinburgh.
 Smith, J. J. Elliot, Dodridge, Ford (*last known address*).
 Somerville, A., Wester Cowden, Dalkeith.
 Steele, J. Norman H., B.Sc. (Agric.), A.M.I.B.A.E., 1 St. Ronan's Terrace, Edinburgh.
 Stoddart, W. J., Loanhead Farm, Loanhead.
 Thomson, James (Farmers' Supply Association of Scotland, Ltd.), 1a George IV Bridge, Edinburgh.
 Todd, J., Pinkie Mains, Musselburgh.
 Watherston, R. H., C.B.E., Crichton Mains, Ford.
 Watson, Professor Stephen J., C.B.E., M.Sc., D.Sc., College of Agriculture, West Mains Road, Edinburgh.
 Whitburgh, Lord, Whitburgh, Ford.
 White, George L., Saughland, Tynehead.
 White, John, Lawfield, Dalkeith.

Moray

Duncan, G. F., Waterton, Elgin.
 Joughin, Michael, Wester Manbeen, Elgin.
 Leitch, D. C. MacKessack, Carden, Alves, Forres.

Scott, James A., Ashville, Rothes-on-Spey.
Stephen, W. M., M.A., B.Sc., Rothills, Duffus, Elgin.
Taylor, G. D., Ardyge, Elgin.

Nairn

Wilson, Andrew R., Brightmoney, Auldearn, Nairn.

Orkney

Garden, W. J. (R. Garden Ltd.), 18 Bridge Street, Kirkwall.
Horne, C. F., Warsetter, Sanday.
Tait, C. W. (J. & W. Tait), Kirkwall.

Peebles

Hamilton, Robert C., Whitehope, Innerleithen.

Perth

Alexander, R. F., Boyne Farm, Inchture.
Bowser, D. S., Argaty and the King's Lundies, Doune.
Broadfoot, A., B.Sc., Atholl Place, Dunblane.
Cunningham, John (Strathallan Growers), Auchterarder.
Duncanson, T. (McCash & Hunter), 8 Kinnoull Street, Perth.
Glen, Alan, Mains of Errol, Errol (*last known address*).
Guthrie, Thomas A., Guardswell, Inchture.
Lindsay, D. H., 7 Market Street, Perth.
Maclean, Captain D., B.Sc., N.D.A., N.D.D., Dornock Farm, Crieff.
Main, A. D. C., O.B.E., B.Sc., Windyedge, Perth.
Marshall, John, C.B.E., Dalreoch, Dunning.
Morris, P. S., Woodside, Coupar Angus.
Murray, William, Rossdene, Glenfarg.
Niven, John A., Braeknowe, Tibbermore.
Paterson, G., Watson Farm, Doune.
Pattullo, I. N., Langlogie, Meikle.
Reid, James, Pictstonhill, Perth.
Roberts, A. Denby, Strathallan Castle, Auchterarder.
Roberts, Sir James Denby, Bt., O.B.E., M.A., J.P., Strathallan Castle, Auchterarder.
Roberts, William J. D., Strathallan Castle, Auchterarder.
Sinclair, David B., Abernyte, Inchture.

Renfrew

Macduff, Peter (Macfarlan, Shearer & Co.), Greenock.
Shearer, William E. (Macfarlan, Shearer & Co.), Greenock.

Ross and Cromarty

Gibb, Lieut.-Colonel Jocelyn E., Keppoch Farm, Dundonnell, by Garve.
Gill, W. H. M., Rosskeen, Invergordon.
Gordon, John O., Balmuchy, Fearn.
McCorquodale, A. C., Kildary House, Kildary.
Paul, Harold D., Munloch Mains, Munloch.
Robertson, John B., Castlecraig, Nigg.
Stirling, Captain J., Fairburn, Muir of Ord.
Sutherland, D., Tullich Farm, Fearn.
Young, J. G., Cadboll, Fearn.

Roxburgh

Biggar, W. Andrew, O.B.E., M.C., B.Sc., Magdalene Hall, St Boswells.
Buckpitt, W. A., B.Sc., Greycrook, St Boswells.
Corner, H. H., Ph.D., Woodcroft, St Boswells.
Currie, Andrew, Waukford, Kirk Yetholm, Kelso.
Hunter, W. C., Copland, Ancrum.
Irvine, Charles (C. Irvine & Sons), 1 Market Place, Jedburgh.

Morrison, W. C., Kennetsidehead, Eccles, Kelso.
Murray, W., Redden, Kelso.
Scott, D., Ferneyhill, Kelso (*last known address*).
Service, A. D. (Laing & Mather, Ltd.), Kelso.
Thomson, D., Cessford, Kelso.

Selkirk

Cunningham, A. U., Threepwood, Galashiels.
Dunn, John, Valley Mill, Galashiels.
Galbraith, Hon. James, Carterhaugh, Selkirk.

Stirling

Dickson, P. H., Craighead House, Blairdrummond, by Stirling.
Gray, James, M.B.E., T.D. (James Gray & Co. (Stirling) Ltd.), Stirling.
Gray, John (James Gray & Co. (Stirling) Ltd.), Stirling.
MacGillivray, John "Iona," 80 Bellsdyke Road, Larbert.
Robertson, J. A. (James Gray & Co. (Stirling) Ltd.), Stirling.
Wilson, Sir George, K.B.E., M.A., LL.D., Kings Mile, Killearn, Nr. Glasgow.

West Lothian

Allison, David, Duddingston, South Queensferry.
Allison, W. N., Almond Hill, Kirkliston.
Cadzow, James B., Glendevon, Winchburgh.
Cadzow, James N., Kilpult, Broxburn.
Dudgeon, A. N., Humbie, Kirkliston.
McGowan, Peter, Wheatlands, Kirkliston.
Wood, Archibald, Carlowrie, Kirkliston.

Wigtown

Hannay, Alex. (R. & A. Hannay Ltd.), Stranraer.
Harper, Thomas, Charlotte Street, Stranraer.
Rodan, A. Martin, Mill Bank, Glenluce, Newton-Stewart.

England

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