

Agricultural Improvement Council

FOR ENGLAND & WALES

Second Report

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SECOND REPORT

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Agricultural Improvement Council for England and Wales

SECOND REPORT

INTRODUCTION

TO THE RIGHT HON. TOM WILLIAMS, M.P.

Minister of Agriculture and Fisheries

Sir,

1. The first report of the Agricultural Improvement Council was presented in June, 1942, a year after the Council had been appointed. It was then intended to present further reports at yearly intervals, but owing to the difficult conditions existing in the war this was found impossible. Short notes on the work of the Council were published in *Agriculture*, the Journal of the Ministry of Agriculture, in January, 1944, February, 1945, and March, 1946. These notes were no more than reports on progress and made no attempt to analyse the work of the Council nor to compare what had been done with the programme originally planned.

2. In the first report the problems involved in carrying out the tasks which had been given the Council and the means it was proposed to adopt to fulfil them were set out fully (paragraphs 4 to 17 inclusive). Apart from a number of changes in plan found to be expedient as the result of experience, there was one major development which could not be taken into consideration in the original scheme. In 1942, a national agricultural advisory service was no more than an idea in the minds of those most nearly concerned with the spread of technical knowledge among farmers. The Committee under Lord Justice Luxmoore, reporting in April, 1943, recommended the establishment of a national service and outlined the form it should take: by June, 1944, the decision to accept this recommendation and to establish such a service had been taken, and the National Agricultural Advisory Service came into being in October, 1946.

3. It was clear from the outset that there must be the closest relationship between the Council and the National Agricultural Advisory Service. The Council, being an advisory body only, had no technical staff on which to call for any action required to put the findings of research into practice, nor had it any nation-wide organization from which it could get an overall view of the farmers' problems. The National Agricultural Advisory Service was clearly the proper body to do this work for the Council, and from the first it was

arranged that the necessary contact should be provided by the attendance at Council meetings of the senior officers of the National Agricultural Advisory Service, and by having as the Council's Secretary one of the Senior Education and Advisory Officers.

4. In the scheme for a national service set out in the Luxmoore report it was proposed that the service should be outside the Ministry but responsible to a Commission to be appointed by and answerable to the Minister of Agriculture and Fisheries. This suggestion could not be accepted, but although the service became part of the Ministry, it was felt that the Minister should have some independent body to advise him on the organization, staffing and work of the National Agricultural Advisory Service. The Council was by its composition clearly well qualified to undertake this duty and, further, it had a direct interest in the efficiency of the service and a close knowledge of its work. The Minister therefore agreed that the responsibilities of the Council should be widened to include this duty.

5. Representations were made by those interested in horticulture that the original terms of reference did not state clearly the Council's responsibility towards horticulture, and that the Council gave inadequate consideration to this important branch of food production. In order that there might be no misunderstanding as to the Council's responsibility for horticulture the terms of reference were amended to read "agriculture and horticulture" wherever agriculture was mentioned.

6. The results of scientific research cannot be applied to agriculture and horticulture without preliminary trials. The co-operation of public-spirited farmers in such trials, which had always been an important feature of advisory work, increased during the war; the farmers not only undertook the work themselves but also willingly placed land and equipment at the service of the technical officers. When it was accepted that the development of food production must be a continuing feature of post-war policy, it was evident that there must be facilities for carrying out this work other than those dependent on the interest and goodwill of private farmers. The Council therefore had added to its other duties the consideration of the best means of studying the incorporation of scientific discoveries into commercial practice.

7. Another result of the post-war policy of continued high output from the land is the positive responsibility placed on those concerned in the introduction of new methods into agriculture and horticulture. It is no longer sufficient to produce new ideas and show the farmer how to apply them. Now that the increase in efficiency forms a definite part of a programme which cannot be achieved without it, those responsible for formulating policy require advice and guidance on how the technical part of the plan can best be fulfilled. It was agreed that the Council should include in its terms of reference the duty of advising generally on these matters.

8. With the object of meeting these new responsibilities, the terms of reference of the Council were revised in 1944 to read as follows :

"To keep under review the progress of research with a view to ensuring that promising results are applied as rapidly as possible to the problems of agriculture and horticulture and that these and any other new technical methods are incorporated into ordinary commercial practice; to advise from time to time concerning agricultural and horticultural problems which appear to require scientific investigation; and to advise generally as to the lines on which a policy designed to raise the technical standard of agricultural and horticultural production can best be implemented."

9. The problems concerned with the application of new methods in farming have changed greatly during the last eight years. Some of these changes have represented only an acceleration of a progress already apparent before the war ; a younger generation of farmers has grown up, which has benefited from the agricultural education carried out during the last 20 years. Again, there has been a progressive movement in the agricultural press and in agricultural shows towards a broad educational outlook, all of which has helped to whet the farmers' demand for technical advice.

10. Other changes are the more direct result of the wartime drive for agricultural production. In the first report of the Council it was stated that " Financial success or failure is also very often as much dependent upon the farmer's business acumen in buying and selling as upon his skill as a farmer." The fixed prices for agricultural requirements and the guaranteed markets and prices for agricultural products reduced the farmer's chance of making a quick profit from mere astute buying and selling and greatly enhanced the importance of technical skill in the business of farming. It became possible for the first time for the farmer to calculate with reasonable accuracy the financial result of applying a new method.

Simultaneously the industry felt the impact of the County War Agricultural Executive Committees' technical development work, which pressed on every farmer the need to improve his efficiency in the national interest.

These influences, however, would not have been so effective had they not been accompanied by a prosperity in farming which made available the necessary capital. Without capital, risks cannot be taken nor additional equipment purchased.

11. With the return of peace many of these conditions have remained. The Agriculture Act of 1947 has given continuance to assured markets and prices for the main agricultural products, the County War Agricultural Executive Committees have been succeeded by the County Agricultural Executive Committees ; the educational influence of press and agricultural shows has been intensified ; and the National Agricultural Advisory Service has been able to stage demonstrations and educational exhibits on a scale which was previously impossible.

12. In horticultural production the change, though notable, has been less marked ; the growers as a whole were more keenly interested in technical efficiency before the war than the farmers, largely because of the higher costs of their crops in labour and materials and the heavy losses which inevitably followed on inefficiency. During the war many horticultural growers were compelled to forego the production of luxury vegetable and flower crops and to concentrate on the production of food crops. Many growers found themselves engaged in a form of production with which they were not familiar and in consequence they increased their demand for technical help.

13. These changes have greatly affected the relative importance of the different sections of the Council's work. Thus the problem of how to persuade farmers to adopt better methods has been largely replaced by the study of how to get the knowledge of the results of scientific research to the farmers in the quickest possible time. Again, the task of ascertaining, from an industry which often showed little interest, the problems requiring investigation has become that of assessing priorities to the many demands made on the limited men and equipment available for agricultural research.

Changes in Membership and Staff of the Council

14. The Council was appointed in the first place for a period of three years expiring in June, 1944. When the reappointment was considered it was decided to give the Council a permanent status, while leaving the appointment of members on a triennial basis.

15. The Council had lost during the first three years, through his sudden death, the services of Dr. W. W. C. Topley, and on the reconstitution of the Council in 1944, Lord Cornwallis, the Earl of Feversham, Captain E. Foster, Sir George Stapledon and Mr. L. G. Troup retired.

The Council from June, 1944 consisted of the reappointed members Sir Donald Fergusson (Chairman), Mr. Dennis G. Brown, Mr. T. Dalling, Professor Sir Frank Engledow, Mr. A. Holness, Mr. C. Nevile and Professor Sir James Scott Watson, together with the new members Sir John Fryer, Mr. A. R. Hurd, Sir C. Bryner Jones, Mr. David Lewis, Mr. T. Neame, Mr. F. Rayns, Sir Edward Salisbury, Mr. F. A. Secrett and Sir James Turner.

In April, 1945, the Chairman of the Agricultural Machinery Development Board (the Earl of Radnor) was appointed *ex-officio* a member of Council to maintain a proper liaison between the Board and the Council.

16. Sir Donald Fergusson resigned from the Council on his appointment to the Ministry of Fuel and Power in July, 1945, and was followed in the Chair by Sir Donald Vandepier, his successor as Permanent Secretary to the Ministry of Agriculture and Fisheries.

17. When the Council members were again due for reappointment all the existing members were asked to serve for a further period in view of the several major schemes under consideration. Mr. A. R. Hurd had already resigned in November, 1946, owing to pressure of parliamentary business. Professor Sir James Scott Watson had, since October, 1946, been attending meetings in his capacity as head of the National Agricultural Advisory Service and Mr. C. Nevile was unable to accept the invitation owing to ill-health.

With these exceptions all members of Council agreed to continue to serve for a further period. At the same time Mr. G. R. H. Nugent and Professor H. G. Sanders were appointed to the Council. On his retirement from the Ministry in May, 1948, Dr. H. V. Taylor was appointed a full member of the Council.

18. During the period 1944 to 1947 the need for a deputy, who could attend to the Council's business in the absence of the Chairman, was felt and Sir Edward Salisbury, on his reappointment to the Council in 1947, was also appointed Vice-Chairman.

The Council was served at first by three secretaries, Sir John Fryer and Mr. E. C. Lloyd acting as Technical Secretaries and Mr. W. R. Black as Administrative Secretary. After March, 1942, Sir John Fryer carried on alone with the assistance on the administrative work of Mr. C. F. Whittington. Dr. W. K. Slater was seconded to act as Chief Technical Officer in February, 1943, and took over the secretaryship in July, 1944, when Sir John Fryer was appointed Secretary to the Agricultural Research Council. At the same time Mr. C. F. Whittington became Assistant Secretary to the Council. The staff of the Council was further strengthened in May, 1945, by the appointment of Mr. A. J. L. Lawrence as Technical Officer.

Mr. C. F. Whittington was succeeded by Mr. B. Dennis as Assistant Secretary in February, 1948.

19. With the dissolution in February, 1949, of the Agricultural Machinery Development Board its Chairman ceased to be an *ex-officio* member of Council. The liaison between the Council and the newly appointed Governing Body of the National Institute of Agricultural Engineering, the Agricultural Research Council Standing Committee on Agricultural Engineering Research and the Ministry's Agricultural Machinery Advisory Committee has been left for the present to the secretariats.

20. By his untimely death in November, 1948, the Council lost the services of Sir John Fryer. He was succeeded in May, 1949, at the Agricultural Research Council by the Council's Secretary, Dr. W. K. Slater, who at the same time was appointed as a member of Council, Mr. W. Morley Davies becoming Secretary to the Council.

21. Mr. Nugent resigned from the Council in March, 1950, on his election as a Member of Parliament.

PART I

THE APPLICATION OF THE RESULTS OF RESEARCH TO AGRICULTURE

22. The first duty of the Council as defined in the terms of reference is

"to keep under review the progress of research with a view to ensuring that promising results are applied as rapidly as possible to the problems of agriculture and horticulture and that these and any other new technical methods are incorporated into ordinary commercial practice."

To carry out this task it is necessary to devise suitable means for the examination of the output of the research laboratories, to keep continuously under review the changing problems of agriculture in order that no possibility of applying new or existing scientific knowledge is being overlooked, and to make arrangements so that ideas which appear to be promising can be tried out in practice under different farming systems.

23. It would be impossible for the Council itself to undertake the examination of the enormous output of the research institutions in Great Britain and abroad. Not only would a very large staff be needed to attempt the task, but the mere examination of the literature by men not themselves involved either in research or its application could be no more than an abstracting service. The Council was therefore fortunate in finding already available means of achieving this end in the study of the literature by the scientists actively engaged in research work in Universities and Research Institutes and in the services of the Commonwealth Agricultural Bureaux. The Agricultural Research Council has set up a number of standing committees and conferences meeting once or twice a year, each dealing either with a single agricultural problem or with an associated group of problems. The members of these bodies are the scientists working in the field together with agriculturists and others who can contribute to the solution of the problem; each scientist reports on the work he has in hand, and summaries of work in progress both at home and abroad are submitted from time to time either by one of the workers or by a member of the staff of one of the Commonwealth Agricultural Bureaux. The papers of these committees and conferences, which form a continuous up-to-date

review of the field under consideration, are made available to the Secretary of the Council, who can if he wishes attend the meeting of any of the conferences as an observer or send one of his staff to do so.

24. By the study of these conference papers and by discussion with members of conferences it is possible for the Council's Secretary and his staff to keep the Council informed on the results of research. In addition the Agricultural Research Council through its Secretariat draws the attention of the Improvement Council to work which appears to be of outstanding importance.

25. While it is therefore possible with a minimum staff to follow the progress of research, a much greater task has to be faced in following the changing needs of agriculture and assessing when new knowledge, or knowledge which has not previously been applicable, is worthy of consideration for incorporation into agricultural practice. No single comprehensive means of solving this problem has so far been devised and it is doubtful if any such solution is possible. Agricultural practice as a whole changes gradually without any sudden obvious development, so that a constant visitor to a district may be conscious of little change even where a revolution has taken place over a period of years. It is only when as the result of some major variation in farming practice a new set of problems press on the farmer that he begins to voice his need for help.

26. The Council's most trustworthy source of technical information on the changing needs of agriculture is the National Agricultural Advisory Service, but even its help is limited. The officers most closely in touch with the farmers suffer from the same inability to stand back and look at the problems of the particular section of agriculture they serve, in relation to neighbouring systems and in relation to the farming of ten years ago. In spite of these difficulties, however, the National Agricultural Advisory Service supplies the most reliable data on farming practice in England and Wales.

The conferences of scientific and husbandry specialists of the Advisory Service are particularly valuable in that they focus attention rapidly on the general significance of any new problems referred to them by their colleagues in general agriculture.

27. The Council was, however, very conscious of the need for the most accurate information on regional problems which could be obtained, preferably of a quantitative nature. The first attempt to get this knowledge made before the setting up of the N.A.A.S. was by means of three pilot surveys, one of farming on the chalk land, another of the intensive grass-cake farming in areas such as south-east Lancashire, and the third of the fen districts of East Anglia. These were sufficiently promising to suggest that the method could be extended and developed. A small committee under the Chairmanship of Sir Frank Engledow was set up in Cambridge to initiate and supervise further surveys and to arrange for the preparation of descriptive records of the farming in a number of counties. The progress of this work has been slow owing to the inability of the officers of the newly established N.A.A.S. to give much time to the collection of field statistics. The progress is now accelerating as more assistance is obtained. A survey of farming on the sand-lands is well under way and another on the importance of hill sheep in British agriculture is beginning.

28. During the war years Dr. F. Yates of the staff of Rothamsted Experimental Station carried out, in conjunction with the Advisory Chemists, a

survey of fertilizer practice. In this, by means of a suitable sampling technique, it was possible to obtain with considerable accuracy the number of fields in selected counties receiving manurial dressings and the average rate of application. This technique, which is closely related to that which became known as operational research during the war, can be used to give within a short time and with relatively small effort, quantitative evidence of the current practice on British farms, and hence to throw up any changes in farming methods.

The survey of fertilizer practice has been followed each year by rapid surveys of a number of selected areas, so that any trends in the use of fertilizers are brought to light. Thus, for example, we know not only that there has been over the last four years a steady increase in the use of fertilizers, but also that the increase is much greater in the areas which were already heavy users and on arable rather than grassland.

29. The technique employed in the survey of fertilizer practice is now being applied to other aspects of farming. Surveys have already been begun on cowshed routine and on potato production.

30. By these various means it is hoped not only to build up an accurate knowledge of existing practice but also to revise it continuously, so that the possibility of applying any new knowledge will not be overlooked. Moreover the overall picture obtained by these means serves not only to indicate where fresh information can be incorporated into the industry but also focuses attention on those problems needing further investigation.

31. When an investigation has reached the point where it has been proved that certain results can be expected on a laboratory or small-plot scale, there is still much to do before it can be applied in practice. If it is concerned with the growth of crops, it will in all probability have been proved only for one soil type under one definite set of climatic conditions, and must be repeated on other soils and in different climates before it can be accepted as suitable for general application. Even when it has been shown that the results are true for different conditions, it is still necessary to find the best way to introduce them into any particular farming system. In the past, farmers have been left to do this for themselves, sometimes with unfortunate results; a few over-enthusiastic men having adopted the new method without thought, failures have occurred and the system has been condemned as useless, only to be shown later, after more careful consideration of the method of application, to be of great value. The making of silage may be quoted as an example. During the years immediately before and at the beginning of the war the methods of making silage by the use of molasses and by the A.I.V. process had received some publicity, yet the increase in silage-making was small. Under the influence of the County War Agricultural Executive Committees, farmers and advisory officers studied the practical details of silage-making; the use of clamp and pit silos became general, methods of picking up the crop used for ensilage were improved, and the labour economy of silage-making was examined under different farming systems. The result of this work has been a rapid increase in the making and use of silage, which is still continuing.

32. The Council set up, in consultation with the Agricultural Research Council, a Committee to consider how best the results of research work could be tested under different conditions of soil and climate, and findings proved suitable for general use applied to different farming systems. The Committee recommended the establishment of a chain of Experimental Husbandry Farms

and Horticulture Stations to cover the major groupings of soil and climate and at the same time the farming systems associated with these physical conditions. The working of the Experimental Horticulture Stations is somewhat different from that of the Experimental Husbandry Farms and this is explained on facing page (paragraph 38).

33. The Council endorsed the recommendation and referred it to the Ministry. After examination, the Ministry decided to set up the Experimental Husbandry Farms and Horticulture Stations as part of the National Agricultural Advisory Service so that selected officers of the Service should form the staffs of the farms and the farms provide experimental facilities for other officers. The control of the farms and horticulture stations has been vested in the National Advisory Service with local farm advisory committees on which, amongst others, outstanding farmers will serve.

34. It was accepted that each farm should consist of sufficient land to provide an experimental area, on which the results obtained in the research institutes could be tried under local conditions and on which the officers of the Advisory Service could have facilities for investigation, together with an area equivalent to the average farm run on the system of husbandry practised on the geophysical type of which the farm is representative. This larger area was to be used for experiments designed to study the adaptability of new methods to the farming system and also for other experiments requiring permanent control over much land, but not generally including any treatment which would result in a complete crop failure. As an example of the latter type of work, the trial of the effect of different lengths of ley in a rotation may be quoted.

35. It was anticipated that there would be a heavy demand for the facilities provided on these farms, and the Experimental Husbandry Committee was set up to consider applications and recommend priorities. The Agricultural Research Council and the National Agricultural Advisory Service are represented on this Committee in addition to the Council itself.

36. Considerable progress has been made in the acquisition and preparation of holdings for the Experimental Husbandry Farms, which are to number seventeen in all. So far seven farms have been acquired. These are in Hampshire (on chalk land), Cambridgeshire (boulder clay), Herefordshire (Old Red Sandstone), Yorkshire (high wold), Nottinghamshire (Bunter Sandstone), Lincs/Norfolk (silt) and Cardiganshire (medium loam and uplands). The programme will be completed in due course as technical staff and other resources permit and suitable properties are found. In addition the Department of Agriculture for Scotland has established a hill sheep experimental farm in Roxburghshire which will serve the needs of both sides of the Border.

37. It is not intended that the Experimental Husbandry Farms should supplant the profitable co-operation in experimental work between public-spirited and progressive farmers and Advisory Officers. It is hoped that this work will continue, not only because the Experimental Husbandry Farms can never provide all the facilities required, but still more because of the great good which comes from farmer and Advisory Officer working together on a problem. There must, however, be a limit set to what can be asked of a commercial farmer, and it will in general be experiments involving a disruption beyond this limit, including very long-term experiments, which will find their place on the Experimental Husbandry Farm.

38. The requirements of horticulture differ from those of agriculture in that there is greater individuality in horticultural holdings and less rigid systems of cropping. It is not intended therefore to set up corresponding stations to study the application of new methods in relation to systems of horticulture, but instead a series of Experimental Horticulture Stations under differing climatic conditions is planned to work in conjunction with the existing Horticultural Research Institutes and the new Vegetable Research Station described on p. 13. These Experimental Horticulture Stations will act not only as Experimental Stations on the problems of local growers but also as a chain of outstations for the main research institutes applying their findings under different conditions of soil and climate. There are to be six Experimental Horticulture Stations (including a National Fruit Variety Testing Station) with some Sub-Stations. Three properties have so far been acquired and are being made ready, and a few small centres taken over from County Councils at the inception of the N.A.A.S. are in use pending the coming into being of permanent Stations.

THE MEANS USED TO ASCERTAIN THE NEEDS OF AGRICULTURE

39. The increased interest of farmers and growers in research work has led to insistent demands for investigations into problems claimed to be of particular importance. This does not simplify, but rather complicates, the task of selection, on the basis of the ascertained needs for agriculture.

Farmers and growers are influenced by their immediate troubles and they often demand action on questions which may or may not ultimately prove to be of primary importance. The total loss of a crop makes a deep impression on anyone who sees it, and although it may affect only one field in twenty there will be a cry for immediate action, yet a condition which results in the reduction of the yield of every field by 10 per cent may pass unnoticed if the resulting yield is that which the farmer has been led to expect. Again, a condition which seriously affects a small area or a specialized crop may, if the farmers concerned are energetic and progressive men, lead to an insistent demand for investigation, although the successful solution of the problem can only make a small contribution to the total agricultural output.

40. The Council has used a number of different methods in deciding on the relative importance of the problems put forward for investigation and in seeking out other problems of importance which the farmers and growers have not advanced. The general agriculture officers of the National Agricultural Advisory Service first become aware of problems in the field, but as their work is confined to a relatively small area the individual officers have no opportunity of assessing the general importance of a problem. When, however, a District Officer finds himself confronted with a new situation which he cannot solve, he consults the appropriate specialist officer. These enquiries from District Officers are collected by the provincial specialists, who are thus in a position to state in general terms the relative importance of the problems of a province. Two or three times each year the specialist officers in any subject meet in conference and discuss any major change in the nature of the inquiries they have received, thus effecting a summation in broad terms of the observations of District Officers throughout England and Wales in matters relating to their subject.

41. The Council receives reports of any matters of importance arising at these conferences and hence on the relative importance of problems as judged by the inquiries sent to Provincial Headquarters of the National Agricultural Advisory Service.

42. The system of reporting insect attack and outbreaks of disease is centred on the Ministry's Plant Pathology Laboratory at Harpenden. At monthly intervals the Provincial Entomologists and Plant Pathologists and others report on the appearance of pests and diseases and on the severity of any attack. From these reports it is possible to assess whether any particular pest or disease is increasing in severity or extending the area in which it normally attacks. This evidence is available to the Council and can be used to decide whether the work on the control of any disease should be intensified or reduced.

43. However carefully estimates are made through the Advisory Service they can only give the general position as seen by its officers throughout the country. It is essential therefore that opportunities should be provided for groups of producers to make their representations direct to the Council itself. This allows, for example, the growers of a specialist crop widely distributed throughout the country, although of relatively small importance in any one area, to make representations for research work. Two instances of such crops are mushrooms and watercress.

It is also essential that there should be no suggestion that without the agreement of the Advisory Service no work can be considered.

44. In order to meet these needs a close liaison is maintained with the National Farmers' Union. Although from the nature of its membership the Council has always contained farmers high in the counsels of the Union, it was felt necessary to place this relationship on a more definite footing. To do so the Council invited the Chairman of the Education and Development Committee of the Union to attend all its meetings and to receive all papers, and so be kept informed of the work of the Council and be able to bring to its notice any problems which specialist groups of the Union's members consider of importance. In addition there are continuous exchanges between the secretariat of the Council and that of the Union on subjects for investigation and on the progress of research.

45. Finally, in order to provide a means of direct approach to the Council without passing through the Advisory Service or any organization such as the National Farmers' Union, the Council set up a series of Husbandry Groups. Each group consists of two members of Council acting as Chairman and Deputy Chairman, a member nominated by the National Farmers' Union, the administrative officer of the Minister most closely associated with the subject and an officer of the National Agricultural Advisory Service acting as convenor. The groups so far set up have been Crop Husbandry, Animal Husbandry, Grassland Husbandry, Poultry Husbandry and Horticulture. Any body of substance can place a problem before the appropriate group. A meeting is then arranged at which the evidence of the applicants is heard, together with the views of any technical specialists the group may wish to consult, and a recommendation is made to Council. These groups have already proved to be of great value in dealing, for example, with requests for investigations put forward as a result of meetings of farmers and by agricultural teaching departments.

46. However many sources there may be from which the Council may hear of work to be done, it remains necessary to ask whether there are not problems still unnoticed but nevertheless of major importance. These problems are most likely to arise from the tacit acceptance of existing conditions, tending to give results well below the optimum. Again, changing economic circumstances may justify expense on disease control in stock or crop which was previously entirely unacceptable, and thus create a need for investigating a means of control previously rejected on grounds of cost. In an earlier part of the report the means used to follow changes in farming practice were discussed (paragraphs 26 to 30) ; it is from these inquiries and surveys that the Council may hope to learn of problems requiring investigation, the need for which is not brought out in any other way.

THE TRANSLATION OF AGRICULTURAL PROBLEMS INTO RESEARCH PROJECTS

47. When it has been decided that an agricultural problem is worthy of investigation, arrangements have to be made for the necessary work to be undertaken. Before the Council can approach the appropriate research organization through the A.R.C. the problem must be analysed and split into the different separate scientific parts, since few questions which arise from agriculture lead directly to a single clear-cut investigation.

48. The analysis of problems arising from farming or horticultural practice cannot be undertaken on any general plan ; each inquiry must be treated according to its own special character. Thus in some instances the problem consists of a number of fairly clearly dissociated factors, which can be studied separately. An inquiry of this type was that for an investigation to find means of preventing the lodging of corn crops, which, it was alleged, was increasing. Such an increase could arise from a variety of causes, *e.g.*, the introduction of varieties unsuited to local conditions, bad consolidation of the seedbed, overmanuring, or fungus attack. The setting down of these factors is a relatively easy process ; to decide which is the cause of increased lodging, either alone or in combination, presents a difficult task. The only way in which it can be done is by careful inquiry through the Advisory Service, preferably by a properly organized survey. Up to the present no regular arrangements have been made for such inquiries, each being treated separately ; the development of this technique must be a major concern of the Council in the near future.

49. The second type of problem is that in which the factors are so confused and inter-related that they cannot be separated easily, if at all. Such a problem is that of the determination of the effect of leys on soil structure and fertility with practical corollary of what is the best type of ley and how long it should be left to obtain the best results. The answers clearly depend not only on the soil type, the climatic conditions, the seeds mixture, the management of the ley, and the use to which the land is to be put when the ley is broken, but also on the interaction of these factors, the one with the other. The solution may be sought by empirical trials under as many conditions of soil and climate as possible, using the Experimental Husbandry Farms and private farmers who are willing to help. It is necessary for such trials to have means of measurement which will enable quantitative results to be obtained, and for this the help of a research institute will probably be needed. The other method of attack is to study in research institutes the fundamental problems such as the

growth and decay of root systems, the change in soil micro-organisms and the effect of these on the physical properties of soil, and then to attempt to answer the inquiry by assessing the result of the various factors acting simultaneously.

50. Some inquiries cannot readily be solved by experiment because they contain too many uncontrolled variables. Thus, for example, it is difficult to design experiments to test the efficiency of different existing methods of hay-making since one method may prove superior under the weather conditions of one year and another method under those of another year ; any rigid experimental plan adopted in attempting to cut out these variables may lead to operations being carried out under weather conditions which render them useless or even harmful. In problems of this kind the better technique may be to undertake a survey of the results of the different methods as carried out on a large number of farms over several seasons.

51. Another type of inquiry for which it is difficult to obtain a suitable experimental design is that arising from the evaluation of pastures. In order to make an assessment of the yields of different swards, it is necessary to use the growth or production of animals as a means of measurement. The interaction of the animal and the sward and the differential rates of growth or production of animals at different stages of development introduce many complications. This technique of measurement is being carefully examined.

52. Questions concerned with the analysis of problems put forward and the estimate of the possibility of solution have been considered by a small committee of the Council known as the Field Experiments Committee and also by the Husbandry Groups which are still carrying out this work in connection with problems submitted to them. The Field Experiments Committee has, however, now handed over its duties to the body which is responsible for allocating work to the Experimental Husbandry Farms, as many of the problems involve work on these farms.

53. When the problem has been defined the Council makes a recommendation either to the National Agricultural Advisory Service or to the Agricultural Research Council that the work be carried out. Thus, if it is primarily concerned with husbandry or requires work in the field it goes to the National Agricultural Advisory Service, if it requires work more suited to a research institute it is passed to the Agricultural Research Council.

54. The link between the two Councils is maintained largely by their secretariats, but there is also a Joint Committee on which, in addition to the Councils, the Scottish Agricultural Advisory Council is represented. This body serves a valuable purpose in providing opportunity for the discussion of problems submitted to the Agricultural Research Council for investigations and of the results of researches which appear to be ready for incorporation into agricultural practice.

55. The Joint Committee has other important functions, arising from its strategic position as the meeting-place of the Agricultural Improvement and Research Councils and the Scottish Agricultural Advisory Council. One of the most important of these was the examination of existing research facilities in relation to the anticipated demand in each subject. These inquiries were made by groups set up by the Joint Committee with authority to call for evidence from any interested party. The findings of each group were examined by the Joint Committee which then reported to the three Councils.

56. From these groups a number of important decisions have arisen. The group considering horticulture recommended the establishment of a new Vegetable Research Station with a number of outstations (see also paragraph 38) and the removal of the Glasshouse Research Station from Cheshunt to a new site. These recommendations have been accepted; a governing body and a director have been appointed for the Vegetable Research Station and a site found.

57. The group dealing with grassland recommended that a Grassland Research Station was essential and that a new station with greater facilities to replace that at Drayton should be set up. This was accepted, and as a result the new Grassland Research Station has been established and property at Hurley acquired as its headquarters.

58. The Group considering Animal Breeding recommended the formation of an Animal Breeding Research Organization to cover the study of genetics as well as the more practical aspects of breeding. As a result, the Agricultural Research Council has set up the Animal Breeding and Genetics Research Organization which has its headquarters in Edinburgh and farms in England, Scotland and Wales. This organization has already been at work for two years.

59. The Group on Animal Nutrition reported that new facilities were required for the study of the physiology of large farm animals. Here again, the Agricultural Research Council has agreed to establish an Institute of Animal Physiology and has appointed a director and acquired a suitable property near Cambridge.

60. Other Groups whose reports have been accepted and many of whose recommendations have already been put into practice were concerned with soils, plant breeding and genetics, plant pathology and entomology, and poultry.

61. The Council has given extensive consideration to the design of Farm and Horticultural Buildings. A Committee on this subject appointed by the Minister produced an extensive report which was published under the title *Post-War Building Studies No. 17: Farm Buildings**. The Council undertook to examine its findings and to draw attention to the ways in which they might best be implemented. Two Council Committees were set up for this purpose, the one to study the problems of farm buildings and the other those of horticultural buildings.

PART II

PROBLEMS CONSIDERED BY THE COUNCIL

It is not feasible to recount the work of the Council over the past seven years in detail, but this section outlines a few matters of major interest in addition to some others of less individual importance but which may serve to indicate the type of problems considered by the Council.

ANIMAL HUSBANDRY

62. **Hill Sheep Farming.** The deterioration of hill grazings was one of the earliest problems before the Council. The work of the Council's Re-seeding and Ley-farming Committee mentioned in the Council's first Report has been continued by the Committee on Hill Sheep Farming, which was set up to

* Obtainable from H.M. Stationery Office, price 3s. (by post 3s. 4d.).

review the position in England and Wales. A separate Committee was set up in Scotland to deal with conditions in that country.

The reports of these two Committees led to the Hill Farming Act, 1946, which makes provision for grants to farmers to encourage the rehabilitation of hill farms. The Committees also recommended the setting up of a number of hill farming stations to investigate regional problems of hill sheep farming. Proposals for these hill farming stations are being considered by the Council's Experimental Husbandry Committee in connection with the setting up of the chain of experimental husbandry farms (paragraph 32). The Scottish Hill Farm Research Committee has guided the establishment of centres in Scotland.

Although the Scottish Committee is independent of the Council's Committee on Hill Sheep Farming, its membership includes representatives of hill farming interests in England and Wales, and a further link between the Committees is afforded by the intention to use the existing hill farming station in Roxburghshire, just north of the Border, for investigations serving the interests of both the north of England and south of Scotland.

63. Artificial Insemination. Pioneer work at Cambridge and Reading, under the aegis of the Council, on the artificial insemination of cattle, has led to the widespread application of the method to commercial herds.

The Council's Supervisory Committee on Artificial Insemination, having fulfilled its purpose, has been replaced by a Central Advisory Committee which is in control of the commercial development of artificial insemination. A small joint committee, composed of members of the Central Advisory Committee and of the Improvement Council, provides the link between the artificial insemination stations and the Council, which is thus able to continue to fulfil its functions of advising the Agricultural Research Council on aspects of research which need attention. The need for further knowledge on the conditions under which spermatozoa will retain their activity (*e.g.*, in storage, or during transport from the A.I. centre to the animal awaiting insemination) is an example of this, and one for which A.R.C. funds have been made available at the request of the Council. The Council has also drawn attention to the need for a more reliable method than we have at present for testing trichomonas infection of cattle. Trichomoniasis is frequently accompanied by infertility in cows; the method of transmission is from infected cows by the bull to clean cows, and the bull itself often becomes permanently infected. It is essential to have a reliable method of diagnosis in cows and especially in bulls, in view of the risk of transmission when large numbers of cows are inseminated from one bull. The question of the use of artificial insemination with goats is also under consideration by the Council.

64. Bloat in Cattle. Bloat or "blowing," which is often fatal unless veterinary help is quickly forthcoming, is commonly associated with sudden changes in the diet of ruminants, for example, when lush pastures are grazed in spring, but little is known of the causes of this and related dietary disorders. The Council's Grassland Group recommended, therefore, a joint study of the problem by Veterinary and Grassland Officers. It was arranged that veterinary practitioners would inform Veterinary Investigation Officers of the occurrence of bloat or similar types of disease in their area. Veterinary Investigation Officers and Grassland Officers would then collaborate in the further investigations. It is hoped to obtain information from such case-history studies,

conducted with attention to both veterinary and dietary factors, on the extent and cause, or causes, of bloat, and of similar disorders, sometimes wrongly diagnosed as bloat, which seem to be connected with dietary disturbances.

65. Pig and Poultry Rations. Pig and poultry production in this country is largely dependent on supplies of suitable feedingstuffs, especially cereals like maize and barley. The recent development of sorghum growing on a large scale in Queensland, Australia, has made it possible to send a temporary surplus of this cereal to this country. The Council therefore arranged for the suitability of sorghum, as an ingredient in pig and poultry rations, to be tested under British conditions.

At the request of the Council, feeding trials with pigs were arranged at the National Institute for Research in Dairying, Shinfield, and at the Hillsborough Research Station in Northern Ireland. Trials with poultry were carried out similarly at Reading University. These feeding trials have shown that the Australian sorghum can successfully replace maize or barley in pig rations on a lb.-for-lb. basis, without affecting growth rate, carcass quality, or bacon flavour.

The poultry feeding trials have shown that sorghum can replace up to 50 per cent of mixed cereals (wheat, maize, barley) in the diet of adult birds on range or under the laying-battery system without affecting egg production. It is not, apparently, so successful in displacing mixed cereals for chickens, though up to 50 per cent displacement appears to be permissible for growing birds.

DAIRY HUSBANDRY

Problems of the dairy industry have claimed the Council's attention in a number of directions.

66. Chemical Sterilization of Dairy Utensils. The report of the Mission to North America to study methods of milk production (1945) included a number of recommendations for testing the suitability of North American methods for this country, notably the use of chemicals for sterilizing utensils and the cooling of milk by the churn-immersion method. The need for increased milk production and the importance of ensuring the production of clean milk from the smaller farms where facilities are few, led the Council to support the recommendations. By arrangement with the N.I.R.D. and planned with the help of the Statistical Department, Rothamsted Experimental Station, extensive trials of the two methods were carried out on a cross-section of dairy farms in England and Wales in the summers of 1946 and 1947 with the help of the Advisory Bacteriologists. These trials showed that where steam sterilization is not available, sodium hypochlorite solution provides a satisfactory substitute provided it is properly used. Churn-immersion cooling of milk appeared to be unsatisfactory under conditions in this country. A full report on these trials appeared in the October, 1949 issue of the Ministry's Journal, and is of special interest in view of the recent revision of the Milk and Dairies Regulations.

67. Survey of Cowhouse Routine. The Mission had also drawn attention to the common use in North America of a less laborious cowhouse routine than that considered necessary in this country. There appeared also to be an appreciable saving of manurial values in North American practice. Trials at Farm Institutes were advocated in the first instance but further consultation with representatives of dairying interests led to a proposal to carry out a survey

of cowhouse conditions. This was to include dairy farms in this country which were using cowhouse routine virtually on the lines of that practised in North America. A pilot survey of farms based on a questionnaire drawn up in consultation with the Statistical Department, Rothamsted Experimental Station, was carried out in three counties in 1948 by the Advisory Bacteriologists. An interim report is in preparation and the survey is being continued. In this survey, cowhouse conditions are compared with the corresponding records of keeping-quality of milk on a particular farm. The survey is also intended to throw light on any weaknesses in advisory work on milk production.

68. Intensive Dairy Farming. Problems of the intensive "grass-cake" dairy farming areas of East Lancashire and the West Riding of Yorkshire, the subject of a report by Mr. J. C. Lynn which was considered by the Council in 1945, have again come before the Council in connection with the choice of sites for Experimental Husbandry Farms. Before the war, farms in these areas were maintained by the use of "flying herds" fed mainly on imported concentrates, whereas present policy is against the use of flying herds (often composed of nondescript cattle, sometimes disease-ridden) and imported concentrates are limited in supply. Apart from this the farms have certain problems peculiar to these areas; for example, they suffer from the effect of smoke pollution and possibly reduced light intensity. Consideration is being given to the question of establishing an Experimental Husbandry Farm in East Lancashire, possibly in connection with a number of demonstration farms run by commercial farmers to study these special conditions. The work on many farms in this area is done entirely by the farmer and his family, to whom the questions of wages and hours worked is secondary in importance to the problem of gaining a living if only at a subsistence level. Thus, the improvement of these areas involves social and economic, as well as technical, problems.

Other dairy husbandry problems which have been considered by the Council include the use of stilboestrol in inducing lactation in barren heifers, and the feeding of iodinated protein to cows, with a view to increasing milk production. Trials were carried out with both these substances during the war years, but with the return of more normal conditions their use has become of less potential importance and, in any case, is undesirable except under strictly controlled conditions.

POULTRY HUSBANDRY

69. Poultry Research and Education. The Survey Group on Poultry set up by the Joint Committee of the Council, the Agricultural Research Council and the Scottish Agricultural Advisory Council, made recommendations for the establishment of two poultry research institutes, one in Scotland and the other in southern England. In Scotland there was already in existence a poultry research unit at Edinburgh University; this has now been enlarged as a Poultry Research Institute and a new building is in course of erection. This Institute will study fundamental problems involving such subjects as genetics and physiology in relation to the fowl.

The Survey Group also pointed out how few trained men were available for poultry research and the difficulty which would arise in staffing a second institute. This shortage of workers has delayed the development of the station recommended for the south. This and the difficulty of recruiting staff for the poultry section of the Advisory Service led the Council's Poultry Group

(set up in 1947 with other associated groups—paragraph 45—to deal with problems in various fields of agriculture) to examine carefully the reasons for the shortage of scientific workers in the poultry field. They concluded that it was due to neglect of poultry education in the past and made suggestions which were endorsed by the Council and have since been passed to the appropriate authorities.

70. Maintenance of Inbred Lines of Poultry. The Council's Poultry Group has considered the work begun at Reaseheath on the breeding of inbred lines for crossing. This method of breeding has been shown to be of considerable promise by Dr. A. W. Greenwood at Edinburgh and has been advocated in commercial practice in the U.S.A. The Group's recommendation that the work should be extended was endorsed by the Council, and the A.R.C. was asked to make provision for this work at Cambridge under the direction of Mr. M. Pease. The A.R.C. concurred and arrangements for providing the necessary facilities are now being made.

CROP HUSBANDRY

The Council has dealt with a wide variety of problems in crop husbandry of which the following are chosen as representative.

71. Deep Ploughing. The work of Dr. B. A. Keen and Dr. E. W. Russell at Rothamsted on soil cultivation produced no evidence of increased crop yields when the depth of ploughing was increased from six inches to ten inches. Many farmers, however, believe that deep ploughing materially increases yields. A general comparison of farms where deep ploughing is practised with neighbouring farms where ploughing is to normal depths, tends to confirm this belief, but this cannot be accepted as proof of the advantage of deep ploughing, since almost invariably the farmers practising deep ploughing are outstandingly good cultivators and unsparing in the use of manure. Accordingly the Council considered that it would be of value to obtain more exact information on the advantages or otherwise of deep ploughing by carrying out a comprehensive series of experiments comparing deep and shallow (or normal) ploughing over a complete rotation of crops and under different soil conditions. Such a series of trials was begun by Dr. E. W. Russell in 1944 in collaboration with the Advisory Officers. They have been continued each year. The effect of sub-soiling, with or without deep ploughing, was also studied.

Some interesting results have been obtained. Sometimes, but not often, marked differences in crop yield in favour of deep ploughing have occurred. One of the main advantages of deep ploughing appears to be the production of a cleaner seedbed. Heavy fields tend also to have a drier surface in early spring where the land has been deep ploughed.

A simple comparison of the crop yields from the two methods of ploughing does not necessarily give a proper assessment of the potentialities of the methods. In these experiments, for example, the response of sugar beet to deep ploughing was found to vary according to whether mineral fertilizers were ploughed-in or added to the seed bed. Similarly, in experiments at Rothamsted in 1948, the yield of potatoes on plots in which potash fertilizer was ploughed-in was 1·2 tons per acre more on deep-ploughed plots than on shallow-ploughed plots, and 2·9 tons per acre more than on shallow-ploughed plots when potash was put in the drills. When potash was withheld the relation was reversed,

shallow-ploughed plots giving 1·6 tons per acre more than the deep-ploughed plots.

An observant farmer is quick to detect any potential advantage which a hitherto untried treatment may confer (*e.g.*, ability to sow earlier) and to plan his method of husbandry accordingly. The conditions under which a field experiment is carried out preclude modifications of this kind being tried, so that the practical value of a treatment may not be demonstrable until the experiment is repeated on modified lines. Future experiments, designed with all the potentialities of deep ploughing in mind, may give a more definite picture.

72. Testing, Multiplication and Distribution of Seeds. A supply of high-quality seed of known origin and purity is one of the major needs of an efficient agriculture. It is also evident that the varieties used should be those most suited to the conditions of the soil and climate under which they are to be grown. The need to consider the most suitable arrangements for the testing, multiplication and distribution of seed led the Council to set up a joint committee with the National Institute of Agricultural Botany, the body most closely concerned with all the scientific and research aspects of these questions.

The joint committee set up a working party under the chairmanship of Dr. W. K. Slater but this working party was not able to present unanimous recommendations, probably because of the additional complications engendered by a subsequent widening of the terms of reference of the committee to embrace requirements for Scotland and Northern Ireland. Such recommendations as were agreed have, however, been referred to the Ministry for implementation. The subject is now under further consideration by a more widely chosen group of workers which includes representatives of plant breeding stations and of the seed trade.

73. Failure of Field Beans. For many years, probably going back as far as 1918, yields of field beans (and also peas) have tended to be so poor that in some instances the growing of the crop is scarcely justified. The present need for more home-grown protein has increased the serious nature of the problems and several attempts have been made to determine the cause or causes of this deterioration in yields.

Various reasons for bean failure have been put forward, among them, poor husbandry, inadequate manuring, especially with potash, use of poor seed, weed competition and disease.

Reports from the Advisory Chemists, the County War Agricultural Executive Committees and from various other sources regarding low bean yields led the Council in 1943 to support the extension of a series of surveys begun by Mr. F. Hanley in Cambridgeshire, in which observations were made of bean fields, and these observations, made during the lifetime of the crop, compared with subsequent yields. The Council also arranged to receive information through the Advisory Service of instances of failure of bean crops.

A series of observations on bean crops were also made on a number of farms in Oxfordshire as the result of the Council's recommendation. Field bean observations carried out during the war by Mr. G. E. Furse in Somerset and also the results of field experiments with beans at Rothamsted were examined by the Council.

These observations and surveys have shown that bean failures cannot be ascribed to any one cause. Although much can be done by encouraging sound methods of cultivating the crop, there are some aspects of the problem which only the scientist, e.g., the plant breeder, can solve. The Agricultural Research Council has been asked to examine these aspects, in particular the possibility of breeding strains of field beans which are more frost-resistant.

The Council's Husbandry Group also considered bean failures in reviewing the problem of winter keep for livestock. It drew attention to the nondescript nature of much of the seed supplied to farmers from local sources, to the lack of contracts between seedsmen and farmers growing beans for seed, and to the frequent confusion of spring varieties with winter varieties. It recommended that stocks of dependable strains of beans and peas should be built up. The Council endorsed this recommendation and it has now arranged through the seed trade for samples of dependable seed to be tested and, if found suitable, grown by the National Institute of Agricultural Botany.

There is some evidence that field beans thrive better when sown as a mixed crop with cereals. A series of field experiments to test whether this is so has been arranged by the Council's Crop Experiments Sub-Committee.

74. Potato Problems. Potato Root Eelworm is an important and, unfortunately, a difficult pest to control. The Council has reviewed present knowledge on suitable methods of control, and at the Council's request an account of them was published in the Ministry's Journal, *Agriculture*.

Withholding the host plant by resting the land from potatoes is a well-established principle in reducing the eelworm population of the soil. However, this method is often invalidated by failure to remove all the potato tubers, the remaining "ground-keepers" acting as hosts to the pest. The Council has arranged, in consultation with Professor G. E. Blackman, for the testing of the effect on ground-keepers of growth-regulating weedkillers, to determine whether such treatment reduced eelworm sufficiently to be practicable.

Eelworm cysts persist for years in the soil, the larvae appearing only under the stimulation of an active principle which diffuses from potato roots. The chemical constitution of this diffusate is now under investigation by Professor A. R. Todd and his colleagues at Cambridge. Its detailed structure is not yet known but it has been possible to synthesize certain other compounds which are active, although much less so than the natural product. If such a compound could be produced cheaply it could be used on infected ground, in the absence of potatoes, to make the larvae hatch. Once hatched they would be far more vulnerable to the effects of fumigation or rotation. This possibility has been in view from the outset. The Council has asked the A.R.C. to give special priority to research on this and other methods of eelworm control.

75. Controlling Potato Blight. This is another important problem for the potato grower. Spraying the potato foliage with copper salts—Bordeaux mixture—at the right time effectively protects against blight attacks. However, the correct time for spraying, the number of sprayings necessary, and so forth, vary from district to district, and there is still not enough reliable information on these points to render advisory work on the control of blight at all straightforward. Accordingly, through its Crop Experiments Sub-Committee, the Council has encouraged the carrying out, in many of the

N.A.A.S. provinces, of an extensive series of spraying experiments for blight control.

Mr. E. C. Large's experiments carried out during the war years showed that in the south-west of England potato yields could be increased by about 2 tons per acre by the use of Bordeaux mixture. His work showed, moreover, that the effect of spraying on yield depends on whether a blight attack is likely to fall during the period of maximum development of the tubers. If it falls after this period the spraying is not economic, as blight can no longer affect the growth of the tubers appreciably. There appears to be little doubt that destroying the haulm with sulphuric acid, or tar oils before the crop is lifted, to prevent blight spores on the foliage from contaminating the tubers, is economic from the point of view of the healthy survival of the tubers during storage.

Storage rots of potatoes, especially those occurring during the transit of seed potatoes from Scotland to England, is another problem on which the Council has consulted the A.R.C.

76. Cereal Diseases. The control of diseases and insect pests, especially those which affect the major crops, is a question which is continually before the Council. Information on the severity of these attacks (paragraph 42) serves as a useful guide to indicate the significance of the probable losses represented by the damage to crops and fruit, and hence to the need for intensifying investigation or research along particular lines. The conferences of scientific and husbandry specialists of the N.A.A.S. (e.g., of the Entomologists, Plant Pathologists and Crop Husbandry Advisers) also serve to bring questions concerning pests and diseases to the Council's notice.

Severe losses of cereal crops are caused by attacks by the fungus diseases known as "take-all" and "eyespot." These diseases increased during the war mainly because of the need to grow large acreages of cereals and the consequent failure to rest the land from cereal crops. The means of minimizing or eliminating these diseases have been fairly fully worked out at Rothamsted and elsewhere but they are not known widely enough among farmers.

These diseases can be greatly reduced by good husbandry (e.g., growing cereals in rotation with other crops, adequate manuring, etc.), and there is no doubt that losses from "take-all" and "eyespot" would be far lower if good husbandry was more widely practised. The Council's Crop Husbandry Group reviewed this problem with representatives of the Advisory Plant Pathologists and of research on these diseases at Rothamsted. They recommended the widespread demonstration of control methods which had been found effective at Rothamsted and the trying out at various centres of newer means of control. Several such experiments have been started.

Among the practices to be tested for controlling "take-all" are, withholding the use of nitrogen fertilizers until the spring or giving additional nitrogen in the spring; the use of leys in the rotation and the use of trefoil undersown in corn and ploughed in afterwards as a green manure. The principal of this last method depends on starving the "take-all" fungus of nitrogen which is taken up during the active growth of the trefoil in the autumn. Moreover, the liberation of nitrogen from the ploughed-in trefoil in the late spring helps the cereal to tolerate infection from the over-wintering inoculum of the disease.

77. Weed Control. Every farmer knows that crop yields may be reduced by half, if not by more than half, if weeds are allowed to get the upper hand. In severe cases of weed infestation there may be no crop to harvest. However skilfully the farmer prepares a tilth for sowing, and however adequately he prepares the soil and supplies nutrients for the crop, it will be of little avail if the element of weed competition is neglected. Harrowing, scuffling and all soil disturbing operations in general help to reduce this. In many instances the labour required in destroying weeds in this way can be reduced by employing chemical methods of weed control. Such methods are becoming more and more widespread.

The Council is in close touch with the Agricultural Research Council Conferences on the control of weeds by chemical means and it has sponsored through the Advisory Service very many field trials of chemical weed killers, notably those of the growth regulator type (e.g., MCPA 2-methyl-4-chlorophenoxy-acetic acid) which have been investigated by Professor G.E. Blackman and his co-workers. The Council also set up a committee on the design of spraying machinery which has been responsible for the design, construction and testing of a prototype machine for use with either weed killers or insecticides. A number of requests for the investigation of specific weeds has been dealt with by the Council, notably for the control of bracken, wild oat, ragwort and weeds in water courses. A programme of field work on the control of wild oat by cultivation methods has been approved and handed over to the National Agricultural Advisory Service for field tests. The N.A.A.S. is also reporting to the Council on farmers' methods of controlling wild oat.

The Agricultural Research Council has also been consulted regarding the poisoning of cattle by ragwort, in connection with the problem of eradicating this weed. Experiments to determine the toxic effects of this weed to cattle fed at different levels of nutrition are under consideration as the result of the Council's approach to the Agricultural Research Council and the Ministry's Veterinary Laboratory.

78. Trace Element Deficiencies in Crops. In the past many instances of crop failure have been incorrectly diagnosed because of the difficulty of detecting deficiency of the so-called trace elements in soil and plants. Research at East Malling, Long Ashton and in the Advisory Service has, however, provided the means of diagnosing these deficiencies (deficiencies in boron, iron, manganese, etc.) from the appearance of the crop or by leaf tissue tests often in time to remedy the deficiency and thus avert crop failure.

Action with a view to keeping advisory staff informed of these technical developments was reviewed by the Council and a summary of practical points arising from these developments was issued to Technical Officers of County Agricultural Executive Committees who were asked to help by reporting mineral deficiencies in their areas to the Agricultural Research Council.

Professor T. Wallace's handbook, *Diagnosis of Mineral Deficiencies in Plants*, and a supplement to it giving plates of different crops suffering from various mineral deficiencies, was issued to officers of the C.A.E.Cs.

GRASSLAND HUSBANDRY

79. Research on Grassland. The extent of grassland in Britain and its economic importance leave no room for doubt as to the need for agronomic research on grassland problems. Intensive studies on these lines have been

undertaken in this country at the Welsh Plant Breeding Station, Aberystwyth and at the Grassland Improvement Station—now the Grassland Research Station—at Drayton, near Stratford-on-Avon.

As mentioned earlier in this report (Paragraph 57) the Grassland Research Station has been transferred to Hurley in Berkshire where there are better climatic and soil conditions for grassland research than at the old station. Many of the conclusions of the grassland experiments carried out at Aberystwyth and Hurley will be further tested at the Experimental Husbandry Farms.

80. Grassland and the Grazing Animal. The Council has been consulted regarding proposals to carry out at the Welsh Plant Breeding Station trials to measure the effect of grazing animals on herbage production from different strains of grasses and clovers, and conversely, the effect of these different strains on animal production. The Council has made a number of suggestions as to how this programme could be co-ordinated with grassland work proposed or in progress elsewhere.

Another grassland problem in the same category which has been considered by the Council, arose from a conference on grassland problems held at Newcastle, the conference putting forward a request for an investigation of the unexplained differences between pastures in their ability to “finish” fattening cattle. The Council’s Grassland Group considered this request in consultation with members of the Newcastle conference and recommended that factual evidence of these unexplained differences in pasture quality should first be brought forward, before quantitative field trials took place. In response to a request from the National Farmers’ Union for guidance to farmers on grazing management, the Council arranged for the publication of a bulletin on this subject dealing with grazing management under different conditions of husbandry.

It is hoped that this bulletin will be issued in 1950.

81. Value of Dried Grass. Questions raised with the Council by the Agricultural Research Council’s Conference on Dried Grass, concerning the future place of dried grass in stock feeding in relation to allocation of men and materials in long-term research, have included one of general interest—whether the special nutritional qualities attributed to dried grass are real or illusionary. Formerly the price of dried grass was often based, rightly or wrongly, on carotene content but now the N.F.U. Crop Conservation Committee advocates a price policy based on protein content.

The Ministry has been consulted on the question of these economic aspects of grass drying and it has made provision for financial assistance in the form of grants and loans for co-operative grass-drying schemes worked on a non-profit basis, and for loans to farmers and contractors in connection with the purchase and installation of grass drying equipment.

HORTICULTURE

82. Reviewing Horticulture Problems. As has already been pointed out (Paragraph 5) the Council is responsible for advising on horticultural as well as agricultural problems. Horticultural interests are well represented in the membership of the Council, and in keeping horticultural problems under constant review the Council is assisted by several committees and groups concerned with the different branches of horticulture. On the research side

there is the joint Committee's Reviewing Committee on Horticulture, representing the Council, the Agricultural Research Council and the Scottish Agricultural Advisory Council. Other committees include, the Experimental Horticulture Committee which guides the work of the experimental horticulture stations set up within the Advisory Service, the Council's Horticulture Group, and the Horticulture Buildings Committee with its study groups for glasshouses, buildings, vegetable and fruit storage and packing.

These committees have considered and reported to the Council on various questions of importance to the industry. Proposals for the setting up of a fruit variety testing station near East Malling and for a vegetable research station and associate stations have been considered and approved by the Council. A Director has been appointed for the vegetable research station and a suitable site in Warwickshire has been acquired. A field station has also been obtained in the seed-growing area of Essex.

83. Frost Damage in Orchards. Special attention has been given by the Council to this important question. The methods of preventing frost damage have been under review and steps have been taken to bring these methods to the attention of the growers.

The need to examine the more fundamental aspects of frost injury as part of the general programme of agricultural meteorology—a branch of agriculture which calls for much greater attention than it has hitherto received—has been the subject of consultation between the Council and the Meteorological Office. As a result of this a member of the Meteorological Office staff has been seconded to one of the Advisory Provinces for special duties in agricultural meteorology, and arrangements are now in hand to extend this work.

The Council has been associated with experimental work on the screening of orchards against frost with smoke-producing devices ; it has also arranged with the National Institute of Agricultural Engineering for the designing, construction and testing of horizontal fans for diluting the cold air in orchards with the warmer air above them, though the possibilities of an economical solution on these lines would appear problematical. A fan has been erected and tests are being made at the N.I.A.E. Wrest Park, as well as elsewhere.

84. Diseases and Pests in Horticulture. Many of the horticultural problems before the Council concern plant disease and pests. The possibilities of breeding strains of brassica which are resistant to the fungus causing club root have been reviewed in consultation with plant breeders. Requests for further research on the control of "canker" in parsnips and of pea aphid have been considered. Special observations on progress in methods of controlling the latter were made by an Agricultural Research Council worker during a visit to U.S.A. research stations, at the request of the Council. A programme of investigation of this pest has now been put forward. At the request of the Council, canker in parsnips is being investigated by the Royal Horticultural Society at Wisley.

85. Minor Branches of Horticulture. Consideration has also been given to the problems of the smaller branches of horticulture, such as willow growing and the watercress industry. Provision for technical advice to growers has been arranged for both these industries, and the Council has appointed liaison officers to keep in close touch with the problems. The position of research

work on hops has been considered by the Council as the result of requests received from the A.R.C. and the N.F.U. Hops Committee.

The Council considered a request from the Mushroom Growers' Association for a grant in aid of research on mushroom production, conducted at a small station at Yaxley (near Peterborough) now financed by the Association. The Council recommended that the A.R.C. should consider such a request sympathetically.

OTHER PROBLEMS CONSIDERED BY THE COUNCIL

The Council's interests have been extended to a number of miscellaneous problems, some of which may be briefly mentioned.

86. Seed Contamination. Among the various causes leading to deterioration of seed stocks is cross-pollination, which makes it necessary to keep crops intended for seed apart from adjacent crops which might contaminate them in this way. The work at the John Innes Horticultural Institution by Dr. Mather has suggested, however, that the spacing usually considered to be necessary between such crops is unduly large. If this is correct we are going to a great deal of unnecessary trouble in this country in our methods of growing crops for seed.

The Council referred this question to a small group of specialist workers. This group has recommended the carrying out of a comprehensive survey of this subject, to confirm the John Innes results, involving the collaboration of a number of institutes and other bodies. In addition, a field experimental programme is being considered in which contamination of seed due to sources other than cross-pollination (e.g., contamination during threshing and cleaning of the seed) will be investigated.

87. New Crops. Several crops have, or may, become important because of the shortage of animal feedingstuffs or of plant derivatives (oils and drugs) which we normally buy from abroad.

The Council has been in close touch with the field investigations of Professor Blackman on such crops as linseed (linseed oil and cattle cake), hybrid maize from America (fodder and silage), sunflowers and poppies (edible oil and morphine), and steps have been taken to see that farmers are kept informed of the best methods of growing and harvesting these crops. Field trials to test the value of German and New Zealand strains of sweet lupin for fodder, and the possibility of growing tobacco for nicotine production (for use against insect pests of crops) in this country, have also been sponsored by the Council.

88. Fenland Problems. The special problems of fenland, dealt with by Dr. J. H. Bates in a memorandum, were brought to the attention of the Council. Those recommendations of the memorandum which dealt with general agricultural and sociological aspects were referred to the Ministry, but in the meantime the Council implemented a number of important recommendations regarding research in consultation with the Agricultural Research Council. Experimental work is going forward on the claying of fens and on the water relationships of fen soils. The latter includes a study of the effect of height of water table in fen soils on crop production. The desirability of setting up a fenland experimental husbandry farm for the study of fenland husbandry problems is being borne in mind by the Council.

89. Control of Dangerous Insecticides. The scheme for the official approval of insecticides and fungicides mentioned in the First Report, has been operated by the Ministry's Plant Pathology Laboratory at Harpenden for some years. This voluntary scheme continues to provide a useful control in the marketing of these products. Particular attention is being given by the Council to the possible harm which may attend the unrestricted use of modern insecticidal compounds of high toxicity, notably the organo-phosphorus compounds. Such compounds are widely used and advocated abroad, although little is known about the effect of prolonged exposure to them on the health of those handling them, nor of their effect on beneficial insects and on the balance of nature. The Council has taken the initiative in drawing the attention of the various bodies concerned with public health, toxicology, insecticide research, etc., to the risks which are involved in the use of these compounds before thorough tests of them have been completed.

90. Agricultural Statistics. The Joint Committee of the A.I.C., the A.R.C., and the Scottish Agricultural Advisory Council has supported a proposal to set up at Rothamsted Experimental Station a central Agricultural Statistical Service to assist research institutions and others in the design of field experiments, and with other statistical problems for which the institutes lack the necessary facilities. This service is now available and the fullest use of it is being made by the Advisory Service. Apart from the use of statistics in the design of field experiments, statistical methods are now being used widely in assessing and defining agricultural and horticultural problems.

91. Farm Buildings. The Council recently reviewed the work of the Farm Buildings and Horticultural Buildings Committees. Under the guidance of these Committees a Farm Buildings Advisory Service is gradually being established as part of the Agricultural Land Service. Each Province has a nucleus staff and short courses for Advisory Staff on such subjects as the use of concrete and timber in farm buildings have been organized. The design, production and distribution of M.A.F. Standard Building Components has been a primary objective and this scheme is proceeding extremely well. The Horticultural Buildings Committee has approved arrangements for the building of glasshouses of experimental design at Bayfordbury for the John Innes Horticultural Institution.

92. Agricultural Machinery. The appointment to the Council, in an *ex-officio* capacity, of the Chairman of the Agricultural Machinery Development Board enabled the Council in the past to keep in close touch with agricultural engineering research problems. This arrangement came to an end when the A.M.D.B. was replaced under the new arrangements for agricultural engineering research which were announced in January, 1949. The National Institute of Agricultural Engineering and the Scottish Machinery Testing Station have now become grant-aided research institutes under an independent governing body constituted as a company. The research programmes are supervised by the Agricultural Research Council through a newly appointed Standing Committee for Agricultural Engineering Research.

The Minister of Agriculture and Fisheries and the Secretary of State for Scotland have also appointed an Agricultural Machinery Advisory Committee to advise them on questions relating to supply and requirements of agricultural machinery.

The Council continues to maintain close touch with research into agricultural engineering problems. A very useful link has been afforded by the establishment at the N.I.A.E. itself of a liaison unit of the N.A.A.S.

Apart from questions into which machinery problems enter only indirectly, the Council has dealt with the following matters : the importation of spraying machines for trials in this country ; the development and testing of a dual-purpose spraying machine for use against weeds and insect pests ; the testing of a prototype drill for fertilizer placement ; the standardization of rowcrop machinery ; field studies of the economics of different types of mechanical harvesters for potatoes, and similar field trials of different spraying and dusting machines for the control of potato blight.

We have the honour to be,

Sir,

Your obedient Servants,

(Signed) *Donald Vandeppeer* (Chairman)

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