SECTION L—CHAIRMAN'S ADDRESS

Agricultural Science: Contributions and Challenges

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OVER 95 per cent. of our export income is derived from the products of our primary industries. At our present rate of population growth we will reach three million within twenty-five years. To maintain our present standard of living we must increase our primary production by 60 per cent. in the same period.

These three statements highlight the greatest challenge of all to the future welfare of this country; and the Director-General of Agriculture did well to draw attention to it in his 1953 report to Parliament.[1]

In size and population, New Zealand is a small country, but in food production per acre of farmed land, in output per worker on the land, and in volume of surpluses of food for export, New Zealand ranks among the major countries of the world. Our success and achievements as a surplus food producer are due to a favourable climate for pastoral farming, to an enlightened and conscientious rural population, and to the sound work which has been done in research and extension by our agricultural scientists.

The same factors which have provided the answers in the past must provide the answers in the future, even though the products from our exotic forests will become increasingly important as contributors to our export income. Production per animal and production per acre must be increased, and this can only come from progress in agricultural research and advisory services and appreciation in full measure of the key position of the farmer in our national economy.

This is the central theme of my address which I propose to cover under three main headings:

A What are some of the contributions and challenges in agricultural science?

B. How can these challenges be met most effectively?

C The place of the university in agricultural science

A. WHAT ARE SOME OF THE CONTRIBUTIONS AND CHALLENGES IN AGRICULTURAL SCIENCE?

In an admirable Presidential Address to this Society in 1952, F. R. Callaghan[2] reviewed some of the outstanding contributions to agriculture made by our scientists. Nevertheless, it is timely to stress these contributions and to review very briefly the challenges which confront us. Timely because so many findings of research have become so much a part of regular practice that the original work tends to be overlooked, and timely because so many of the problems which are yet to be solved will require for their solution the co-ordinated painstaking efforts of teams of specialists from many fields associated with soil science, plant science and animal science

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This reference to co-ordinated work is necessary because I propose—simply because it is convenient—to review contributions and challenges under the three headings of Soils, Plants, and Animals. As a soil man, I can be pardoned for putting soil science first, because it is on our soils that we grow the crops to maintain the livestock industries.

1. Soil Sciences

The first glimmerings of the scientific study of the soil in New Zealand appeared away back in the 1880's in the work of W. E. Ivey, the Director, and George Gray, the chemist, both of Lincoln College. Ivey introduced scientific method into field trials with superphosphate and Gray laid the groundwork for soil and fertiliser analysis. Much later Aston and his associates in the Department of Agriculture added greatly to our knowledge of soil use. The very diversity of the soils stimulated interest in surveys and the systematic mapping of soils was initiated in the 1920's. These early surveys undertaken by the Department of Agriculture and the Geological Survey were conducted on the basis of mechanical analysis of geological origin and were of limited value. In 1925, T. Rigg—later Sir Theodore Rigg—introduced the concept of the soil profile as the basis for classification. The adoption of this concept, which has been interpreted and adapted to our conditions by Grange and Taylor and others of the Soil Bureau, marks the real beginning of soundly based soil science. If we accept this as a fact then soil science in New Zealand is scarcely twenty-five years old, and yet in that short period of time great progress has taken place and many important contributions have been made.

The accurate demarcation of soil types and the interpretation of the pedological processes which produce them is of basic importance to land development, land utilisation and to all aspects of plant and animal research. The detailed survey of Waipa County made in 1933 was followed in 1935 by regional surveys in North Auckland and Hawke's Bay and these in turn provided the information which made possible reconnaissance surveys of the whole of the North Island. The recent publication covering the soil types of the North Island is an important contribution to our knowledge. Rapid progress is now being made on the South Island and it should not be long before a second publication will complete the general picture of soil type distribution in New Zealand.

Soil survey work is only one of the activities of the Soil Bureau, for in 1946 sections were established to deal with chemistry, physics and soil biotics. These sections have already made valuable contributions.

The Soil Bureau is not the only contributor to soil science. The Rukuhia Soil Research Station, in addition to servicing the hundreds of field trials established throughout the country, has done really good work on many problems. The increased production which will follow from their demonstration of the importance of molybdenum on many soil types, of the potential productivity of the peat soils and of the responses to spray irrigation will do much to make possible the achievement of the necessary goals in primary production.

Outside the Departments are the two Agricultural Colleges and the Cawthron Institute Hudson and his assistants at Massey College have pioneered research into drainage problems and provided the information necessary for the installation of efficient drainage schemes. Walker at Lincoln

has recently added to our understanding of the soil nitrogen cycle and drawn attention to the importance of the interactions between molybdenum, sulphur and phosphate in clover establishment on many South Island hill soils. I have left Cawthron to the last—not because its contributions have been least, but to pay special tribute to the contributions in the trace element field by Sir Theodore Rigg, Askew and their assistants

In 1951 I commented that "although much excellent work had been done on the trace nutrients, I have no hesitation in saying that we are only at the outset of research in this field."[6] In the three years since then molybdenum, once a name known only to chemists, has become a familiar word in the rural community, interest in nickel referred to by Dixon in the 1930's in connection with "Morton Mains disease" has revived; and among the "back room boys" vanadium occasions more than casual comment. So much for the contributions of soil science—and that is but a fraction of them.

What of the challenges and in what ways can soil science help us to reach the goal of increased production? There are two broad fronts: first, by increasing the area of productive land and, secondly, by increasing the production per acre of the land now being farmed.

Soil surveys have shown that we have about three million acres of relatively unproductive soils which should be capable of being developed. Granted that nearly half of this area is made up of the problem soils, such as the fibrous peats, the "ironstones" and the "pakihis", it should be possible within twenty-five years to solve the problems and bring them into production. To increase the per acre production of the developed land will require an intensification of efforts to supply answers to the most significant problems in soil physics, chemistry and biology.

To many of you this may seem like a brief resumé of soil-plant relationships, so in order to round out the picture and indicate to those of you most directly concerned with animals that soil science has much to offer in the solution of animal problems, let me quote the following from N. H. Taylor:[3]

> "What is needed in order that our lines of investigation may be well co-ordinated is further work in characterising soils along lines suggested by animal research. In particular, now that better techniques are available, surveys of the 'minor' elements in the soil should receive the same attention as has been given in the past to survey.. of the 'major' elements. This work should be undertaken not merely as part of a procedure to investigate current problems. It should be done, as it were, for its own sake, if we are to anticipate the problems of to-morrow Fortunately, there are in New Zealand enough virgin soils for the soil man to be able to short-cut the lengthy piecemeal approach of field to field studies. By studying the inherited and acquired characteristics of our virgin soils he should more quickly be able to understand, and in certain cases perhaps predict, those characteristics likely to be induced by the farmer.
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> "How far, then, can the soil man assist in animal research problems? As his knowledge grows, he can present soil data illustrated with maps and arranged in an orderly manner such as will help in understanding the relationship between soil, plant, and animal, but farther than this he cannot go without the help of workers in other fields. For instance he can rarely, of his soil knowledge alone, say that such and such a figure indicates suffici-

ency of any particular element. If, however, the necessary data on the plant and animal sides are forthcoming he will be able to indicate, in terms of the animal, the meaning of the particular soil characteristic within certain sets of soils, and to estimate how far this interpretation may be expected to hold true for other sets. Where an animal problem has its source in soil conditions he may be able early in the investigation to delineate key areas for research and to direct attention to other areas which could profitably be examined: and when the investigation is complete he can draw maps, based on soil surveys, to indicate the nature, distribution and extent of the areas to which the results are applicable."

2. Plant Sciences

Progress in and contributions from research in the plant sciences have been outstanding. By saying this I do not want to imply that these comments cannot also apply to the soil sciences and the animal sciences, but it is a fact that work with plants has gone on over a longer period and on a broader front. These contributions fall into two broad categories: first, the improvement of the yield per plant by selection or the breeding of improved lines, and by reducing losses from disease and pests, and, second, by making better use of plants through the introduction of improved management practices and more efficient methods of fodder conservation.

Systematic plant breeding was initiated at Lincoln College by the late Professor Hilgendorf, and since his early work on wheat the plant breeders have made many contributions. Releases of improved varieties and strains of wheat by Hilgendorf and Frankel, of pasture grasses and clovers by Levy and Corkill, and of forage crops by Hadfield and the late R. A. Calder, are well known and have been so successful that the use of these improved lines has become regular practice.

The plant pathologists, mainly of the Plant Diseases Division, through their studies on the life histories of the causal organisms, have introduced effective control measures for many of the most devastating diseases of field, orchard, and market garden crops. The adoption of the present well-defined seed treatments for cereals, pulses and vegetables, and the regular spray schedules for orchard crops using certified therapeutants emphasise how directly practices have been influenced beneficially by the findings of research.

The entomologists must be credited with reducing the depredations of many insect pests by the application of biological control measures, e.g., for white butterfly, and by their development of a practical method of protecting pastures against grass-grub and grass caterpillar.

Plant physiologists have been closely associated with the work on trace nutrients and specialists in the virus diseases have kept this country in the forefront of this rapidly advancing and diversifying field.

All of the contributions in the plant sciences mentioned so far have led to increased production per plant. The ecologists and agrostologists—among whom Levy and Sears have been outstanding—have made, in collaboration with their colleagues in soil and animal management, progress equally as significant in raising crop and pasture yields per acre. In addition, officers of the Soil Conservation Council have made good progress in association with others on conservation and development practices for the hill country.

So much for the contributions—now what of the challenges in the plant sciences? These fall into four broad categories:

(a) The continued improvement of our crop and pasture plants by introduction, selection and breeding, and here the plant breeder will have to call upon the pathologists and the entomologists to an increasing extent.

(b) The prevention of the importation of diseases and pests by the operation of an efficient quarantine service In this connection it is fair to comment that the present system based on isolation on growers' properties is very debatable.

(c) The solution of the specific disease and pest problems still outstanding—what we might call the day-to-day problems—as well as those which will inevitably arise through importation or mutations.

The pathologist still has to give us a measure of control of dry-rot and club-root in infected root crops, of mildews and root rots in cereals and of white-rot of onions. The entomologist must obtain more fundamental knowledge of the life histories of the codling moth, leaf hoppers and leaf rollers of large fruits and the eryophied mite of small fruits, the vectors of many virus diseases including that for yellow leaf of phormium, and the nematodes so that methods of control can be based on sound techniques.

(d) The metabolic problems associated with animal production on high-producing pastures The problems in this, the most difficult group of all, provide a convenient bridge to the animal sciences.

3 ANIMAL SCIENCES

When we consider the overwhelming importance of our animal industries—produced certainly on the crops raised on the soils—it is surprising to find that until about 1940 most of the contributions of research to animal production came from the interpretation and application under our conditions of the findings of workers overseas. The introduction and application in our dairy industry of strain 19 vaccine for contagious abortion and of penicillin for mammitis and of blackleg vaccine for sheep are among the greatest of the contributions to animal production.

New Zealand owes a heavy debt to other countries in research, but it is very satisfying to know that within the past fifteen years our workers in the animal sciences have made sufficient progress to be able to return the compliment to an extent that our animal research stations and agricultural colleges are now "meccas" for specialists from other countries.

We can credit our own scientists with important contributions towards production through the work of Filmer and Cunningham on cobalt, copper and other trace elements; the work of the late M. J. Scott and McMeekan on pig production, and the initiation by McMeekan and others of the important studies at Ruakura on sheep and cattle production on intensively managed pastures. From some of these studies, observations of marked practical significance have already been made and the findings adopted in practice. Even more significant is the accumulation by the workers at Ruakura, Massey and Lincoln of basic information on grazing behaviour, food intake and conversion, reproduction, carcase growth and conformation, and many other aspects of animal production. This information together with that on diseases will lead to rapid progress on many of the problems in animal science.

This quick review must suffice though it does not do justice to the many contributions made.

The challenges again are formidable. Lambing percentages are much lower than they should be; growth rates in fat lambs are highly variable, which warrants further investigations on milk production in strains of breeding ewes; hogget unthriftiness occurs all too frequently; and failure to breed in both sheep and cattle is common. The veterinarian has yet to find the cause of white muscle disease and effective acceptable means of control for bovine tuberculosis and Johne's disease. The metabolic diseases require special attention and I will discuss them further under the next section.

4. Converging Fronts in Soil-Plant-Animal Relationships.

In each of the sections covered you will have noted frequent references to the need for a co-ordinated team approach to solve some of the most urgent and challenging problems in agricultural science. Although there are now and there will always be the rather simple straightforward problems which can be handled by one or two specialists, it is abundantly clear that real progress towards the solution of the many complex problems can only come from painstaking co-ordinated work. To stress this still further I propose to list five of the major fronts on which a vigorous research attack must be made by teams of scientists combining knowledge of soils, plants and animals. Several of them are directly related to the fact that our livestock industries are based on all-the-year-round utilisation of high-producing pastures. In this, we in New Zealand are almost unique and we must advance the frontiers on these problems by our efforts and in our own interests. In addition, work on these frontiers will enable our scientists to make significant contributions to the overall understanding of the soil-plant-animal relationships. As a country which has benefited handsomely from work done overseas we have that obligation and we have the opportunity to honour it. These broad fronts are:

(a) Balance and imbalance in the mineral nutrients required by plants and animals.

Contributions on the major and trace mineral nutrients have been made by many of our scientists working on specific projects in soils, plants and animals, but what is now required are comprehensive studies to follow the effects of the level of these nutrients in the soil on uptake by pasture plants and mobilisation by the animals grazed on them. It is abundantly clear that pasture management practices and continuous high per acre production are extending the marginal areas of trace element deficiencies and that corrective measures must be applied very carefully to prevent the development of serious interactions between nutrients. We need to know a great deal more about the major nutrients: phosphorus, calcium, sulphur and magnesium, and about the minor nutrients: cobalt, molybdenum and copper.

(b) Studies on the physiology and metabolism of pasture plants and the significance of plant metabolites in animal nutrition and health.

This is the broadest and most critical front of all. The capitalisation of our favourable climate for pasture growth by the use of high-producing strains of grasses and clovers has induced under certain conditions problems in animal production which are mainly metabolic in origin, e.g., facial eczema and bloat. McMeekan[4] has rightly drawn attention to the fact "that dairy cows are

apparently incapable of attaining adequate intakes of digestible dry matter when given ad lib access to autumn-saved or early spring pasture of high digestibility and nutritive value when measured by current standards, yet find no difficulty in doing so later in the year on relatively sparse pastures of lower quality." The observation that sheep do not thrive on lush white clover-dominant pasture is well known and was clearly though not accurately expressed by a farmer who stated that the percentage of lambs sold fat-off-the-mothers is inversely proportional to the apparent quality of the pasture.

It has been claimed that stock raised under our conditions obtain an excess of protein and a deficiency of energy elements Clearly this point is one for the biochemists, the animal physiologists and the husbandmen. and it is very gratifying to know that Melville and his associates of the Grasslands Division are already making good headway in collaboration with workers at Ruakura. This front is one in which our scientists are leading the world and they warrant full support.

(c) Problems associated with reproduction in sheep and cattle.

The facts that we have far too high a proportion of animals which do not breed and that there are many dairy cows which calve too late to enable them to make full use of the spring flush in pasture growth pose difficult but important problems for the pathologists, physiologists, biochemists and endocrinologists.

(d) Problems associated with the development, management and conservation of hill country pastures.

Aerial topdressing has spotlighted the potentialities of development on much of the hill country and opened up a broad front for the continued attention of specialists in soil science. agrostology, ecology, conservation, animal management and economics.

(e) Chemurgy in relation to primary products.

This may appear as a strange heading under agricultural science and it is included merely to draw attention to the need to investigate the industrial potentialities of products which can be obtained from the treatment and fractionation of milk an ! milk products and of the blood from the freezing works.

B HOW CAN THESE CHALLENGES BE MET MOST EFFECTIVELY?

1. Present Organisation for Agricultural Research

At the present time agricultural research is conducted under the aegis of six major agencies and the gross expenditure by them over the past few years is outlined in Table I from Hamilton.[5]

Although each institution covers many facets of research, animal investigations are most heavily concentrated in the Animal Research Division of the Department of Agriculture, plant investigation in the Department of Scientific and Industrial Research, and conservation problems under the Ministry of Works. In particular, your attention is drawn to the very limited grants given to the two Agricultural Colleges and to the significant fact that over the past eight years when grants to the other organisations have increased sharply, those to the Colleges have actually declined Certainly the picture is somewhat brighter than is shown in the table, because the teaching grants made to the Colleges

Gross Expenditure by Agricultural Research Agencies in New Zealand over the Period 1946-47—1953-54. (Hamilton).

	Actual Expenditure.							
	1946-47 £'000	1947-48 £'000	1948-49 £'000	1949-50 £'000	1950-51 £'000	1951-52 £'000	1952-53 £'000	Estimates 1953-54 £'000
D.S.I R. and Affiliated Research Associations	211.3	265.0	303.2	386.0	373.8	441.0	417.8	455.0
Department of Agriculture . .	186.3	242.9	309.0	389.6	408.5	489.7	491.4	505.7
Cawthron Institute .	14.6	16.6	18.7	19.8	19.5	21.1	20.1	20.4
Agricultural Colleges* . .	15.0	11.8	12.8	12.0	11.8	12.3	10.3	12.0
New Zealand Dairy Board .	10.0	10.0	10.0	12.0	12.0	14.0	15.0	16.0
Soil Conservation and Rivers Control Council	6	4.4	26.9	34.8	36.7	51.3	53.4	54.4
Totals .	437.8	550.7	680.6	854.2	862.3	1029.4	1008.0	1063.5

* Apart from some minor grants from the University and from other sources the Colleges are dependent for research grants on the Department of Scientific and Industrial Research.

do allow for some research by the academic staff. Nevertheless, it is true—only too true—that the Agricultural Colleges are the indigents and yet the Colleges are expected to train a proportion of the research workers and all of the field and advisory officers I propose to refer again to this position. Furthermore, the table does not give any real indication of the very widely scattered distribution of research centres. Many of these are single units and in some instances sub-stations of either the Department of Scientific and Industrial Research or the Department of Agriculture. Of these two departments, the

former has located important sections near both Massey and Lincoln Agricultural Colleges, an arrangement which has proved mutually beneficial.

2. Regrouping of Research Centres

Some degree of scattering is warranted to handle specific regional problems, but there are four important reasons why further scattering should be stopped and indeed why some re-grouping should be undertaken.

Firstly, the greater the number of scientific disciplines represented at a centre the more stimulating the atmosphere and the more dynamic the research programme. This would be of particular value to the teaching and research training given at the Agricultural Colleges in that senior and post-graduate students would have the advantage of contacts with research personnel in the various fields represented at the regional group centre. Furthermore, strong centres will tend to attract able scientists from overseas, particularly if we in New Zealand can extend to them the opportunity to test on groups of farm animals the results they have obtained with small laboratory animals in their own countries.

Secondly, an increasing proportion of the major problems will require for their solution the co-ordinated efforts of specialists from many fields.

Thirdly, the provision of suitable laboratory buildings, field facilities and technical personnel is less costly in large units. Moreover, research laboratory equipment is becoming so complex and so expensive that for its efficient operation it should be handled by specialist operators and regularly used in the service of a number of scientists.

Fourthly, the existence of many small scattered units reduces the flexibility in research programmes.

The dispersed nature of the present set-up has led to many criticisms, some of which are unjustified and others justified The charge often made of duplication and overlapping on projects between various research laboratories is, I am sure, quite unwarranted, for in point of fact there is very little such duplication. On the other hand, I would support the charges that there is insufficient co-ordination of research efforts as a whole and that progress on many projects is handicapped through lack of collaborative effort between specialists. The Department of Scientific and Industrial Research has met some of these criticisms by the seconding of specialist officers between divisions, but this approach is limited in scope and effectiveness

3. Proposed Policy and Planning for Agricultural Research

How then can better co-ordination and integration of effort be attained? This has been debated for many years, but I have no hesitation in supporting the view that the overall guidance of agricultural research should be the responsibility of one authority. To achieve this an Agricultural Research Council responsible directly to Cabinet should be set up and charged with the duties of sponsoring and financing all research into the primary industries.

The finance for this research should be provided by levies on our primary products and subsidised by Government grant. In addition, it would be reasonable to expect contributions from the business enterprises dependent on the processing and handling of the primary products.

It should also be made a definite policy to limit the number of major centres for research; and at each such centre there should be stationed the headquarters of some important branches of agricultural science together with specialists seconded from those branches with headquarters at other centres. The major centres should be housed in permanent, well-serviced buildings, provided with sufficient land for field work, and wherever possible, they should be beside but independent of a unit of the University of New Zealand. Three such centres at Hamilton, Palmerston North and Lincoln would meet our needs for many years, especially as there are already strong centres for regional research at Auckland and Nelson. Supplementary local centres would be required at various points, but it is essential that such centres should be flexible in operation. Though the implementation of these proposals on administration of research and the development of major research centres would present many difficulties, the adoption of some such programme would be in the national interest.

4. Extension Services

The findings of research are of little practical value unless they are adopted into practice. Already our research information is far ahead of practice except for that small group of really efficient farmers who keep fully abreast of progress and act as a very valuable stimulus to research personnel. One of the most effective correctives to this position is the operation of really dynamic general extension services supplemented by a small number of specialist officers. At present we have a multiplicity of extension services under several administrations, most of them with a sectional responsibility. This is unsound. Each farm is a business unit and in extension work should be treated as such. Moreover, general advisory work on animal production, which has lagged behind that on crop production, should be increased. For this work agricultural graduates with special training in animal husbandry and farm management are better suited than are veterinarians.

Parallel with progress in research therefore, must be progress in the extension services to provide a strengthening of the link between the research man and the farmer. It would be an added advantage if strong regional headquarters of the extension services were located in association with the main research centres. Development of the general extension services along the lines of the Farm Advisory Service of Lincoln College, the Franklin Group Scheme and the scheme operated by the Dairy Board would be a great step forward. At present most extension officers are hampered by routine and by their very diversified duties and they are neither accorded the professional standing nor paid the salaries warranted by the importance of their position.

Even with these handicaps the extension officers have done well, but over the next twenty-five years the extension services must be greatly expanded, revitalised, re-oriented in their outlook to stress the farm management approach and the officers must be given opportunities and paid salaries commensurate with their responsibilities.

C. THE PLACE OF THE UNIVERSITY IN AGRICULTURAL SCIENCE

1. Research as a University Responsibility

The University is charged with the responsibility of providing the basic training for the teachers, extension officers and research workers in agricultural science and of inculcating in its graduates a due sense of civic responsibility.

This is especially true of the Agricultural Colleges which act also as focal points for the rural population and interpret the rural scene for the community as a whole. In the next twenty-five years the Agricultural Colleges have a major role for which they are as yet inadequately equipped. By way of illustration, let us take research. You will recall from the figures given in Table I that the total research grants to the Colleges are about £12,500 per year. In addition, the Colleges themselves provide stock and assistance. With staffs heavily engaged in teaching and other essential activities, such meagre financial support means that research is relegated to a minor role, and yet no one would question that stimulating teaching at the University level is always associated with departments in which many members of the staff are engaged in a vigorous research programme. Indeed, it is fair to say that the prestige of a University depends on the calibre of its scholars and its contributions to research.

It is not suggested that research at the Agricultural Colleges should rank in importance with teaching, but it is essential that research be recognised as a major function and members of the College staffs with special qualifications should be given the time and the facilities to carry on active research programmes, particularly on problems of a fundamental nature or requiring long-term investigation. The development of such programmes would also make possible through post-graduate courses the training in this country of some of the specialists required in the research organisations and give the strength necessary to provide refresher courses for graduates. The research organisations and the Agricultural Colleges cannot live unto themselves alone and the marked expansion in research which has taken place in recent years in non-university institutions must be paralleled by an intensification of the research activities within the Colleges if they are to provide a real source of inspiration and mental stimulation.

Most of my comments have referred to the Agricultural Colleges, but the case for increased research grants to the University Colleges—particularly for use in the science faculties in which are trained many recruits to agricultural science—is equally stong. The present direct grant of £15,000 for research to the University of New Zealand—excluding the Medical and Dental Schools—is far from adequate and scientists will be doing a national service if they support wholeheartedly the University in its request for a substantial increase.

2. THE NEED FOR GRADUATES IN AGRICULTURE

At the present time the number of graduates in agriculture each year is about 25, or less than 2 per cent. of the total output of the University, and this is in a country dependent for its welfare on the primary industries! Contrast this with the position in Oregon, Ontario and British Columbia. The State of Oregon, with a population of 1,500,000 including 60,000 farmers, has over 600 students in the School of Agriculture, most of whom take the degree course; Ontario has over 400 degree students, and British Columbia, with a quarter the number of farmers we have in this country, has nearly 200 degree students. In each of the places mentioned the facilities provided and the scale of staffing are far beyond those available in this country. It seems clear that the average American and Canadian citizen must have a much higher regard

for the value of university education in agriculture than his New Zealand counterpart.

The position which now exists in this country cannot continue without handicapping seriously our agricultural development. The Agricultural Colleges must receive an adequate proportion of the annual intake of students into the University and this can only be brought about through bringing to the attention of students in the post-primary schools the great opportunities which lie ahead for the agricultural graduate. At the same time the incentive must be provided by improving working conditions and paying better salaries to research and extension personnel so that they are comparable with those of other professions.

Granted these incentives and an intensification of research at the Colleges, I am sure that professional agricultural training would take its place as one of the most important avenues for University students to enter the service of the country.

D. SUMMARY

In this address I have endeavoured to make these points:

1. The greatest challenge to New Zealand is the need to increase primary production at a rate sufficient to compensate for our increasing population. Over the next twenty-five years Fawcett has forecast that to do this we must attain an output from the primary industries 60 per cent. above present levels.
2. Although industries based on the exotic forests will assist with export income, by far the greatest increases over the next twenty-five years must come from agriculture.
3. The answer to this problem in the past has been provided by an intensive effort on a national scale by farmers supported by the adoption of the findings and contributions of agricultural scientists—and in this connection our scientists have a proud record.
4. To attain our goals a progressive national policy is required. This must be based on an expanded and vigorous research programme from which the findings must be interpreted and disseminated through dynamic extension services with a core of officers trained in farm management and assisted by specialists and put into practice by the primary producers whose part must be adequately recognised
5. It is suggested that the research section of this policy can be most effectively achieved by the establishment of an Agricultural Research Council to co-ordinate and sponsor all investigational work related to primary production by way of grants to Government research establishments, independent research institutes and University departments. Such a Council, responsible directly to Government, should receive finance for research from producer organisations, Government grants and industries associated with processing and marketing of primary products.
6. To provide the most effective organisation of research within the limitations of our financial resources three major permanent research centres should be developed at Hamilton, Palmerston North and Lincoln with secondary centres at Auckland and Nelson. Other centres at present in existence should handle only specific regional projects and should not be developed on a permanent basis.

7. Strong extension services should be based at the major research centres. At Palmerston North and Lincoln the research and extension organisations under their own administrations should be located in close proximity to the Agricultural Colleges for the mutual benefit of staffs and students and to act as focal points for the rural community.
8. Agriculture must receive an adequate proportion of the annual intake of University students and the position of the University as a whole should be strengthened and stimulated by increased grants for research so that greater opportunities are made available within the country for students to obtain the specialised post-graduate training necessary for research positions.

We cannot afford to be either complacent under our present rate of progress or content with stop-gap adjustments. We need far-sighted planning and vigorous action in research, extension and education. This applies equally to agriculture, horticulture and forestry, the three associated sections at this Congress and the three legs of the tripod upon which the welfare of this country is based and will continue to be based for many years to come.

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GENERAL SYMPOSIA (SECTIONS L1 AND L2)

1 *Aims and values of soil analysis.*
See Section B

2 *Climate and Agriculture.*
See Section F.

3 *Impact of substitute foods and fibres on New Zealand's primary industries*
See Section B.

4. *Legume Establishment.*
See Section C.

5 *Trace Elements*
See Section B.

SECTION L1

The following papers were also read:—

HUDSON, A W Is sub-soiling of clay-pan soils desirable?
JAMES, J P The role of artificial breeding in New Zealand dairying.
SALISBURY, R M Infectious infertility of sheep and cattle in New Zealand.
WHITE, J. V. The development of agriculture in New Zealand in relation to population.

SECTION L2

The following papers were also read:—

HENRY, J E. The development of native vegetation on pumice country and its relationship with exotic pine forests.