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of the
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Farmers' Conference
1966
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LINCOLN COLLEGE FARMERS' CONFERENCE
1966

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Hon. Secretary,
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Lincoln College.
# PROGRAMME 1966

## OPENING ADDRESS

**DEVELOPMENT OF RESEARCH FOR AGRICULTURE**

I. L. Baumgart, Assistant Director-General, D.S.I.R.

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**AGRICULTURAL AVIATION—NOW AND IN THE FUTURE**

0. G. James, James Aviation, Hamilton.

**RECENT DEVELOPMENTS IN MIXED CROPPING**

R. H. Smith, Lauriston Farm Improvement Club.

**A REVOLUTION IN DAIRY FARMING**


**"SOME FUTURE FARMING TRENDS"**

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Ronald Vine, Feature writer for *New Zealand Farmer*.

**SHEEP PRODUCTION**

I. J. Inkster, Ruakura Agricultural Research Centre, Hamilton.

**WHEAT PRODUCTION**

R. H. M. Langer, Professor of Plant Science, Lincoln College.

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In 1964 the Agricultural Development Conference set out a programme of rapid expansion of agricultural production and made recommendations on how this might be achieved. Government accepted this expansion policy as the principal base on which the national economy could grow in the foreseeable future. The Agricultural Development Council was set up to seek ways of achieving the targets set, and science is now being called on for research, for support and for leadership.

Also in 1964 the National Research Advisory Council surveyed research activities throughout New Zealand by a series of working parties. In 1965 it made recommendations to Government for the expansion of research and scientific services in several fields. The largest of these was agriculture for which a considerable and increasing expansion was recommended for the succeeding five-year period. Government accepted this policy of expansion and put the first year's recommendations into effect immediately.

And so today we have the farming industry committed to meet a challenge, and science committed to help the industry to meet it. How much is the industry dependent on science in this matter?

At its 1963 annual conference the Institute of Agricultural Science brought together all the available data to assess the potential for agricultural development in New Zealand. Though many of the data were incomplete and the limitations of some of the assessments were recognised, the Institute concluded that by fully utilising known resources and known techniques, agricultural production could be increased by about 80 per cent. Beyond that further increase depended on new knowledge. At the rate of four per cent per year (compounded) at which the Agricultural Development Council is aiming, this means that on a national average knowledge is only thirteen years ahead of practice. However, since the best farmers are much quicker to apply scientific advances than the average farmers, and since one of the most effective ways of encouraging the application of science to the farm is by example of the best farmers, the "lead time" between the scientist and the best farmers is more critical than that between the scientist and the average farmer. The critical lead time is therefore very much less than thirteen years— in some fields it may be virtually zero, and the best farmers are "breathing down the necks" of the research workers. Hence a call for increased production makes an immediate demand on agricultural science to move ahead sufficiently fast to at least maintain the present lead time.

FAO figures issued in the Report on the State of Food and Agriculture 1963 show the estimated gross output per adult male engaged
in agriculture for the period 1956-1960. New Zealand leads the list substantially and the following examples show the relative scale (indices based on Italy 100).

<table>
<thead>
<tr>
<th>Country</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand</td>
<td>1380</td>
</tr>
<tr>
<td>Australia</td>
<td>941</td>
</tr>
<tr>
<td>United States</td>
<td>869</td>
</tr>
<tr>
<td>Canada</td>
<td>567</td>
</tr>
<tr>
<td>Denmark</td>
<td>367</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>346</td>
</tr>
<tr>
<td>Argentine</td>
<td>224</td>
</tr>
<tr>
<td>France</td>
<td>204</td>
</tr>
<tr>
<td>Italy</td>
<td>100</td>
</tr>
<tr>
<td>Greece</td>
<td>72</td>
</tr>
<tr>
<td>Japan</td>
<td>41</td>
</tr>
<tr>
<td>Philippines</td>
<td>25</td>
</tr>
<tr>
<td>India</td>
<td>21</td>
</tr>
</tbody>
</table>

Though these figures may have a comforting ring about them they should not induce complacency. Though the figures are not strictly comparable, if you compare them with the often quoted figures of Colin Clarke for the 1949-52 period there is a disquieting impression that the lead of New Zealand over other countries is less than it was, and that some of our competitors are progressing more rapidly than we are. Increased mechanisation is raising the output per labour unit in U.S.A. and U.K. and reducing the cost of production based on stall feeding. Cheap nitrogen produced by the chemical plants of highly industrialised countries is raising the productivity of their all-grass pastures. Improved understanding of the nutrition and management of tropical fodder crops is leading to greatly increased production in the wet tropics, and irrigation coupled with plant adaptation is making the dry tropics productive. These developments and others like them, reduce the natural advantages of New Zealand's temperate climate and grass-clover pastures on which stock graze throughout the year. Though increasing world population and rising standards of living will ensure a rising demand for food products, increasing efficiency of production will become more necessary as our competitors raise their efficiency.

Our programme of expansion is aimed both at developing new markets and at securing a greater share of the old markets. To achieve both it is necessary to ensure that the product we offer for sale is in the form that the buyer demands. Proportion of fat on meat, high standards of hygiene, packaging and presentation, preferred sizes of fruit, are examples of special requirements which the seller has to consider if he is to expand his market. On a competitive market quality may involve much more than the production of a good wholesome product, and our agricultural industries are currently becoming more aware of these requirements.

I would stress therefore, that, though the call for increased production has emphasised a quantity increase, quality of product and increased productive efficiency are aspects of agricultural production which will require close attention at the same time if we are to maintain our very profitable and prosperous farming industry in the face of international competition from countries whose farmers are on a much lower standard of living than our own.
As in most improvement programmes it becomes harder to make spectacular progress the further up the efficiency scale we move, and New Zealand has reached the stage where some of our most critical agricultural problems are exceedingly complex. The scientific problems in increasing New Zealand's agricultural production the next 50 per cent are greater than for the last 50 per cent, and for this reason it is necessary to increase scientific effort at this stage rather more rapidly than the planned rate of production increase. It was this thinking which prompted N.R.A.C. to advise that increases in the total agricultural research effort should be at the rate of 7½-10 per cent per year for the next five years.

However, having decided on this policy, it is not simply a matter of turning on a tap and waiting for research results to begin to pour out. Funds do not produce research results directly; they only start a chain of reactions involving reorienting present staff, recruiting new staff, training future staff, and, even further away, interesting the staff of training institutions in producing the type of graduate required for the new programme. This is apart altogether from the obvious matters of providing necessary equipment and accommodation.

Research, to be successful and productive, depends ultimately on new ideas. The development of these original ideas involves most of the manpower and facilities of the research institution, but without the ideas the whole system is sterile. For this reason we have to give a lot of attention to securing the "ideas man" who is generally, though not always, a high-class graduate who has already established his brilliance in the university. New Zealand has produced a good proportion of this class of man in the past, but has lost too many of them to overseas countries. Some of us think that this is partly because the problems and challenges of science in New Zealand have not been presented adequately during the student's university training, and by the time he has worked with overseas textbooks written by overseas scientists from famous overseas laboratories, quoting overseas examples and citing overseas applications, the student naturally feels that it is overseas that science is really exciting, and deliberately sets out to go there. Conversely, and with some justification I think, the universities have criticised New Zealand research institutions for not looking far enough ahead, and telling the universities what we will need in the way of graduates, in what fields of interest, and when. And so between us I think there has been some unnecessary wastage of our scientific talent which we can ill afford to lose.

As a first step then to meet our part of this challenge, we are deliberately setting out to increase the supply of scientific manpower which can be focussed on to problems of importance to New Zealand. We are therefore aiming to work much more closely with the universities. University staff have taken a considerable part in the planning functions by serving on working parties of N.R.A.C., and co-operative research projects between Government departments and universities are being increased. You probably know that D.S.I.R. has provided research funds for Lincoln College for many years; that the Agricultural Economics Research Unit at the College is funded largely by D.S.I.R.; that the Agricultural Engineering Institute is
funded largely by the Department of Agriculture; that the Tussock Grassland and Mountain Lands Institute is funded largely by the Soil Conservation and Rivers Control Council. I am glad to be able to tell you that the first of what I hope will be a series of research contracts with New Zealand universities has been arranged with Lincoln College, under which Dr Harrison’s Agricultural Zoology Department will carry out studies on the inheritance of resistance to insecticides in certain insects. Out of this we hope there will be two products—firstly more knowledge of insecticide resistance—a real nightmare when our agricultural production is dependent on maintaining effective chemical control of insect pests; secondly, and perhaps more important in the long run, we expect that some of the students passing through Dr Harrison’s department in the course of their degree studies will be interested and then intrigued by this work going on, and will see in it a challenge which will draw them into work in New Zealand in a topic of fundamental importance to our future agricultural development. And so by awarding a contract to Lincoln in 1966 we hope to be able to recruit some Ph.D. entomologists trained and interested in New Zealand problems by about 1970.

Some people seem worried about so-called duplication—I am not. No research scientist worth his salt wants to do work that somebody else has done before him, and he takes mighty good care to find out what has been done before he starts. A little bit of competition with work in progress can be stimulating, and adds to overall efficiency rather than being wasteful. I am much more concerned about getting enough work going on the problems that are most important—and that brings me to what I consider the most important part of this talk. On to what problems should research be guided?

This question of priorities is real, because there will always be more problems awaiting solution than can be handled. A live industry always wants more information on which it can base its development, and we in research expect that New Zealand agriculture will continue to push for more and more work to be done—more than our capacity to carry out. While New Zealand agriculture remains progressive, we will never have fully satisfied customers, and you will never be able to get everything you want done when you want it done—even with a policy of research expansion. And so we must consciously and constantly be dealing with priorities.

The first and most obvious factor is the financial or social significance of the problem. For a large industry a relatively small problem solved may make a large impact on the national economy. For a small industry a major advance may have minor impact on the national economy, but may have social significance well beyond direct economics. Health, cultural, national independence, or defence considerations may raise the priority of a project beyond simple economic assessments. In farming terms this simply means that, all other things being equal, our main effort must be concentrated on our big industries—meat, wool, and dairy production. But some smaller industries with potential for expansion due to future marketing opportunities or changing standards of living (e.g. forest products, fruit, vegetables) with special local significance (e.g. hops, tobacco), or with the capability of making New Zealand independent of
imports (e.g. wheat), may merit support which appears disproportionate on a financial basis. However, quite a large amount of necessary research is "across the board," common to all agriculture, because it is dealing with principles of soil-plant-animal relationships, and the principles apply even if the plants or animals are changed. Soil studies, plant physiology, plant nutrition and much of entomology and plant pathology are basic to whatever form of agriculture we develop.

The next factor is based on scientific considerations. It has two facets: firstly, what is the prospect of a successful outcome to the investigation? Occasionally it has been necessary to decide against beginning a project because we simply have not been able to see a way of getting into it effectively, and it is a complete waste of scientific resources to begin a frontal attack when a discreet probing from several directions is what is really needed. Sometimes it may even be advisable simply to keep informed on work going on overseas which may open up a lead for us. On the other hand we have to be ready to revive a project held in abeyance or change the pattern of attack rapidly on a current project if some development gives us a new lead. The classic example of this is probably facial eczema which over-night through one discovery changed from a plant chemistry problem to a problem in fungus physiology, with major differences in type of staff, pattern of investigation, and research institutions involved.

The other consideration under this heading is the availability of suitable staff to undertake the work. It is useless our undertaking a project unless we have or can obtain suitable staff, trained in the necessary disciplines, to make progress in it. In the earlier days of agricultural research, when much progress could be made by fairly straightforward well-established methods familiar to most agricultural research workers, it was the number of available staff which often limited progress. Today when the more complex problems call for highly specialised skills it is often the type of staff available which may limit the amount of effective work which can be undertaken—especially those "ideas men" I have referred to previously. There is a growing role for the general agriculturalist in research, but the lack of a key specialist can sometimes hold back important projects for long periods.

The third factor which influences research priorities is largely in your hands, and the fact that you are at this conference indicates that you are probably aware of it. It is the rapidity with which results are applied. An industry which is hard on the heels of research, ready to apply results as soon as they are proved, and sometimes even taking chances before results are fully proved, will receive continuing support. Apart from the stimulus and encouragement research workers receive from rapid adoption of results, and the constant check on the soundness of our work which practical application imposes, research which results in small gains can be a sound financial investment if it is rapidly applied, but may not be sound if results lie unused for many years. The production of a new variety of cereal crop with a 10 percent yield increase gives a fine return for a research investment, because
it can be adopted widely by the industry at virtually no cost as soon as the seed is available. A new variety of apple, however, could only be gradually incorporated into the industry and would require a very substantial improvement to warrant the costs of its development and adoption.

I realise that in speaking to a gathering such as this I am talking to the progressive farmers I referred to earlier whose example is the biggest factor moving the whole industry forward. Most of you are in that group in which the “lead time” is much less than the thirteen years’ average I referred to. Some of you are “breathing down the necks” of the research institutions. You now have a policy and programme in operation for the development of agricultural research; you now have increasing university participation in projects of importance to New Zealand agriculture; you now have rejuvenation in the farm advisory services; if you wish to maintain this overall intensification of science for agriculture you must in turn be ready to apply scientific developments as rapidly and as completely as you possibly can. In this way the farmer and the scientist together can keep New Zealand agriculture leading the world.
"Recent Farming Developments"

AGRICULTURAL AVIATION—NOW AND THE FUTURE

O. G. James, James Aviation Ltd., Hamilton.

Of all farming services started since the war, none have been as spectacular in their success, or contributed so much to the development of primary production, as has aerial topdressing. From a very humble beginning, it has grown into a major industry with several million invested (Table 1) and many more being earned as a direct result of the services it renders.

**TABLE 1. ESTIMATED CAPITAL INVESTED IN THE INDUSTRY—1965**

<table>
<thead>
<tr>
<th></th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft</td>
<td>2,750,000</td>
</tr>
<tr>
<td>Loaders</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Motor vehicles</td>
<td>150,000</td>
</tr>
<tr>
<td>Buildings</td>
<td>500,000</td>
</tr>
<tr>
<td>Equipment and spares</td>
<td>300,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>£4,700,000</td>
</tr>
</tbody>
</table>

Like many other similar undertakings, it was born of necessity. Land erosion, falling production, shortage of labour and a high return for farm produce, all played a part in creating the right atmosphere for the industry to start.

Many people lay claim to being the ones who made the first move, but it is certain that without the development work and promotional activities of the Soil Conservation Council in the early years, the progress would have been considerably slower.

The Meat and Wool Board finance that was made available in 1955 and the gamble taken by Cable Price Corporation in ordering 100 specially built agricultural aircraft were landmarks in the growth rate of the industry. Last of all we should remember those operators who put their life savings into uninsured aircraft and risked all in the belief that there was a future in the operation of agricultural aircraft in New Zealand.

From acorns oak trees grow, and so it has been with this venture. In 1950 there were five companies operating a dozen or more Tiger Moth aircraft, where today there are approximately 60 companies with 260-odd aircraft flying 130,625 hours, almost double that of our airlines.

Government has also done a great deal more for the agricultural aviation activities than has been done by other governments in other countries. The Air Services Licensing control which was introduced in 1962 has been of major importance in directing and channelling the efforts of operators into building sound businesses and which would have sufficient stability to attract capital. Civil Aviation Administration has also taken a very positive attitude by giving many concessions to the operators as they have come of age and become more responsible.
In as far as the Air Services Licensing and Civil Aviation Administration are concerned, we operators in New Zealand are envied by our counterparts in other countries, hence the fact that the New Zealand agricultural aviation industry is on a much more sound basis than any other country that I know of.

It is estimated by Soil Conservation that the increased overseas income that can be attributed to the use of aircraft is £55,000,000 per year and increasing annually. When it is considered that there would be no more than 930 employed in the industry, then it could be truly said that many people benefit by the efforts of so few.

The growth rate of the industry is as great today as ever it was and shows no sign of slowing down (Figure 1). With the introduction of new fertiliser works and the Government policy designed to increase production, it is felt that the target figure of 1,500,000 tons by 1975 will easily be achieved. It is felt in the industry that we have the ability to meet these targets without any undue strain, in fact the equipment already in operation is capable of doing considerably more than it is at present.
The growth rate of the use of chemicals is also considerable and I believe will move forward at an increasing rate with the introduction of new types of materials. A major breakthrough in this field could be the use of Paraquat for improving pastures in hill country.

The downward trend in rabbit poisoning means a loss of business and is regretted by the operators, but must be gratifying to those responsible for rabbit control. However if there are no rabbits then there must be a greater need for fertiliser and seed.

The constant rising costs are a challenge to operators to improve their business without passing on the increases to the farmer. It is clear that the lower the rate the greater the tonnage there is to sow in any given area and secondly if we can condense the area of operation the higher the utilisation of the equipment and the lower the cost to administer the operation.

An indication of the investment related to the tonnage sown per unit is set out in Table 2.

**TABLE 2. CAPITAL INVESTED PER OPERATIONAL UNIT**

<table>
<thead>
<tr>
<th>James Aviation Limited</th>
<th>1950</th>
<th>1957</th>
<th>1965</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Investment (£)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aircraft</td>
<td>750</td>
<td>7,500</td>
<td>10,500</td>
</tr>
<tr>
<td>Loaders</td>
<td>1,000</td>
<td>2,500</td>
<td>5,625</td>
</tr>
<tr>
<td>Administration</td>
<td>250</td>
<td>1,000</td>
<td>3,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,000</td>
<td>11,000</td>
<td>19,125</td>
</tr>
<tr>
<td><strong>Tons sown</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td>5,000</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>Tons per £100 Investment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>45</td>
<td>42</td>
</tr>
</tbody>
</table>

Charge out systems vary throughout New Zealand. Quotations per ton, cost per ton mile and an hourly rate are all used with varying advantages to either the operator or the farmer.

A quotation system is used for departmental work because of the department’s insistence of knowing the cost in advance. In addition the work is usually tendered for with the result that the jobs tend to change from operator to operator, depending not on the efficiency of the operator, but how sharp a pencil he has. The results are generally that they get so low that the operator finds it difficult to make any profit and resorts to cutting corners. Fortunately in many areas the principle has been adopted that the operator who has done the job before has the contract renewed, providing the costs have not increased. This has improved the stability of areas where a considerable tonnage in a district has been for Government departments.

The ton-mile system is used to enable an operator to cost a job in advance, depending on the distance of haul from the airstrip and the altitude to where it is spread. Generally there is a minimum rate which yields a high return on the short and the distant work is often down to cost.

The final system is the hire of aircraft, personnel and loading equipment at a cost per hour (Table 3). In this case the charge will
fluctuate according to weather, airstrip conditions, etc., and means that the operator's income per hour is constant and the farmer pays the actual cost to do the job. The system has no minimum rate, with the result that any improvements the farmer makes to speed up the operation, he will get back by a lower charge.

This is by far the fairest system of charging and has resulted in some extremely low costs per ton where both the farmer and operator have planned to take advantage of the system.

It is considerably cheaper to cart fertiliser by trucks at 1/- per ton mile haul than use aircraft at 30/- per ton mile. This system is used exclusively in the Auckland Province (Table 4).

The weakness of systems, however, is that the farmer finds that he is being sold a type of aircraft as opposed to a service and from the operator's point of view it is difficult to establish an hourly rate for each aircraft which will give a similar result and not lead to instability.

Competition is extremely keen with the result that the operator finds that if he does not drive his business as hard as he can, he loses work. This is bringing about a result that is proving both costly and unacceptable. The Civil Aviation Administration statistics of accidents speak for themselves. (Table 5.)

### TABLE 3. COST PER HOUR

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Cost (£)</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEAVER</td>
<td>39 10 0</td>
<td>1 ton</td>
</tr>
<tr>
<td>FLETCHER</td>
<td>30 15 0</td>
<td>15 cwt</td>
</tr>
<tr>
<td>PIPER PA25</td>
<td>27 10 0</td>
<td>12 cwt</td>
</tr>
<tr>
<td>CERES</td>
<td>39 10 0</td>
<td>1 ton</td>
</tr>
<tr>
<td>SNOW</td>
<td>39 10 0</td>
<td>1 ton</td>
</tr>
<tr>
<td>CESSNA</td>
<td>30 0 0</td>
<td>15 cwt</td>
</tr>
<tr>
<td>PIPER PA18</td>
<td>19 0 0</td>
<td>8 cwt</td>
</tr>
<tr>
<td>AGRICOLA</td>
<td>30 0 0</td>
<td>15 cwt</td>
</tr>
<tr>
<td>D.C.3</td>
<td>85 0 0</td>
<td>5 ton</td>
</tr>
<tr>
<td>LOADSTAR</td>
<td>60 0 0</td>
<td>3½ ton</td>
</tr>
</tbody>
</table>

### TABLE 4. SOWING COST PER TON

<table>
<thead>
<tr>
<th>Province</th>
<th>Average Cost £ s. d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Auckland</td>
<td>2 6 0</td>
</tr>
<tr>
<td>South Auckland</td>
<td>2 12 0</td>
</tr>
<tr>
<td>East Coast (Gisborne)</td>
<td>4 0 0</td>
</tr>
<tr>
<td>Hawke's Bay</td>
<td>3 2 0</td>
</tr>
<tr>
<td>Wellington</td>
<td>3 3 0</td>
</tr>
<tr>
<td>Taranaki</td>
<td></td>
</tr>
<tr>
<td>Otago</td>
<td>3 4 6</td>
</tr>
<tr>
<td>Southland</td>
<td></td>
</tr>
<tr>
<td>Marlborough</td>
<td></td>
</tr>
<tr>
<td>Canterbury</td>
<td>3 15 0*</td>
</tr>
<tr>
<td>West Coast</td>
<td></td>
</tr>
</tbody>
</table>

*Approximate estimate only.
TABLE 5. ACCIDENTS 1965

<table>
<thead>
<tr>
<th>Fatal Accidents</th>
<th>Serious injury</th>
<th>Slight injury</th>
<th>Replacement Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Aircraft Destroyed: 14
Major damage: 28 (50%) £140,000

£280,000

ACCIDENTS PER 10,000 HOURS FLOWN

<table>
<thead>
<tr>
<th>Year</th>
<th>1950</th>
<th>1955</th>
<th>1960</th>
<th>1965</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23.0</td>
<td>10.5</td>
<td>4.0</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Accidents are more likely to be fatal than they used to be!

Whether an operator is responsible or not he must in some way accept some of the blame for these results. Accidents are usually the cause of bad selection and training and sometimes maintenance, but in almost all cases by poor administration of the company’s operations. There are many men who have flown for years accident free because of the attitude to their work, attention to standards of safety and an ability to assess conditions.

My plea to the farmer is give us good airstrips to work from with ample storage for phosphate and create an atmosphere that a pilot can fly in without tension. With these conditions and sound operational control and planning, I feel sure both accidents and costs can be reduced.

Over the past three or four years there has been a growing desire to consolidate the business into larger better organised groups.

Some of the reasons are as follows:

Management

Generally speaking the transition from being actively engaged either in the flying or engineering role to an administrative role is difficult for most airmen. The reasons are that the training necessary for either role is specialised and in most cases fully occupies the personnel without exposing them to management, budgeting or financial control, so necessary to become a good administrator. It follows that many men who have been excellent owner-operators do not succeed when they endeavour to expand their business.

Equipment

The only way to satisfy the farmer with reasonable charges is to constantly increase our tonnage sown per hour with improved equipment. Increased payloads, increased horsepower, improved and duplicated loading equipment, radio communication and more sophisticated administration have all placed a burden on the smaller companies which some have found difficult to meet.

Personnel

The dedicated, blood-sweat-and-tears type of people who founded the industry are no longer available. In their place you have men looking for an assured future with opportunities to improve their position in companies which have stability and security. Seldom do we interview a man who is wanting to fly or be associated with air-
craft for the love of it, which was the case when the industry started, but rather you would find him asking what are the long term opportunities in the industry. This has meant that the smaller companies are not always able to attract future management type personnel with the result that it has restricted the companies’ opportunity to grow.

Finance

Generally speaking aviation’s history as an investment has been extremely poor, particularly in the air transport section and as such does not attract capital very readily. However, in the beginning, agricultural aviation money was easier, mainly through the farmers assisting and Meat Board funds. This does not apply today. With few exceptions, all aerial work operators have been in business for 12 or more years, with the result that finance is only available to companies who have a sound record and capable of meeting competition.

The final point is the founders of these businesses’ attitude to the future. Most principals of the company are ex-service personnel, approximately 46 years of age. They are primarily interested in securing what they have, rather than gamble the future with heavy liabilities and uncapitalised companies, and this has led operators to amalgamate or sell out to protect what they already have.

The climate we trade in is very different from 10 years ago. We as operators stand or fall on efficiency and can only retain our custom on our performance. In the early years the farmer associated himself with the smaller company development and would put up with the shortcomings of operators, in helping him build his business whereas today he expects a service equal or better than that which he could get from other companies or he will change his custom.

I believe there are many advantages to large companies, one of which is experimenting and developing new equipment or techniques. For example, if it were not for the size of my own company, we could not consider the re-engining of the Fletcher aircraft with turbine power which we have just undertaken. The development cost of the airframe will be approximately £8,500 and the engine, propellor and instruments a further £10,000. It is my view that this engine will increase safety and improve economies, but without spending £20,000 on one aircraft, we will never know. Such a project as this, is beyond any of the smaller companies, but should it succeed they will have the opportunity to benefit by it.

The future for agricultural aviation is immense, particularly when considering the need for food for the increasing population of the world. The awareness of Governments of the value of agricultural aircraft was obvious by the addresses given at a World Congress I had the opportunity to attend. This awareness and the growing market for the service of agricultural aircraft encouraged more and more aircraft manufacturers to build specialised machines for the sole purpose of meeting the growing market.

From New Zealand’s point of view, this is excellent. We can take advantage of these new types of aircraft where the development cost is spread over several production runs of aircraft as opposed to a relatively small number in use here.
The move in design is to have a much increased payload with a higher horsepower to weight ratio. The aircraft will be tailor-made for the job with more sophisticated dispersal equipment and improved pilot safety, corrosive resistant material and will be cheaper to operate per pound of weight carried.

The method of operation and the attitude of Government in the various countries overseas is of interest. The greater the reliance on agriculture for the national income, the more interest Governments have taken.

The largest user of agricultural aircraft in the world is the U.S.S.R. followed by U.S.A. In Russia approximately 50,000,000 acres of land are treated annually. The most favoured aircraft is a 1000 h.p. biplane carrying approximately one and a half tons and manned by a crew of three. The operation is a state enterprise, so it is difficult to say how efficient it is and from the delegates at the Conference point of view, they were not prepared to tell.

In U.S.A. the operation is private enterprise and no licences are necessary. The only requirements have been that the pilot should have a special agricultural licence which has its accent on his knowledge of the aviation laws of the state he wishes to fly in and of the chemicals he is to use.

Despite their own competition attitude, there has been considerable pressure to have some form of economic licensing. This pressure has come from the Government, the aircraft manufacturer, the operators and the farmer. The reasons are obvious. If there is no stability, then there cannot be any progress in development of aircraft, methods of operation, nor can the operator hope to capitalise his business to enable him to buy the higher cost new type equipment which is now becoming available.

Spraying at night has become more common in the States. Advantages obtained are greater effectiveness of the chemicals for weed control and better control of grubs. Higher utilisation and lower drift of chemicals are other advantages.

Pilot employment varies according to the seasonal aspect of the work in the area. Most companies have no permanent staff and work on the basis of a contract with the pilot. In some cases the pilot leases the equipment and in others contracts his flying time on a share of the gross receipt.

Operations in the U.K. and Europe are comparatively small compared to Australia, New Zealand or U.S.A. The attitude of some of the Governments appears to be very positive, but from what I could see the U.K. is just becoming aware of legislative shortcomings and planning changes. The area over which operators work is much greater than ours. For instance there appeared to be keen competition between several operators in the Netherlands and the U.K. for work in the Sudan.

The use of helicopters for agricultural work is on the increase. This is largely due to development work on specialised equipment they offer with the machine. Spray booms of up to 50 feet with an effective spread of 90 feet are in use.

There are now available spray booms, rotary brushes, rotary atomisers and spreaders. In addition, there is a new duplicated rig for spreading emulsified sprays.
From the distribution of fertiliser point of view, it would appear that we still lead the world, a point which was freely admitted by several speakers, at the Conference. It is also clear, however, that we are not as conscious of distribution patterns as many countries. There are two reasons: one that we sow at much greater weights per acre of comparatively low phosphate control materials and secondly that most of our material goes on range country where overseas it is principally for crops. This does not mean that we should accept the position, but rather that we endeavour to maintain our present economics and use the overseas experience to improve our services.

Referring back to the New Zealand scene and looking to the future, I would suggest the following as being the trends:
1. Further amalgamation of operations for the reasons already stated.
2. The reduction of minimum rates in sowing charges.
3. Increased payload for aircraft and higher performance.
4. Shorter haul operation and greater use of heavy aircraft.
5. Closer participation with the farmer in reducing charges by better planning and a spreading of the season.
6. Some form of advantage given to farmers who provide adequate storage and better airstrips or in reverse, a charge where because of lack of these facilities we are unable to get utilisation and have to increase charges overall.
7. A minimum tonnage for a job.
8. Use of chemicals will increase.

As an industry we have been given many advantages to allow us to develop our company with the minimum of interference by Government.

These are some of the advantages:
- Fifty per cent depreciation.
- Special depreciation on all equipment.
- E plates on ground equipment.
- Low duty on aircraft.
- No licences for importation of agricultural aircraft.
- Economic protection under a licensing system.
- Freedom to fix our own charges.

With these privileges goes an obligation. I am confident that we in the industry have not abused any of these conditions but endeavoured to serve the New Zealand farmer in the way Government expected us to do. From the operator's point of view, there is only so far we can go in controlling our own economics after which it is dependent on the farmers and their co-operation. If you will undertake to give us good airstrips and sufficient storage in bins so that we get better utilisation of our equipment then I can see no reason why we should not be able to hold out against the steady increase of costs for some time to come but it will be only possible with the full co-operation of the farmer.

This business has been an exciting and demanding undertaking which has had its reward in the knowledge that we are doing a job of national importance in helping our primary producer produce higher incomes, which in the end will improve the prosperity of New Zealand.
Introduction

Before I begin I would like to point out that in this paper I am confining my remarks to those farms on good medium-to-heavy soil in areas where the climate is dry in summer and is suitable for mixed cropping. I realise that there are a number of farms with particular problems, such as winter wetness, bad contour, etc., that create difficulties for some of the crops which I will mention; however the general principles to be discussed still apply to these places.

Mixed cropping is probably the most complex and exacting type of farming that a farmer can engage in. No other farming offers such a great number of alternative enterprises, or such a great number of possible combinations of these. No other type of farming requires the farmer to have knowledge of such a wide number of different subjects. To be successful the mixed farmer must not only have most of the livestock knowledge needed by his sheep-farming counterpart, but he must also have a good understanding of cultivation, costing, and the various crops and their disease problems. He must understand soil fertility, chemical weed control and the operation of complicated machinery.

As a result, few other types of farming present such a challenge to the farmer nor reward him so well for his skill. It is not unusual to find the very good mixed farmer with a net income five times as great as that of a more average man on a farm of similar size and conditions.

Why do we grow crops at all?

Wouldn’t it be a lot easier just to run sheep?

While a number of farmers crop because they really prefer this to sheep farming, by far the most important reason for most of those on this heavier land, is that cropping is far more profitable than sheep farming.

That most people in the farming community realise this, is borne out by the fact that while these heavier farms are capable of carrying very few more sheep than lighter land which is much cheaper, farmers are prepared to pay a substantial premium for this soil, which is only justified by its ability to grow high-yielding crops.

We must beware of using the example of the man whose crop undertakings have been disappointing, to justify an extension of sheep farming on this class of country, for while a farmer may have only been growing 40 or 50 bushels of wheat per acre, with which sheep compare very favourably, the fact remains that, handled in the right way, this land can grow from 70 to 100 bushels per acre. This sheep cannot match.

I emphasise this; let us compare six sheep per acre with 70 bushels of wheat. You will see that sheep have a gross margin of £3
per ewe equivalent after deducting all direct costs such as replace­ments, winter feed, shearing, veterinary expenses, etc. This gives us
a profit of £18 per acre.

Now each bushel of grain whether wheat or not carries a direct
charge per bushel of about 2/- for heading, bags and cartage.

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<tr>
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<tr>
<td>Therefore 70 bus at 12/6</td>
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<td>44.5</td>
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<td>Less seed</td>
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<td>2</td>
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<tr>
<td>Cultivation</td>
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<td>4</td>
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<tr>
<td></td>
<td>.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>£38.5 per acre</td>
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Background to Present Methods

Let us pause here for a moment and have a look at some of the
cropping practices which are common today and see how they arose
and what their weaknesses are.

Many of the practices still in use today are a legacy from another
age of mixed cropping—the period which lasted through the 'thirties
until the early 1950s.

In those days conditions were quite different from those that
exist today. On all except a very few areas of recent soil the good
land of this province was too sour or phosphate-deficient to grow
legumes like white clover, peas, or lucerne well. This meant that
fertility-building was slow. If reasonable yields were to be expected
too much wheat must not be grown. As recently as the early 1960s
some big areas of good land in Mid-Canterbury still did not grow
clover or peas well due to low pH.

In those earlier days, pastures were more open, less productive
and often riddled with grassgrub. These conditions of course provided
a wonderful opportunity for such weeds as twitch and browntop to
thrive.

As a result the summer fallow was a must. The fertility require­ments of some crops were not well understood. This lead to such
practices as the growing of nitrogen-fixing legumes such as the pea,
immediately after grass was broken up, at the very point in the
rotation when the nitrogen level in the soil was at its highest.

Nowadays conditions are different, many things have changed
and the need for many of these practices of another day has long
since disappeared. On farms where the pH or lime status, and phos­phate levels are satisfactory, and where insect pests such as grass­grub and porina are under control fertility-building is much faster
than it ever was before. On a good mixed cropping farm today the
total fertility removed by a very good crop of wheat can be com­pletely restored in less than two years of vigorous pasture growths.
These same vigorous pastures have mostly eliminated the browntop
and twitch problems of yesteryear with the result that fallowing for
these weeds is no longer necessary.
So there we have a picture of what we may call traditional cropping practices and how they arose. A system which evolved under conditions that need no longer exist.

High Yields Important

The very first thing that must be appreciated by all mixed cropping farmers today, is the absolutely critical importance of high yields to high profits—remembering that no more work is involved in sowing a good crop than a poor one.

To illustrate this point let us compare firstly the profitability of an 80-bushel crop of wheat with that of a 50-bushel crop.

Deduct 2/- per bushel, heading, bags and cartage from the wheat price of 14/6 per bushel.

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<tr>
<td>80 bus wheat at 12/6</td>
<td>50</td>
<td>31.5</td>
</tr>
<tr>
<td>Less: Seed</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Cultivation</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Proportion of overheads of farm</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Net profit</td>
<td>£36</td>
<td>£17.5</td>
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</table>

The profit from an 80-bushel crop is over double that of a 50-bushel crop.

Now let us find out how many acres more a man growing 50 bushels of wheat per acre would have to grow to equal the profit of a man growing 10 acres at 80 bushels. Let us assume the farm is carrying five sheep per acre which are producing a net profit of £10 per acre.

Because the sheep are producing £10 per acre and the 50-bushel crop of wheat £17, the actual gain in profit from each acre removed from sheep and put into wheat is only £7 per acre.

Now as there is £190 of profit to catch up the 50-bushel man must grow a staggering 27 acres more wheat or a total of 37 acres. This principle applies to all crops.

How to Increase Yield

Soil fertility is the key.

As our main money-producing crops, wheat, barley, oats and grass seed have high fertility demands, soil fertility becomes a critical factor in the profitability of our cropping farms.

The higher a farmer can get his fertility the higher his yields will be—the faster his fertility can be restored after one crop the sooner another may be grown.

This is by far the most important single factor contributing to higher yields. It is not enough just to achieve high fertility, it must be maintained all the time.
While, as I have already said, certain limited areas of land have a high natural fertility, the greatest part of our potentially good land does not. On this land the critical fertility-building white clover does not grow well as a matter of course. It must be made to grow well by correcting the low pH's of much of this country with lime, and low phosphate levels with super. Your pastures must be protected from grassgrub and porina. Not until the white clover is growing really well on your farms are you on the road to better yields and higher profits.

On very large areas of the good land of this province even today, the fertility is not nearly as high as it should be.

The results of improved fertility can be spectacular indeed. I have seen farms on good land where, when wheat was sown out of old browntoppy pastures it would yield only 40 bushels per acre. In one case such a paddock after having been in good grass for four years yielded 70 bushels of wheat per acre. We must remember that an extra 10 bushels of wheat per acre in one crop in one year will pay for an extra 1½ tons of lime per acre and 5cwt of super—any further benefits are all profit.

When soil fertility is good and low pH's have been corrected, as they must be to achieve this, crops such as peas and white clover can be grown successfully where they would never grow before.

Wheat to Wheat

Let us now look back for a moment at our older rotations. It will be seen that it was a common practice in those days to grow two and sometimes more, nitrogen or fertility demanding crops in succession.

If maximum yields are to be obtained all the time, this is a practice which must be avoided unless a farmer has a very good reason for not doing so, as the second crop will be growing under conditions of lowered fertility, and will not yield as well as the first.

Our experience shows, that where no disease, drought or poor cultivation factor has prevented the first crop from yielding properly, a second crop of wheat will yield substantially less than the first. Often on the more medium land this difference will be as much as 20 to 30 bushels per acre.

A paddock must never be cropped to a standstill. Not only is this most unprofitable but the fertility becomes so low that it can take as long as two or three years before fertility really begins to build up again, even though the soil conditions may be good for white clover growth.

You must begin to rebuild a paddock while its fertility is still quite high. The object is to keep skimming the top from the store of fertility. Never deplete it completely.

Today we have a new set of conditions for mixed cropping, where high fertility is of paramount importance and maximum yields are the objective. We can grow peas, white clover, red clover and lucerne well, pastures grow vigorously and we should never grow two fertility-demanding crops in succession except on the very best land.
Land Utilisation

The next thing we must consider when dealing with this subject is land use. How should you arrange the use of land on your farm to get the maximum from it?

By far the most important time of the year on a cropping farm is the spring-summer.

This is the time of the year when nearly all the money is made. The number of acres available for grazing sheep in the spring absolutely fixes the number of ewes and lambs that can be carried. The number of acres available for crop and small seeds, absolutely fixes the area of these you may have.

Along with low yields, wasteful land use is the most important cause of low incomes on cropping farms.

Every acre which is idle or poorly used in the spring means a substantial loss of income.

What are some of the most common examples of wasteful land use?

(1) **Spring fallows**: A 20-acre paddock which is fallow but could have been carrying sheep had things been arranged differently means the loss of 20 acres of crop elsewhere on the farm. If this was wheat it would mean the loss of about £700 of profit. A lot of money.

(2) **Excessive hay production**: Except in the case of studs sheep are the least profitable enterprise on the farm. Making large quantities of hay for them in the spring when they could have been wintered just as well on less hay, roots and saved grass means a further heavy loss of income.

(3) **Too many sheep**: A farmer should have only that number of acres under sheep grazing in the spring that are absolutely necessary to keep fertility at its maximum. Indeed there is a lot of evidence to suggest that sheep are not necessary at all. The late Dr Sears showed that rapid fertility-building could take place under white clover with no sheep grazing at all.

(4) **Fattening Feed**: Rape has no place as a fattening feed on today's cropping farms. If the lambs won't fatten the veterinarian should be consulted. If they will, they should be drafted at lighter weights.

Rotations

I think it is most important for a mixed farm to have a basic crop rotation. Only if basic rotations are followed is it possible to farm a cropping farm intensively without running a risk of getting badly out of balance by, say, swinging from 100 acres of wheat one year to 50 the next.

The rotations need not be rigid, they can be changed whenever the need arises, but unless some plan is followed it can make management much more difficult. On many farms, indeed, it is desirable to have two or three different rotations working at once.

Now, let us take a look at the rotations which incorporate the principles we have been talking about and compare them with the older ones.
Old

(1) (2) (3)
20 acres Old grass → peas → wheat → wheat → green feed →
(4) (5)
summer fallow → to new grass → grass seed → white
clover and seed → grazing

New

(1) (2) (3)
20 acres Old grass → wheat → peas → wheat → white
(4) (5) (6)
clover/new grass → grass seed → white clover →
(7)
1 year's grazing

(1) (2) (3) (4)
20 acres old grass → wheat → white clover → wheat → peas/new
(5) (6) (7)
grass → grass seed → white clover → 1 year's grazing

(1) (2) (3)
20 acres Old grass → wheat → white clover → wheat → white
(4) (5) (6)
clover/new grass → grass seed → white clover →
(7)
1 year's grazing

N.B.—The figures in the parenthesis represent the years in the rotation.

I would mention here that peas particularly do just as well after wheat as before it. On soils which are not wet in winter they may be autumn-sown.

But what have we gained?

We have lost the second crop of wheat ex wheat which will mean a gain of say 15 bushels or £9/10/- per acre. We have gained a crop of white clover which at say 1½ bags dressed will net £30 per acre—yet the grazing area is the same so the same number of sheep may be carried. The peas and grass seed will yield just as well as before. Over the 140 acres considered this change would mean an increased profit of £790 per year.

Let us compare these rotations with another common type.

(1) (2) (3)
20 acres Old grass → rape → wheat → wheat/new grass
(4) (5) (6) (7)
grass seed → white clover → 1 year's grazing → 2 year's grazing

25
The gain is even greater.

In this case we have gained:

1. A crop of peas at £23 per acre net = £460
2. An increase in yield of wheat of £9/10/- per acre = £190
3. A crop of white clover at £30 per acre = £600
4. 20 bushels grass seed per acre at 14/- net = £280

Less:

1. 6 sheep per acre at £3 net = £18
2. Lower price for lambs 280 at 5/- = £70

A very large sum of money on only 140 acres.

I would point out here that on all except the very heaviest land a grass seed crop sown after wheat will yield at least 20 bushels less than a crop sown after a fallow or white clover.

Problems

What are the problems associated with this approach to mixed cropping?

On some classes of country it is difficult to establish clover successfully under wheat.

Farms which have problems with annual grasses, such as barley grass, goose grass, hair grass or perennial weeds such as yarrow or twitch can have trouble taking specialist white clover as these weeds do very well under such conditions.

If these weeds are a problem, the farmer may have to shelve the idea until the farm is cleaned up.

Results

But how has this worked in practice?

Here are figures taken from actual farms. These are the gross income figures per acre taken from a number of very similar farms on a medium-heavy soil. They have been averaged because, of course, individual figures are strictly confidential. The rises in income have been due to introducing the principles mentioned and as you will see from the relatively static stock income, the increased crop and seed income has come from a roughly similar acreage.

The figures for sheep are net of stock replacements and small seeds are net of machine dressing.
No potatoes are grown.

Gross profit from:

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<tr>
<td>Sheep</td>
<td>9.2</td>
<td>9.0</td>
<td>11.5</td>
<td>11.4</td>
</tr>
<tr>
<td>Crop and seeds</td>
<td>13.3</td>
<td>17.0</td>
<td>20.2</td>
<td>26.7</td>
</tr>
<tr>
<td>Total</td>
<td>22.5</td>
<td>26.0</td>
<td>31.7</td>
<td>38.1</td>
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</table>

On only 300 acres this would mean an increase in gross income of a staggering £4,680 per year.

The increased cost of production measured by expenditure on lime, manure, seed, sacks, contracting, repairs to plant and motor expenses rose by £4.1 per acre over the period.

Irrigation

No discussion on mixed cropping would be complete without mentioning the place of irrigation.

Irrigation, if carried out properly will give very substantial increases in the yields of linseed, wheat, barley, grass seed, white clover and potatoes, particularly on land which is a little lighter and drier than the best soil.

On the good soil, particularly where rainfall is over 30 inches per year, this response is much less marked in autumn-sown crops but is still substantial in the case of linseed, clover and potatoes. In dry years profitable gains can be made by irrigating grass seed, late sown wheat and barley.

Conclusion

In the short time available I have not been able to deal with many of the techniques which are being used so successfully by good mixed cropping farmers today, but you have seen that a whole vista of new possibilities is opening to the cropping man who is prepared to look ahead and adopt the latest techniques in this most interesting type of farming. I think no man has a more interesting or rosier future than the mixed farmer of Canterbury.

We have only begun to scratch the surface.
A REVOLUTION IN DAIRY FARMING


Ten years ago we still had over a year to wait before the first satellite was fired into orbit. How many of us could have foreseen then that more than a thousand man-made objects would have been placed in space by now, and that men would hurtle around the earth at a speed of more than seventeen thousand miles an hour inside spacecraft, let alone outside them. This incredible progress in space exploration has left us pretty hard to impress by new achievements.

So much for space, what’s been happening down here on earth? Well there’s been a revolution in dairying too. I suppose it’s been going on for a long time and will continue, but the pace seems to have quickened in the last ten years. This period has been marked by a constantly decreasing number of dairy farmers producing an ever-increasing volume of milk, but here again we tend to take new achievements for granted after a very short time. There’s been a marked change in outlook with less emphasis on what can’t be done and more on finding out what can be done.

Dairy farmers are hungry for new information to allow them to progress faster and the extension services haven’t enough men to adequately service the demand. It has become clear that the easiest way to achieve maximum per acre production is to increase the rate of stocking and a streamlining of the whole system has allowed output per labour unit to be increased remarkably. Let’s remind ourselves of some of the changes that have taken place over the last ten years.

**Fertiliser use and pest control**

To state that “fertiliser increases pasture growth” would not be saying anything new, but the ideas we had on quantity a few years ago seem pretty conservative when we look back now.

**TABLE 1**

<table>
<thead>
<tr>
<th>Fertiliser applied per acre on dairy farms</th>
<th>WAIKATO</th>
<th>Taranaki</th>
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<tbody>
<tr>
<td>1950/51 to 1952/53</td>
<td>2.96cwt.</td>
<td>3.10cwt.</td>
</tr>
<tr>
<td>1964/65</td>
<td>4.27cwt.</td>
<td>4.90cwt.</td>
</tr>
</tbody>
</table>

(The rate per acre is calculated for each farm by dividing the total tons applied by the total area in grass. The figures for the three seasons 1950/51 to 1952/53 were obtained from nearly six hundred farmers using the herd testing service, the figures for the 1964/65 season were obtained from more than five thousand farmers using the artificial breeding service).

Table 1 shows that the average topdressing rate per acre has been increased from 3 cwt. to 4½ cwt. in Waikato and from 3 cwt. to 5 cwt. in Taranaki in a period of about 13 years. When it was realised that good responses could be obtained from heavy dressings in some areas, confidence grew in the capacity of the land to carry more stock. Better winter growth and better growth through dry periods are
marked features of high fertility farms. Potash has taken its place alongside phosphate as a standard item of topdressing in many districts. Applying this extra fertiliser has not necessarily led to more work for the farmer but less in many cases because bulk topdressing services have been developed over this period.

The job of pest control too has developed into more of a routine practice over the last ten years. A range of new insecticides has become available in that time, though problems of resistance have arisen and the insecticide regulations have presented some practical difficulties. Despite this, pasture pests can be fairly well combated and I'm sure that a much higher proportion of the grass grown is now being consumed by cows and less by insects.

Increased fertiliser dressings and control of pasture pests have led to confidence that more pasture can be grown. This and allied changes in pasture management have given farmers confidence that they can carry extra stock.

Pasture management, stock numbers and time of calving

Pasture management has seen great changes over the decade. In the mid-nineteen fifties extension workers spent a good deal of time persuading farmers to close enough autumn saved pasture to feed the cows adequately until spring growth started. Winter and spring feeding are still considered of prime importance but it is now realised that much autumn saved pasture was left too long so that feed wasted by rotting. Winter saved pasture is now replacing autumn saved pasture.

The necessity of feeding cows well at the right time is still recognised but there's a greater realisation that feeding them too well is wasteful.

In dealing with pasture and stock management let's remember that there can be two periods of shortage in pasture growth, one in the winter caused by low temperature, lack of sunlight and perhaps excessive wetness, the other in summer caused by high temperatures and lack of moisture. The severity of these restrictions to pasture growth varies from district to district and to some extent from season to season within a district.

The aim has always been to produce as much butterfat as possible between these two periods in case the dry spell proved severe. This was achieved by calving the cows as early as possible, well before spring growth started. The deficiency in grass growth from calving until spring growth really got cracking was made up by using hay, silage or crop, and by storing fresh pasture in the paddock by the autumn saving technique. At the same time improvements in winter pasture growth were being made by increased fertiliser dressings and more use of short-rotation ryegrass.

These factors encouraged farmers to calve early and get as much butterfat as possible up by Christmas. The trend had gone too far though especially as herd numbers were being increased and supplies of grass would run out in August and September on many farms. This left the herd underfed at a very critical period of their lactation. It is interesting that attempts to prevent this feed shortage were usually in the from of providing more supplementary feed or more saved pasture rather than by calving later. Such are the limitations
of our mentality that we can become so obsessed with avoiding one problem, in this case the summer dry period, that we created a more serious one ourselves by calving before feed was available. Eventually however it became very obvious that some changes would have to be made if stocking rates were to be increased further, and it was seen that some farmers calving later than normal were avoiding these problems. Later calving is being associated with heavier stocking for two reasons. The first is that there are more mouths to be fed through the period of flush growth so less grass can be cut for hay and silage. Then there are more mouths to be fed through the winter so it is not possible to save so much grass for spring feeding, and at really heavy stocking rates the herd must rely almost completely on fresh spring growth after calving. "What about crop to fill in the gap?" you might ask. Well that policy has largely been discarded except in low fertility areas because of the work involved in growing and feeding it. Further, pasture renewal becomes less necessary as fertility is raised and pasture pests controlled.

The picture emerges then, of heavy topdressing producing more grass, of more cows on the farm with calving adjusted so that their feed requirements coincide more nearly with the natural pattern of pasture growth. With a higher proportion of the years’ pasture growth being consumed direct from the paddock a lower proportion is made into hay and silage and some of the losses associated with making these are avoided. This results in an increase in the efficiency with which pasture growth is used. The extra stock speed up the turn round of nutrients from the soil, presumably leading to more efficient use of fertiliser and a further increase in the rate of pasture growth.

A trial of the new system

Let's take the case of one Waikato farm run by father and son who decided to test whether the new system had application in their district. The 200 acre farm was treated as two farms, one of 140 acres, the other of 60 acres though fertiliser was applied at the same rate to the whole area and both herds were milked through the same shed by the same milkers. The differences were in stocking rate and calving date. The larger part of the farm continued to run according to normal district practice with cows calving on the 10th July and a stocking rate of 80 cows per hundred acres. On the smaller part of the farm stocking rate was increased by 50 per cent to 120 cows per hundred acres and calving was delayed for six weeks until the 25th August. These simple changes resulted in an increase in production from 277 lb. fat per acre on the "normally" run farm to 402 lb. fat per acre on the late-calving heavily-stocked farm. The danger many people see in late calving is that if the cows are calved too late then they'll only just be getting under way when the summer dry spell hits them. This might be true enough where summer drought is a real problem and if extremely late calving was practised, but it is interesting to note that on the farm just described, the late-calving heavily stocked herd overtook the other one in production per acre in early December, before the dry spell usually occurs.
No feeding out?

If you want to make progress it helps to know clearly what you're aiming for and I'd like to comment on the experience of one Taranaki farmer who aims to farm with no feeding out at all. His system involves calving late enough that no grass needs to be shut through the winter and the herd can be wintered over the whole farm. To assist winter growth topdressing is heavy, usually over 6 cwt. and last year over $\frac{1}{2}$ ton to the acre.

Last winter more than a cow to the acre was wintered without supplements but slow growth in the spring forced the farmer to feed out silage to the equivalent of about five bales of hay per cow in August and September. He hopes to avoid this next spring by calving another fortnight later again (10th September).

It still may not be possible to winter enough cows to cope with the feed in the flush and he wants to avoid making silage which will no longer be needed in the winter. A possible solution to this is to buy extra cows in September, milk them through until March or April and sell them either to the works or as in-calf cows. This type of farming may sound a bit like a pipe dream — no hay or silage to make, no feeding out to do, fertiliser applied by bulk contractor, the only job left to do is to milk the cows. Don’t dismiss the idea too lightly though, in case this man and others like him have it working while we’re still thinking up reasons that make it impossible.

One of the themes in this talk so far has been more cows but the extra animals have to be handled somehow and this leads to the next problem.

Handling extra animals

On a sheep farm extra stock may need extra facilities for handling them but this is not a very critical problem as the product is harvested infrequently and the animals handled only occasionally. With a job like shearing for instance more sheep can be handled with the same facilities even if the job does take a day or two longer.

On a dairy farm however, the product is harvested twice a day so all activities must revolve around the job of milking. If this takes too long then there’s none of the day left. For this reason milking must be kept within the same time limits on all farms no matter what their size.

Extra cows to milk means extra effort — or does it? Ten years ago stoopless milking was just coming into use in this country, the tandem shed having a brief run before being overtaken in popularity by the herringbone shed. There was great resistance to the change, an interesting example of how new ideas are often regarded with suspicion, even labour saving ideas. A survey carried out some years ago showed that milkers in herringbone sheds were on average milking 10 cows per man hour more than those in conventional sheds. This part of the revolution still has some way to go as nearly 80 per cent of sheds are still of the old back-breaking type.

Let me detail the experience of one farmer over the last few years.
<table>
<thead>
<tr>
<th>Season</th>
<th>Type of shed</th>
<th>No. of sets of cups</th>
<th>No. of cows</th>
<th>Milking time</th>
<th>B'fat production</th>
</tr>
</thead>
<tbody>
<tr>
<td>61/62</td>
<td>Walkthrough</td>
<td>4</td>
<td>74</td>
<td>1 hr. 50 mins.</td>
<td>25,000 lb.</td>
</tr>
<tr>
<td>62/63</td>
<td>Herringbone</td>
<td>7</td>
<td>90</td>
<td>1 hr. 35 mins.</td>
<td>27,500 lb.</td>
</tr>
<tr>
<td>65/66</td>
<td></td>
<td>10</td>
<td>132</td>
<td>1 hr. 30 mins.</td>
<td>41,000 lb.</td>
</tr>
</tbody>
</table>

Four years ago, in his last season in his conventional walk-through shed he was taking an hour and 50 minutes to milk 74 cows. This season in his herringbone he was able to milk 132 cows in less time. He says the herringbone did these things for him:

1. Made life much happier on the farm.
2. Made the farm rather than the shed the limiting factor to increased cow numbers.
3. Made milking a pleasure.
4. Gave him extra time and energy for sport.
5. Made it possible for him to produce a net income of over £30 an acre in each of the last three seasons.

There are other factors which have made milking a less onerous job. These include the development of the high pressure hose for yard washing, the motorised backing gate for bringing cows into the shed, and the circulation system of cleaning the milking machines. These are first class examples of how machinery can ease the work of men.

It's also interesting that none of these gadgets can be used for anything else so there's no chance of becoming a slave to them. Machinery should be used only to get necessary work done at the right time. It sometimes happens with a machine like a tractor, which can be used for many types of work, that jobs seem to be organised to keep the machine going rather than taking their proper place on the list of priorities.

Another change leading to reduced work for the farmer has been the development of tanker collection of milk to the stage that over 60 per cent of the butterfat processed leaves the farm this way. What has this meant on the farm? Well, the farmer stays in the milking shed throughout milking, without having to go into the dairy to switch over cans, or to start up the separator and skim milk pump. He doesn't have to take cream out to the road or take milk cans to the factory. The change to tanker has allowed many farmers to dispense with the pigs formerly used for turning skim milk into some sort of profit. This skim is worth real money now in the form of dried milk or casein and with the pigs off the farm the farmer can concentrate on producing milk.

With more cows in the herd more calves will have to be reared but the revolution has overtaken this section of the business too in the last ten years. Calves are now fed once a day instead of twice and for only 8-10 weeks instead of 12-16 weeks, and frequently in the paddock instead of at the shed. Apart from the labour saving angles, the new systems often result in better calves, because when they don't have to be brought to the shed twice a day they are more likely to be rotated around the farm on good grass than kept in dis-
ease infested calf paddocks close to the shed. An entirely different system of calf-rearing is now becoming popular because of the work it saves. With this system the calves are suckled on cows, several calves to each cow, the cows returning to the herd for the remainder of the season after the calves are weaned. Calf rearing is certainly not the time consuming and frustrating job it once was.

**Breeding**

If efficiency of conversion of grass to milk is to be increased then these calves must be better producers than their dams. Well, there’s been a revolution in dairy cattle breeding too. The basic rule of successful breeding is simple — select superior animals and breed from them. The important details concern how to select truly superior animals and how to use them. If we're out to make money we can't afford to take chances by guessing how good an animal is, we must actually measure the superiority. In the case of the sire, he can be responsible for so many progeny that we must be absolutely certain about him, and the only sure way is by progeny testing, in other words by measuring the performance of his offspring.

For many years the Dairy Board has provided a progeny testing service known as Sire Survey, so that farmers would know which of the three thousand bulls surveyed each year were raising production and which were lowering it. The logical next step of course is to use the best animals not just in a few herds but in many herds and this is now done by artificial insemination.

The combination of these two factors then, progeny testing to identify the best animals and artificial insemination to use them as widely as possible, allow giant strides to be made in live-stock improvement. For instance, a bull which would be naturally mated to about fifty cows in a season is mated to 10,000 or more through the artificial breeding service. This tremendous increase in the use of top sires results in rapid increases in production at no extra cost to the farmer in money or effort. For the season just ending the estimated increase in overseas earnings through the use of the artificial breeding service is nearly £2 million though less than half the dairy farmers are yet using the service.

**Development of large herds**

A fascinating aspect of the revolution in dairying is the development in very recent years of farming on a large scale. It was once thought that many difficulties would beset anyone who tried to run too large a number of cows in one herd. As so often happens with new developments the difficulties proved either to be non-existent or were capable of solution. If there is a breaking point it is much more remote than previously imagined because herds of 300 cows are becoming quite numerous and some of them are up to 500 cows. What's more, these large farms are showing they can be just as productive per acre as smaller units.

Farming enterprises of this size might not suit everyone, because not everyone has the capital needed to buy the necessary acreage, nor the temperament or managerial skill to develop and run one. However, they offer scope for giving labour similar opportunities as in other industries, with the chance of progressing up the scale to responsible and highly paid positions. There can be some specialisation of labour
and with a number of men working on the farm regular weekends off for all become a reality.

I feel these large farms will be of immense benefit to the industry because the short cuts and labour saving devices developed of necessity there will then be available for all farmers to use.

**Attitude to change**

If we want to achieve progress we musn’t say “it can’t be done” or “it won’t work”. Then when someone shows that it can be done or that it will work our first reaction must not be “it wouldn’t suit my place”. Certainly some farms and some districts are less suitable than are others for really high production, because of climate, soil type or topography. But if a man thinks every new idea is unsuitable for his farm then the obstacle lies more in the mind than on the land.

Resistance to change can be very real and this is illustrated by the reaction to the new practice of tail docking in cattle. It was to be expected that this idea wouldn’t suit all tastes but there were some attempts towards actually preventing people doing it. Not only did some of the critics condemn it without a fair trial, but they also wanted to stop it having a trial at all. Such an attitude retards progress because although every idea isn’t going to be successful the only way to be really sure is to try any that show promise. Adoption of the successful ones is the way to progress.

**Conclusion**

I hope you will have seen that the revolution in dairying has not been a convulsive upheaval, but rather a matter of steadily accelerating progress. It’s different to other revolutions in that those who aren’t with it are not destroyed but merely left on one side. From there they can at any time move out into the main stream of progress and obtain the same benefits for themselves. They can do this because there’s nothing difficult about increasing production by these methods that are now well proved. More important, the changes have been towards a more simple system so extra output doesn’t have to mean harder work. There’s no virtue in hard work if the same results can be achieved with less effort. Sound planning means less drudgery and less drudgery leaves more time for planning. Farming being what it is I doubt if anyone can have things his own way all the time. But by planning his moves and maintaining a flexible attitude to meet changes as they occur a farmer can make things happen the way he wants them to most of the time.

The basic system being used at present consists of

*** growing more grass by liberal use of fertiliser and by good grazing management.
*** harvesting as much of this grass as possible directly by the animal.
*** making the most efficient use of this feed by using animals of high genetic merit.
*** making use of labour saving devices to reduce the effort and cost required to produce a pound of butterfat.

This system seems good now, but what of the future? Ten years ago we had little idea of what we’d be doing now and similarly we can’t forecast what developments there’ll be in the next ten years. One thing I am sure of though, there’ll always be some people looking for a better way or an easier way of doing things so we can be certain the revolution will continue.
"Some Future Farming Trends"

CROSS-BRED BEEF PRODUCTION

Ronald Vine, feature writer for New Zealand Farmer.

In accepting the invitation to address this conference on crossbred beef I have assumed that the beef I am to talk about is beef of dairy-cow origin. If this isn't so it's too late to do anything about it now, because I have prepared this talk on that assumption.

At the beginning, too, I would like to clear up one other misconception that might arise from the title: the dairy beef I am going to talk about isn't necessarily crossbred beef. In fact, as I hope to show, I think that when dairy beef does eventually become a major item in New Zealand's farm production, much of it will not be crossbred at all; or at least not from a cross in which any beef breed plays a part.

There is yet another way in which I want to provide myself with a "square-off" at the outset. This is to emphasise something which may well become all too apparent as I go on: that I am not as well informed as I should be about some of the details of farming in the South Island, as compared with farming in the North Island.

I point this out in case I make some too-sweeping generalisations about farming conditions or practices which, though they may apply well enough in the North Island, are not wholly valid in the South Island. If this happens, I hope you will tick me off appropriately after the address, or even before if the offence is bad enough.

And now, unless the chairman objects, I intend to drop this rather ambiguous phrase "crossbred beef" that has been handed to me, and refer instead unashamedly to "dairy beef".

I'm not sure whether it is necessary to spend time going into the reasons for believing that in the long run New Zealand's best hopes for substantial increases in beef production — if not, in fact, her only hope—lies not in her beef herds but in her dairy herds. But since it is still possible to find people — some of them in very high places in our meat industry — who appear not to take this contention very seriously, I dare say it will be worth while to spend a few minutes on those basic considerations which make this, I believe, an inevitable conclusion to anyone who succeeds in shaking off the influences, of habit, tradition and vested interests.

My argument is based on the assumption that New Zealand's chief role in world trade is to continue to be one of supplying an ever-increasing volume of competitively-priced human food, chiefly protein of animal origin — and that this production will continue to depend largely on our one great natural advantage; our good grassland climate with its capacity for capitalising, through the pasture legume and the grazing animal, on supplies of cheap atmospheric nitrogen.

In other words, we're going to continue to depend largely on the grazing animal to convert our raw material — pasture — to saleable human food.
If this is so, I think it reasonably follows that we must expect to look increasingly to the standard of efficiency of the process of conversion. Immediate economic considerations—the price you get for what you grow—may call the tune at the moment, but in the long run in competitive industry, it is the basic efficiency of a production process that determines the trend.

Now of our three main grazing animals—our converting machines, so to speak—the dairy cow, the ewe and the beef cow—the dairy cow wins hands down in efficiency of conversion of grass to human food.

We can leave sheep out of the comparison because at the moment we are considering alternative sources of beef.

Weight for weight, the maintenance requirements of the beef and the dairy cow are very similar. But of the productive part of the ration, much more is recoverable as human food from the dairy cow in the form of milk than from the meat animal in the form of meat. This is partly because the whole of the dairy cow's product—milk—is highly digestible, and also because it is harvested much more frequently.

So it's clear that, given markets, the more we can increase our highly productive dairy herd, the bigger will be the proportion of our raw material—pasture—which gets the benefit of this relatively efficient conversion process. And that brings us to beef.

Both the dairy cow and the beef cow produce one calf a year. In this respect they are both very inefficient as compared with, say, the sow or even the ewe, but there it is—one calf a year. Obviously some of the heifer calves from the dairy and the beef cows are destined to be grown into future breeding cows, but the rest of them are all capable of being grown into meat.

The surplus calves from the beef cows may begin with certain physical advantages as meat producers, but economically they start life with a very great disadvantage. At the end of its gestation the beef calf has already incurred a heavy debt for the maintenance costs of its mother, who has done nothing productive during that time but gestate this one calf.

The surplus dairy calf, by contrast, is by way of being a bonus—a free gift. During its gestation period its mother has paid her way handsomely by producing milk twice a day. And although she hasn't made this milk out of thin air—she's eaten a lot of grass to do it—this is a very good thing, because we've already seen that in producing milk a good dairy cow is converting grass to saleable human food in a highly efficient way. And on top of it there's the calf.

There are well over a million and a quarter of these surplus dairy calves produced in New Zealand each year. What happens to them after birth is no longer under the control of the cows. That's up to us.

My aim so far has been to try and make the point that, other things being equal, the national dairy herd is miles ahead of the national beef herd economically as a source of calves. The question is: can these surplus dairy calves in fact be grown into saleable beef?
No one who looks objectively at the results of research already done on this question, or who considers the facts of our meat export trade as it exists today, can possibly doubt that they can. There's no need to go into the question of how beef of dairy origin can compare with that of straight beef breeds grown for the highest quality quarter beef which was in demand when we had an export chiller trade, though in fact first-quality chillers have actually been exported from animals of dairy origin.

The fact is that the great bulk of our beef exported today goes as boneless or trimmed fabricated cuts, and this meat comes ideally from lean and relatively lightweight carcases. Calves of dairy origin are not only satisfactory for producing this kind of meat; they are ideal.

And since even for butchers' meat the modern demand is for relatively light and lean carcases, steers from some dairy breeds, or from any dairy breed crossed with a beef bull, are also ideal. This is not merely surmise; animals of this class, when well grown, are being eagerly sought by butchers in some districts in the North Island. And in Britain, of course, this is by far the most important class of beef produced.

The only substantial argument against the suggestion that our national dairy herd is the logical source for the massive increases in beef production which New Zealand needs is that so many of our dairy cows are Jerseys — undoubtedly the least suitable of dairy breeds for beef production.

Current research with Charolais bulls on Jersey cows, and earlier research with other beef bulls, is by way of an attempt to overcome this problem. But the fact is that there's no need to wait for this to make a start in quite a big way with increasing beef production from surplus dairy calves.

There are already something like 200,000 Friesian or Friesian-cross calves available surplus to dairy herd needs, and most of these are still being killed as bobbies — or were last season.

Every one of these is potentially a good beef animal. These, grown to about two years' age, could have a total export value of well over £10 million. Just a starter.

And now there's the question of who is going to rear these calves, and who grow them on to beef?

At present, in the Waikato and the Manawatu, increasing numbers of Friesian and Friesian-cross calves are being reared by dairy farmers and sold to graziers. In fact in several districts it is no longer easy to buy Friesian bobby calves.

Some of these calves are being raised on liquid skim milk by farmers not yet on tanker supply, some on reconstituted milk, and some on nurse cows. All three methods have proved quite practicable and profitable for dairy farmers who want to rear extra calves for sale.
But for the dairy beef industry to get going properly, even in this preliminary phase of using only the currently available Friesian calves, I don’t think that enough dairy farmers could be induced to do all the rearing, though of course I might well be mistaken there.

Moreover, for the industry to be as efficient as possible, I don’t think that all the rearing should be done by dairy farmers. This is because it should be done, if with milk at all, with liquid skim milk. And fewer and fewer dairy farmers have liquid skim milk available.

The objection to using reconstituted milk is simply that the considerable cost of drying the milk can be avoided if the milk is fed to the calves before it is dried. This, to my mind, points clearly to dairy factories as the logical location for calf-rearing plants, whether these are run by dairy companies or by individuals. Dairy factories are rapidly becoming the only place where liquid skim milk is available in quantity.

Small, but highly concentrated, calf-rearing farms could be set up close enough to dairy factories for skim milk to be piped to them.

Whether or not dairy companies would be interested in this enterprise I have no idea, but I believe that they should be asked to consider it. And since it would initially be an experimental job, with no comparable precedent from which positive recommendations could be made concerning the design of equipment, I believe that the Government should underwrite the experiment for the first season or two for any firm or individual who’s game to give it a go. This wouldn’t necessarily involve the Government in any actual expense and at worst it would be only chicken-feed by today’s standards. We’re considering, remember, the setting up of a new industry with a potential for export earnings of £50 million a year or more.

While this calf-rearing experiment was still confined to the 200,000-odd Friesian calves available, I don’t think there would be the slightest problem in selling the weaned calves to graziers to grow on to beef weights. These steers grow very well indeed — faster than straight beef herds — and where they have been well reared to weaning in quite large numbers in the North Island there has been an unsatisfied demand for them from sheep farmers.

With skim milk and the necessary minimum whole milk at current market values the economics of rearing these calves in large numbers appears to be good, with a demand for the weaners at about 1/3 a pound liveweight from birth to weaning. This is a common valuation for Friesian weaners of about twelve weeks’ age at present in the Waikato.

But it’s quite likely, I realise, that the value of skim milk, either liquid or as powder, will gradually increase. In the long run it may well be too valuable as a human food to be used extensively as a calf food. For this reason I believe that the most urgently needed research now for the future benefit of the dairy beef industry is in rearing methods that use minimum quantities of milk solids.
Alternative sources of protein — probably vegetable protein — should be investigated. We want to find out how little milk we can get away with in rearing calves.

And now, before time is up and it's too late, I must take heed of your programme organiser's decree that this should be one of a group of talks the theme of which is "Future Farming Trends". This means that I am to try and foresee what place the production of dairy beef might have in the overall farm production pattern of the future.

I base my guess at this on those basic principles of efficient conversion of grass to human food which I tried to set out at the beginning of this talk.

On the strength of these, and on the assumption that as our hill country pastures improve and become more intensively stocked so that the function of breeding cows as land development implements declines, I believe that in future an increasing proportion of our total beef output will be from the progeny of dairy cows, and a decreasing proportion from the progeny of the specialised beef breeds.

If the quality of our hill pastures continues to improve, as I believe it must, and if the national dairy herd continues to expand, as I believe it will, and if our main markets for beef continue to be for lightweight, lean meat at relatively low values, as I think they will, then I believe that eventually our beef output will be predominantly from dairy cows, with the beef breeds playing only a minor part.

You'll notice that I'm not saying how long I think it will take for this to happen. I haven't any idea. It may be a long time, particularly if there should be any substantial fall in wool values, which might change the relative profitability of the ewe and the breeding cow, and create an exceptional demand for breeding cows of any kind.

It could also be delayed, as it appears to be being delayed now, by procrastination and even opposition at official levels. But on the other hand I believe that it could possibly happen soon enough to surprise us all.

How will these dairy beef animals be bred? I daresay there will always be among them some bred by beef bulls mated to Jersey and other dairy cows. But I think that the great majority will be black and white. This is not because a Friesian or a Friesian-cross steer is necessarily any better than one by a beef bull from some other dairy cow. It is because the practical advantages of using a dairy bull rather than a beef bull on surplus dairy breeding cows are very great.

If you use a Friesian bull, or Friesian semen, rather than a beef bull, you haven't committed yourself to any particular number of dairy replacements. You can use the whole lot of the heifers in the milking herd if you want to, or sell some of them as milkers to some other dairy farmers, or you can send them all away to be grown into beef.

And in any case, only a small proportion of any dairy herd can be mated to a beef bull, because you have to mate at least twice as many cows with a dairy bull as you want dairy replacements, to allow
for half of them being the wrong sex. So a big proportion of the dairy steers available for beef are going to be by dairy bulls whether we like it or not.

You can get an idea of the kind of picture I visualise for the future of beef production in New Zealand from the fact that even now the national dairy herd produces, on top of the 570,000 heifer calves it needs for its own replacements, some 650,000 surplus calves without counting any of the straight Jerseys at all. Every one of these, I believe, will eventually be grown into beef.

And on the strength of the great scope that exists for higher stocking rates in our best dairying districts, and on the hopeful prospect of world demand for dairy products, I base my belief that the national dairy herd will eventually expand very greatly, perhaps to double its present size. And it may well change its breed composition so that that additional store of calves now being born as straight Jerseys is also added to the pool.

If I must go so far as to make a guess at the system of farming that will develop eventually to grow a million or so surplus dairy calves a year into beef, I would suggest that they will be bucket or trough fed on something in which milk is reduced to a minimum up to, perhaps, twelve weeks and then grown on pasture and killed at about 500 lb carcass weight at twenty months — that is, they'll be killed before they have to be wintered twice.

In the very ponderous and leisurely discussions that have gone on in official circles over the past decade about the possible development of a dairy beef industry, much has been made of the need for seeing that, if dairy calves are to be grown into beef at all, they mustn't, at any cost, be allowed to replace any of the straight beef that is already normally grown by graziers.

The only objection I have to straight beef animals is that one of the inherent inefficiency of the beef breeding cow as a machine for converting grass to saleable human food. But I think that this is an inevitable and a very valid objection. And if, in the future on our improving hill pastures capable of growing killable beef, every beef breeding cow and her calf could be replaced by three straight or crossbred steers of dairy origin, it would be a very profitable thing — not only nationally, but for the owners of the land as well.
Your committee suggested that I talk about changes which may occur in the next ten years. Now I ought to tell you, that before asking me, they approached a number of other people, and they were all older and wiser than I, and they all declined.

Much of the change which will occur in the sheepfarming industry in the next ten years will depend on overseas demands and prices, on the incentives which are offered to sheep producers, and on the way you as individuals react to these changing economic conditions. As a representative of the Research Division, I can be expected only to predict technological changes which may occur as a result of current research, and to report on the research which will help you to meet changing requirements.

Whatever the future “product-mix” from sheepfarms, and in spite of an increasing production of beef, most people will agree that there will be a steady increase in the number of sheep carried. This is not going to be achieved to any extent by breaking in fresh areas of land, but by increases in the carrying capacity of land already used for grazing. According to the N.Z. Institute of Agricultural Science, a doubling of carrying capacity (at 1963 levels) is possible without any increase in knowledge. The problem is one of extension, of farmer response, and most important of economics.

At this point, let us assume that the carrying capacity can be doubled, and that the necessary incentives for farmers are created and are operating successfully. One then is faced with problems of how to bring about these changes in the most economic fashion. In this area, I believe that specialized farm management advisers are the key men and the job of scientists is to provide them with precise estimates of the inputs which are required to bring about any desired type or level of production.

There are two broad classes of agricultural research. One is the type which permits breakthroughs in farming; by helping to overcome a limiting factor such as the discovery of a new trace element deficiency, as in the case of molybdenum or selenium; by leading to new management practices such as flushing and early weaning; or by reducing wastage from disease, such as vaccination against a range of infections. The other class of research is the one which defines for different environments and farming systems, the levels of inputs, such as fertilizer, which are required to maintain or attain a new level of production.

The first type of research cannot be programmed. That is, one cannot predict when the experiments now in progress or planned will pay off. For the second class of research, continuous progress is made which enables farm management advisers to define more precisely the optimum combination of inputs.

Now let us consider some of the ways in which I consider research is going to affect sheep-farming in the next decade. We shall consider
feed production, breeding of stock and feeding and management of stock.

There are several recent examples of the way in which field research has led to pasture improvement and enhanced carrying capacity. For instance, on the moist hill country in Central Otago (of which there is estimated to be 1,035,000 acres) as a result of the work of Ludecke in defining fertilizer requirements, following oversowing it has been possible to convert fescue tussock country, carrying 1/3 of a ewe per acre, into pasture which carries 1 2/3 ewes per acre. It has been estimated that with fertiliser and seed, and fencing into 300 acre blocks, this development programme costs about £4.10.0 per acre. This is surely some of the cheapest land development in New Zealand. The present programme of research on soil fertility will enable us to know before the end of the ten year period, the rates and ratios of fertilisers required for all the major soil types in the country. Similarly it is anticipated that reasonably precise information will be available on the relationship between fertiliser needs and stocking rates on different soils.

At the same time, a series of experiments is being extended which are exploring and evaluating different techniques of pasture establishment and renovation, particularly for country which cannot be cultivated for either physical or economic reasons.

Research of this type has a dual impact. Its most spectacular effect is in solving the problems of obtaining good pastures on what are currently regarded as problem soils. Equally important is the information it yields on the economics of level of fertilizer application on land where the types of fertilizer required are well-known.

Hand in hand with pasture research, is a programme aimed at improving varieties, types and methods of production of supplementary fodder, particularly for winter feeding. I shall mention this again in connection with changes which may occur in the management and feeding of sheep.

So far, I have dealt with feed production, and I would now like to consider animal production. Our overseas earnings depend on the efficiency with which we convert the feed we produce into saleable animal produce. This in turn depends on the quality of the stock we use, and our management skill in ensuring that the feed is converted most efficiently.

If I had to lay money, I would bet that the most radical change which will occur in the sheep industry in the next few years will be in the field of animal breeding. In this regard, I believe we are falling behind overseas countries in scientific animal improvement, and are well behind our colleagues in the N.Z. dairy industry.

The Romney is the predominant breed in New Zealand, and considering the range of environments in which it is used, it performs remarkably well. However, especially from the point of view of the export lamb producer, it has the disadvantage of having low fertility when compared with breeds overseas. This low fertility is the factor
which most seriously limits our efficient conversion of grass into animal product.

Evidence from a breeding experiment at Ruakura has demonstrated that the fertility of the Romney can be improved by exercising strong selection for the character. While in the flock under study, progress was not spectacular (about 3 per cent generation) nevertheless, it was clearly demonstrated that worthwhile progress can be made.

There is a tendency in some quarters to blame the pedigree breeders for low fertility in the Romney. I do not subscribe to this view. Stud breeders are in business, and in the absence of clear cut requirements from their customers, have concentrated on an overall improvement of their flocks along traditional lines. It has been clearly demonstrated in the dairy industry, that when clients began demanding herd-sires with a pedigree of production, the majority of breeders adapted their breeding systems to meet the new demand. If we are to make rapid genetic progress in the improvement of productive characters in the Romney, the first step must be taken by the flock farmers insisting on purchasing their rams on the basis of their pedigree of production.

To a large extent, scientists must accept some of the blame for the failure of the sheep breeding industry to adopt modern breeding methods. Over the years criticism of traditional breeding methods has been voiced, but no practical schemes have been put forward. I now believe that the selection scheme, based solely on productive traits, put forward by Professor Rae is completely practicable, and that we cannot afford to postpone the implementation of such a scheme on an industry basis. While gains from genetic improvement seem small in comparison with those arising from improved management, the gains are cumulative and we should start accumulating them right now.

I also predict that radical changes will occur in the selection of export lamb sires. Already in Britain, a commercial firm has started using modern genetical methods for improving the productive characters of fat lamb sires, and in New Zealand, experiments comparing different methods of selection have been initiated. In the future it is probable that the greatest emphasis in the selection of export lamb sires will be laid on rate of growth rather than characteristics of conformation.

One other aspect of sheep improvement should be mentioned. Some phenomenal success has been achieved in Britain in the improvement of fecundity, milking ability and growth rate of lambs as a result of crossbreeding. The Colbred, is a well-known example. Because of the value of wool in our export earnings, it is not believed that breeds such as the Colbred would be more profitable substitutes for the Romney in New Zealand. However, the whole field of crossbreeding needs intensive examination under our conditions and it is hoped that when the maximum security quarantine station is established, it will be possible to import samples of some of these exotic breeds so that our geneticists can evaluate their potential.
The export lamb industry at the moment is predominantly based on the Southdown sire, but it is probable that the use of this ram will be less widespread in the future. An increasing proportion of our lamb may be sold in markets other than the U.K., the development of pre-cutting and packaging techniques and perhaps of air freighting are all indications that we may expect differing market requirements for lamb and mutton carcases. I believe that market research and intelligence services are going to play an enormous role in helping define the types of lamb which will be required. ‘When the requirements are defined, on the basis of present experimental work, I believe we will be able to give sound guidance on the most efficient way to produce the article demanded. In the current research programme, the progeny of different breeds of export sires crossed with the Romney ewe are being fully evaluated, at different ages and at different weights, in terms of carcase weight, carcase grade, composition of tissues and palatability. With better market information, better planning will be possible and it is probable that farmers will tend to specialize in lamb production for specific markets.

It is difficult to predict the changes which will occur in sheep feeding and management. For farmers now producing well below their potential, the greatest change will be one of attitude of mind in changing the emphasis from production per animal to production per acre. In many cases, spectacular increases in production can be achieved, without any modification of management practices, merely by increasing the stocking rate. Farmers who are already achieving high production will need to introduce more subtle changes in management, and I believe that the research on nutrition and management at present going on in New Zealand will form the basis for further increases in production. The lines of work to which I refer involve the evaluation of a variety of feedstuffs, the precise estimation of the requirements of different classes of stock at different times of the year, and studies of different grazing management systems. More fundamental, but in the long run very important, are investigations on the efficiency with which different classes of sheep convert feed energy into meat and wool. Research of this type, provides the basic information for the theoretical comparison of different types of farming and different forms of management. New systems derived theoretically can then be tested in practice.

While predicting that sheep numbers are going to continue to increase, it is not envisaged that the labour on the farm will increase proportionately, and new production systems will probably be based on high numbers of sheep per labour unit. On many farms, I see the farmer relying to a much greater extent on contract labour for his general farm work, and directing his energies into stock management to ensure the fullest possible production from his flock. One obvious bottleneck in any system of sheep farming with a small permanent labour force occurs at lambing time, and I believe that greater emphasis will be placed on methods of reducing the amount of individual attention required by ewes at this time. There is good evidence that the amount of lambing trouble can be greatly reduced by paying careful attention to the level of nutrition of ewes prior to lambing. To assist in this aspect of management, there is a very real need for
a technique which would accurately, quickly and cheaply enable twin-bearing ewes to be detected, but so far no such method is in sight. In general sheep-handling operations, there is likely to be a substantial increase in contract services and in addition to shearing and dipping etc., it is possible that shearing contractors will supply docking, foot-rotting and drenching services.

Now in the foregoing, I am likely to be blamed for not sketching in bolder outline, the actual patterns which sheepfarming is likely to assume. It is my contention that this will be determined by economic and other pressures, and it is the job of the experimental agricultural scientists to refine existing farming techniques and establish the principles which will enable farmers to develop alternative farming methods when these are required.

In summary, I would say that the most important change which will occur in the next ten years, will be towards objectivity. By this, I mean that there will be a clearer definition of goals in terms of type and quality of product. Perhaps this will have its greatest effect in the sphere of animal breeding; where the emphasis in selection will be placed solely on characters which are of commercial importance. In the farm management field, greater precision will be possible in establishing input-output relationships because of the information which is being produced by series of carefully planned experiments. Finally, farmers are going to become increasingly production minded, and they will spend a higher proportion of their time in planning and exercising their management skill.
Future trends in wheat production can be discussed from many different points of view. The economist would begin by considering prices, markets and demand. The farm management expert would review farm programmes and profitability. The politician would think in terms of trade agreements and balance of payments. The plant breeder would concentrate on new varieties, the plant pathologist on disease control and the agronomist on soil fertility. Whatever the bias, we must all start by taking stock of the past and present situation, and only then can we cast our eyes into the future. My own approach will be to aim at three objectives: Firstly, to analyse wheat yields over the last fifteen years or so; secondly to discuss some factors which determine yield, and finally to suggest the direction in which we should move in the future. I shall confine myself to what is physically possible, without very much concern for what might be economically or politically desirable.

To start with, let us examine the past trend in wheat yields in New Zealand (Fig. 1). A similar review was undertaken by Calder in 1953 and by Walker (1962) nine years later. Between 1949 and 1956 the average yield throughout the country ranged around the 40-bushel mark, considerably higher than in previous years. Cross Seven was the dominant variety by the end of this period, but by 1958 its position became challenged by Arawa. In 1960 Aotea took over as the most widely grown variety. Average yields rose to about 45 bushels between 1957 and 1959, and the following two years saw yields lifted to 50 bushels and above. However, drought and disease then intervened, so that the general rise was not maintained. It was not until the 1966 harvest that the 50-bushel mark may again have been exceeded, although it will be some time before official figures are known. Aotea has recently declined from its predominant position, and Hilgendorf has regained popularity following its release as a mildew-resistant variety in 1962.

It is, of course, dangerous to attribute fluctuations in national average yields to single causes, but few could quarrel with the assertion that between 1956 and 1961 wheat breeding had shown handsome dividends of the order of some 10 bushels to the acre. Since then the position has become less clear, and one can only hope that the steady advance will be maintained. We must also remember that the type of land used for wheat and the total acreage both influence average yield, and that there are several other factors that should be discussed.

Turning now to the United Kingdom we note that British wheat yields, again expressed as national averages, were very similar to those in New Zealand during the first six years of the period under review (Fig. 1). Between 1955 and 1958 yields then rose to about 46 bushels per acre and during the next three years the average moved up to over 50 bushels. The New Zealand farmer began to catch up during 1960 and 1961 when the wide-scale growing of Aotea
raised our yields to some 53 bushels. However, since then we have gone through a leaner period, whereas Britain has enjoyed yet another lift, this time to the 60-bushel mark which has now been attained consistently since 1962. In New Zealand the tide also turned in our favour, but right now it looks as if yields are settling around 50 rather than 60 bushels per acre.
How are we to interpret these interesting trends? Once again, it could be most misleading to single out causes but, at the risk of being proved wrong, I am going to suggest what appear to be the more important factors. First of all, there is the widespread use of heavy nitrogenous fertilizers in Britain on stiff-strawed varieties which are designed to withstand lodging. Secondly, it is only too obvious that the British farmer has at his disposal a much greater number of varieties than we have. Not only does he draw on his own breeding stations and commercial firms, but from all over Europe wheat varieties are pouring into the United Kingdom. It is not easy to obtain accurate information, but the varietal picture is changing continually. A few years ago it was mainly Hybrid 46 and Atle, then attention changed to Beseed and Koga II, and later Capelle Desprez, Peko and Rothwell Perdix were in favour. And here the third factor comes into prominence, for the British have created a most efficient, independent organisation, the National Institute for Agricultural Botany, which tests crop varieties accurately all over the country and advises farmers on the most suitable varieties for each district. For example during the 1956-60 period some seventy wheat varieties were under test. Forty-nine were discarded after preliminary trials, sixteen were given a "Consumer Service" report, and the remainder were carried on for further observation. These wheats had been gleaned from government and commercial breeding centres in France, Holland, Germany, Sweden, Belgium and Great Britain. All this makes for strong competition among breeders, but it is excellent for the farmer.

Before we indulge in too many comparisons, we must admit one important difference between the two countries. In the United Kingdom only some 20 per cent of the wheat crop is used for bread-making, whereas in New Zealand we place much greater emphasis on quality, and in fact in the South Island we rely entirely on home-produced grain. Good quality and high yield are not easily compatible, and so British agriculture with its low-quality wheats enjoys a natural advantage in terms of yield. However, in other respects this comparison ought to make us think, and I for one cannot easily close my eyes to the fact that the British farmer obtains such outstanding service. He has literally hundreds of plant breeders working for him. Here in New Zealand we have a very small, valiant team, which has been consistently successful and man for man probably has few equals anywhere. But there should be more of them, keeping up the flow of varieties suitable for our diverse farming districts, resistant to pest and disease, and satisfying the demands of the consumer. The second suggestion for the future I want to make is that we might be able to make some use of overseas varieties. Now I know that in recent years the best of these have been examined at Lincoln and on the whole they have been found wanting in yield, disease resistance or in quality. I also know that our climate is different from that in Northern Europe, and that their wheats are bred to suit their and not our conditions, but I would still like to see an independent organisation in New Zealand, free from official control, charged with the responsibility of testing varieties in several parts of the country in different climates and levels of soil fertility. Much the same could be said of grass, clover and other crop varieties. Healthy competition usually leads to a raising of standards.
I now want to turn to the more basic question of what determines yield in wheat. At its simplest we can consider total yield as being made up of two major components—the number of ears per acre and the weight of grain in each ear. These two components bear closer examination, if we want to analyse yield structure carefully. The first of them, the number of ears, depends on the number of tillers produced by each plant and on how many survive to form an ear, given a certain level of plant establishment. Although our New Zealand wheats are not very prolific producers of tillers, they excel when it comes to tiller survival, and consequently a normal crop contains a dense population of ears. Over thirty years ago Frankel (1935) drew attention to differences in climate between Southern England and Canterbury, which were responsible for preventing English wheats from realising high yields in New Zealand. For our conditions he stressed the importance of tiller survival, and I am sure that we can have every confidence that the good record of our present varieties will be retained in future breeding programmes.

The second yield component, the weight of grain in each ear, cannot be dismissed as easily. To start with, it can be further subdivided into (a) the number of grains per ear and (b) the average weight of the grains or, as it is usually expressed, the 1000-grain weight. Let us take these two fractions in turn and explore the factors that determine their magnitude on the basis of some of the research we have done at Lincoln College. In order to understand what controls the number of grains we must study the development of the wheat plant from an early stage onwards. Some six or seven weeks before the ears emerge a very important event occurs, because at that time the plant changes from the vegetative to the reproductive conditions. It is then that the number of potential grain sites is determined. First to be formed are the spikelets, or groups of florets along the length of the embryonic ear. And then each spikelet differentiates into individual flowers. Long before the ears appear, the plant thus lays down the framework on which it will build subsequently. All this happens predominantly under the influence of one environmental factor—the length of the day. As the days get longer in the spring, each variety of wheat reaches its own critical time when these changes are triggered off. Hilgendorf is usually slightly ahead of the other New Zealand varieties. The interesting point that has emerged is that it is possible to vary the number of spikelets in all wheats. If the plant is made to hurry through its development, as it were, then short ears with few spikelets are the results. Conversely, a slower rate of development leads to long ears with more spikelets. We have achieved this difference under experimental conditions by manipulating the length of day, but I see no reason why it should be difficult to select plants which take advantage of our natural day length in the spring by producing a greater number of spikelets.

However, this is only part of the way towards more yield. We still want to see each spikelet produce as many grains as possible, in order to obtain heavy and full ears. But here we come up against another perplexing feature which should have a bearing on our plant breeding programme. Supposing we counted the number of potential grain-producing sites, the individual florets, immediately after ear emergence, and then at harvest we determined how many grains
have actually developed, we would find a fairly high rate of wastage. For example, in a recent experiment with Hilgendorf wheat we found an average of four florets per spikelet at ear emergence, but in the end only just over one half were filled with grain. The rest was empty and contributed nothing. Field evaluation of the major wheat varieties has confirmed that a large part of the potential is not realised.

At present it is not at all clear what could be done to improve this aspect of yield, although some important facts have been discovered. It is known, for instance, that most of the carbohydrate in the grain is produced after the ears have emerged. The ear itself, the flag leaf and the shoot above it are largely responsible for this production, and only some 15 per cent comes from the lower parts of the plant. This means that the weather after ear emergence is critical in controlling grain yield. Some districts, like Southland, with their long, bright days and relatively favourable moisture supply often record high yields although not necessarily the highest quality. However, changing the climate, or the district for that matter, is not within our powers. The answer to our problem appears to be to make the plant more efficient. By that I do not necessarily mean that it should be producing more dry matter, because even under unfavourable conditions, for example by reducing light intensity or by cutting the leaves off, grain production is not seriously affected. What happens then is that the roots and other parts of the plant tend to make up for what the ears and flag leaf are unable to manufacture. The key to the problem is to discover the mechanism that controls the distribution of dry matter and to manipulate it in such a way that more than the normal share goes into the grain. In practical terms we might say that we require a higher proportion of grain to straw. This seems to me a challenging problem for future scientific work.

Until the physiologist has unravelled these questions or the plant breeder has selected varieties with improved grain-filling characteristics, we can do little more than use normal methods to raise the yield of existing varieties. Fertilizer and water are the obvious factors we can vary. In neither case do we have a great deal of accurate information about time and rate of application. It is generally held that wheat following pasture does not respond to nitrogen, although a second crop often requires fertilizer. I cannot help wondering whether the lack of response in the first year simply signifies that more than enough nitrogen is available from the preceding legume or whether in addition our present wheat varieties have a relatively low yield potential that is easily satisfied by the available soil nutrients. This in itself would be an interesting study, because without doubt rising levels of fertility demand varieties capable of increasing yield response. As regards water, there can be little argument that in many seasons yields are depressed through drought conditions and that irrigation would be beneficial. The main question in this respect is really an economic one, for I doubt whether gross margins of revenue over costs would continue to rise at about £6/12/- for every extra ten bushels per acre, as shown by Dr Stewart for unirrigated wheat at the 1963 Farmers' Conference.

In summary it appears to me that the trend in wheat production will continued to be towards higher yield while maintaining quality,
although how fast we go will depend on how much attention is given to the problems I have raised. And that depends on us. Of course, many other changes are on the way—more wheat growing in the North Island, bulk harvesting, and grain drying—and many problems require solution, such as disease control or the distribution of surplus wheat from production to population centres. Whatever the outcome, I believe that we can feel confident that the bad old days of the wheat bonanza or the period of low acreages in the 1950's will not reoccur.

References


THE OPTIMUM USE OF LAND

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In the history of New Zealand, land has been a plentiful commodity but labour and capital have been in short supply. This has been true of all the countries of the "New World" but New Zealand, the last to experience close settlement, still shows this pre-development condition to an extent unparalleled in the Americas or Australia. New Zealanders have not yet got used to thinking of land as a scarce resource and their whole history deflects them from readily accepting it as such. Nevertheless, there are warnings from both urban and agricultural areas that this situation is changing, warnings which come from the physical impossibility of accommodating all demands for land in some areas as well as for prices for land which are extremely high by world standards. We should recognise that we are beginning to feel the stresses and strains of development which are already acute in most parts of the occupied world, and we must prepare ourselves to face the intensification of these problems in New Zealand.

Land is one of the scarce resources of the world and the problem of how best to use each acre is one which faces every community in all types of society.

Land and Food

Most obvious is the shortage of land for agriculture. Through the work of international aid and relief organisations and news reports we are aware of the critical situation which exists in many of the underdeveloped countries where food output is unable to keep pace with rising population. India alone contains nearly one-seventh of the world's population, about 500 million people, the majority of whom exist on an inadequate diet and are continually exposed to hunger and risk of starvation. It can be said with some confidence that only a small proportion of the human race are as free of the threat of famine as we assume ourselves and our children to be almost as of right. It is well-known that the conquest of disease, especially that of decimating epidemics, is far ahead of comparable increases in food production so that the rapid expansion of the world's population is by no means assured of its food supply.

It is commonly stated that there is, in fact, no general shortage of food in the world, but only inadequate means of exchange. True, inability to purchase other people's surplus stocks hinders alleviation of food shortages in countries which are poor in export possibilities, but I know no evidence that if all the surplus stocks of wheat in North America and Australia were evenly distributed to the deficient areas there would be no more food problems. Still less is there any evidence that these countries which have surpluses today will still have surpluses in ten or twenty years time.

As to a country's ability to produce the food it needs for its own population mere possession of a large area of land is no guarantee that it can feed itself let alone export a surplus. The greater part of
the earth's land surface is of negligible or low productivity because of excessive cold, aridity, steepness of slope or other physical causes. India has a land shortage by any account — only about one and a half acres of all kinds of land per head of the population, but only about half of this is regarded as arable. China's problem may appear to be even greater, with only about one-ninth of its land regarded as arable, that is, about one-third of an acre per person. China's attempts to overcome the problem by complete social reorganisation and industrialisation are well-known, but even the most advanced science and technology and total land reform will not necessarily solve the problem, as witness the case of the U.S.S.R. The Soviet Union, which can send spacecraft to the moon, cannot comfortably feed its 230 million people although it has one-sixth of the earth's land surface to work with. Because of harsh climate and poor soils even this vast area yields in effect less than two acres of arable land per person and much of this is of low or unreliable productive capacity.

Thus, it is important that throughout the world the more fertile lands should be preserved for food production and long-term production from these lands maximised by good husbandry.

Land and Building

A second aspect of the world food supply problem is the increasing trend towards urbanisation. About one-third of the world's peoples now live in cities and towns. There are over 2,000 cities with more than a million inhabitants. These now account for a fifth of the world's peoples and most are growing rapidly.

Not only does growing urbanisation mean a higher proportion of people dependent on others for their food supplies but also it means a steady encroachment of the built-up areas over agricultural land. We cannot stem this growing urbanisation, which is as true of communist countries where state planning and direction is maximised as of countries where capitalism and the profit motive are given freest reign. The best we can do is try to guide urban expansion so that it does not cover the best agricultural lands. Unfortunately the most fertile land is usually also the best for building purposes and urban and industrial developers can pay far more for land than it can earn in agricultural use, so unless there is some measure of restriction through legislation it is agriculture that usually suffers. More correctly, it is the community's agricultural potential that suffers because the individual farmers can be adequately compensated even if they do not actually make a small fortune when their land is taken for building.

Land for Communications and Power Supply

In addition to agricultural production and urban-industrial development, significant competition for land comes from other human needs. Serving dwellings, factories and farms alike, power and transport demand increasing amounts of land for their efficient functioning. A modern six-lane highway totals about 120 feet in width, using up 15 acres per mile of routeway. A large clover-leaf junction may use 500 acres of land, and an airport requires thousands of acres. Again the greatest demand for transport facilities comes in lowland areas where usually the most fertile land is to be found. The land requirements for power generation are similar to those of industry in general, but the hydroelectric generating branch usually in addition
requires large reservoirs, while special transportation in the form of transmission lines and oil pipelines have a not negligible land requirement. Fortunately, the water gathering grounds for electricity, like the similar reservoirs for the general water requirements for town and industry, require land where rainfall is high and this is commonly in mountain country and competing land uses at least somewhat less numerous than in the lowlands. But the difference is not absolute but relative and cases of serious conflict of interests occur from time to time. It is of course in this connection that we find a case to examine today, the development of the water resources of the Mackenzie country and the consequent effects on agriculture. So great is the problem of water for direct and indirect human consumption that we may feel justified today in listing water conservation as one of our most important uses of land.

Open Spaces

Mankind has need of land also for recreation. The more crowded and urbanised a country becomes, the greater the need for preservation of land readily accessible for rest and recreation. New Zealand is fortunate in this respect, luxuriating in numerous substantial parks and playing fields in urban areas as well as immense reserves of mountain and hill land within easy reach of the cities. Inevitably, with increasing population, industry and transport needs there will be increased demands on the open spaces, especially the "urban lungs"; the case of Christchurch's Hagley Park will not be the only example of a historic open space being carved up to suit the growing tempo of our mechanized civilization.

Yet another demand on land which is fortunately relatively small in New Zealand comes from the armed forces. Britain has considerable areas under military control and modern weapons tend to increase this class of requirements also. Bombs and cows mix no better than concrete and corn.

Multiple Use of Land

It is, of course, highly desirable that wherever possible land shall be used for more than one purpose. For example, there is no reason why sheep should not graze or mountaineers climb on catchment areas of hydro-electric schemes. Sometimes there is argument about one use being adversely affected by another; thus there is debate as to whether there is more or less run-off water available when a catchment is planted. Even if there is less water available in the reservoirs the total social value of the smaller supply of water plus the trees may be greater than the larger supply of water without the trees. It all depends on the needs of the community. Multiple use is a basic principle of good land use, but inevitably there will be competition and the need to allocate land to particular uses in preference to others.

Balancing Competing Demands

Most competing demands for land are settled by straight financial considerations or over-riding community needs and the public is not consulted. But unfettered private enterprise has produced some appalling results in the last 200 years. Planning demands that whenever a question of community interest arises the authorities involved should consider the alternative sites that are available for the contemplated development, together with the alternative uses for each
possible site. The decision should be made on the findings as to location, inherent qualities of the land and its potential. It is easy to state these principles and few today would argue that no planning control is needed over development, but it is less easy to lay down hard and fast rules to guide the decisions.

One method of wide applicability is cost-benefit analysis. This approach has been recommended strongly for use by farmers who are contemplating specific developments to their individual holdings. It may similarly be used by any industrial firm or public authority with a large scale scheme to consider. The essence of the approach, which will be familiar to most of you, is to compile as honestly as possible a balance sheet of the costs which would be incurred in the projected development, and the benefits expected from it. Cost, the economists teach us, is what is gone without in order to obtain any specific good or service. Cost-benefit analysis must include things to be foregone such as income which is ploughed back as investment, and the income or capital appreciation which could be obtained by investing the same sums elsewhere. Non-financial costs and benefits should also be set down; for example, the sacrifice of leisure in planning and seeing plans through, possible changes in vulnerability to market swings, and the psychological results of these situations as well as the secondary or indirect costs and benefits which owe their origin to the contemplated development.

There are a number of weaknesses in cost-benefit analysis. One is the tendency to spurious accuracy conferred on the operation by the setting down of figures which may be no more than enlightened guesses as to future and perhaps actually unpredictable conditions. However, it does force an examination of issues that may otherwise be casually overlooked. Another weakness appears in its use for a development which may be carried out in a large number of different places. While it is relatively easy to carry out an analysis in one place or even two or three alternative places, it does not offer much guidance in the initial selection of the alternatives to be examined from the whole range of possible places. To put it another way, it is first necessary to hypothesise that development x may benefit places a, b or c and then test the hypotheses in each case. It does not suggest how to select places a, b and c from all possible places.

The initial enquiry has to be “What developments may benefit which location”. To get the enquiry off the ground all possible information is needed about all possible locations, that is, the characteristics of each location must be ascertained as accurately and comprehensively as possible. Detailed inventory, however, cannot be carried out quickly enough or cheaply enough for every need to be met by an ad hoc survey. This is where prior assembly of data in anticipation of future needs proves its value. This is why statistics and returns of past performance of enterprises have to be collected and processed. Provided the basic data is available in the right form it may be processed quickly enough these days by computers. But computers can only process what has been fed into them.

The Role of Maps in Decision-Making

Many decisions have still to be made without much, if any, help from computers or even from statistics. In question of competition for land it is often maps that can best help in making decisions. The
information carried on maps may also be arranged in a form suitable for the computer to tackle, but the prime virtue of a map lies in its presentation of data in a readily assimilable and comparable form. Some maps need specialist training to be properly understood, but most data that can be mapped at all can be set out in such a way as to be understandable by non-specialists. Soil maps are a case in point. Considerable training is needed to interpret detailed soil maps, but a soil map can be simplified to convey particular information in a manner easily understood by, say, town planners lacking a training in pedology.

For several decades now attempts have been made to compile maps which will serve the needs of authorities charged with interpreting questions of land competition. Such maps are known in general as land classification maps. An American report of 1941 recognised five types of land classification, these being in terms of:

1. Inherent characteristics of the land.
2. Present use.
3. Use capability.
4. Recommended use.
5. Programme effectuation, i.e. allocation of areas to planned changes at given dates, etc.

Category 2 maps are the simplest to construct. There are many problems in mapping land use but at least it is a subject capable of relatively objective recording (no classification can be entirely devoid of subjective considerations). Maps of present use are known usually as land use or land utilization maps, though the term land cover has been suggested for the actual vegetation cover, whether natural or cultural. The second type of land use map shows the purpose for which the cover or cultural vegetation is used, i.e. cash crops, fodder growing or grazing.

Types 3, 4 and 5 form a series for planning purposes. The type 3, use capability map is the type best known in New Zealand conditions using the American soil conservation 8-class system with its emphasis on vulnerability to erosion, but this is only one system of classification which might be employed for such maps. Type 4, recommended use, and type 5, programme effectuation, are maps which follow from capability maps and are employed in farm plans.

But as O'Connor has pointed out use of capability maps should, as recognised by the designers of the 8-class conservation system, be preceded by type 1 maps, to show the inherent characteristics of the land. It is true that we have some of these inherent characteristics mapped, such as relief, geology and soils, but none of these constitute maps of the kind envisaged in this category.

Land Potential Maps

The subject of maps of inherent characteristics was dealt with in a valuable booklet 'Land classification for land use planning' issued by the Commonwealth Agricultural Bureaux in 1946. A number of schemes used in different countries are examined there. This type of land classification map seeks to express the inherent, natural quality of the land. To the extent, however, that past cultivation and other uses have modified the fertility of the soil they may be taken as having become absorbed into the inherent quality of the land. Such maps are sometimes called land potential maps but the term "poten-
"Poten- ti al" must be used with caution. There is a great deal of difference between immediate (short term) potential, which can be realised with­ out major investment schemes, and long term potential which can only be realised by elaborate and often expensive measures such as regional irrigation or draining schemes. Land potential mapping should always be carried out with a clear idea of which of these alternative notions of potential is being used, though it is not always easy to separate them completely.

All maps of inherent characteristics or potential must have re­ gard to the following features of the land: (4)

1. SITE
   (a) Surface Data.
      (i) Elevation.
      (ii) Degree of slope.
      (iii) Aspect — important for insolation.
      (iv) Drainage.
      (v) Micro-relief.
      (vi) Liability to erosion.
   (b) Climatic Data.
      (i) Precipitation.
      (ii) Temperature.
      (iii) Exposure.
      (iv) Frost-free periods etc.

2. SOIL
   (a) Physical Properties.
      (i) Depth.
      (ii) Texture.
      (iii) Stoniness.
      (iv) Structure.
      (v) Drainage.
      (vi) Consistency.
      (vii) Organic matter.
   (b) Chemical Properties.
      (i) More or less permanent factors—carbonates.
      (ii) Temporary factors—phosphate and potash status.

The evaluation of each site and soil property is extremely difficult. The aim must be to minimise the subjective element and to this end some classifications embody numerical coefficients. With the balancing of output in terms of, say, ewe equivalents, or dry matter yield per acre, against input it is possible to construct some reasonably objective maps. Certainly, where physical conditions vary greatly, as in New Zealand, between areas of contrasting relief and soils, a land potential or land quality classification map can be effective in summarising production conditions. Such a map should be regarded as an essential document in any question of the best use of land.

(3) G. V. Jacks, Land classification for land use planning, Imperial Bureau of Soil Science, Harpenden, 1946.
(4) Adapted from A physical land classification of Northumberland, Durham and part of the North Riding of Yorkshire, North East Development Association, Newcastle, 1950.
THE USE OF THE MACKENZIE COUNTRY FOR PRODUCING POWER

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Introduction

This paper sets out to answer the questions: "Why develop hydro-electric power at all?" "Why develop the power available in the Mackenzie Country?" and then to describe a probable form the development will take, and its effect on the countryside.

The author wishes to acknowledge the permission of the Chief Engineer (Power) to present this paper, and the assistance of numerous colleagues, past and present, in the New Zealand Electricity Department and Ministry of Works, who have contributed to the planning, design and construction of hydro-electric power in New Zealand. He stresses that any opinions expressed are his own and also that where he discusses work not yet undertaken it has not necessarily received the approval of those in authority and can only be classed as a probable line of development.

Definitions and Size of the Electrical Generating System

Two important factors in planning the supply of electricity are: How many switches are turned on at once, and how long they are turned on for.

The number of switches used, and the size of the load they command, controls the amount of generating equipment which has to be installed. The length of time they are on controls the amount of energy, be it from water or steam, needed to supply the demand. The size of the load is measured in kilowatts (kW), and the amount of energy in kilowatt-hours (kWh). An old-fashioned one-bar heater uses a kilowatt, and if used for an hour it consumes one kilowatt-hour of energy. Sometimes the term megawatt (mW) is used. A megawatt is 1000 kilowatts and because of the size of the electrical system this term is coming more and more into use as it saves writing lots of noughts. Similarly gigawatt-hours (gWh) are nowadays often used for 1,000,000 kWh. As an example Benmore power station has an installed capacity of 540,000 kW (540 mW) and there is sufficient water available to allow about 2,200,000,000 kWh (2,200 gWh) a year to be generated.

Last winter (July, 1965) the peak electrical demand was 2,260 mW and the energy supplied in the year ending 31 March, 1966, was 1,600 gWh (Figure 1). This was about 10 per cent more than the demand in the previous year and if extra generating equipment had not been commissioned, it would have been necessary to impose restrictions on the use of electricity.

Ever since large scale generation was started in New Zealand the electrical load has been approximately doubling every nine years. This increase is world-wide, it being a little faster in countries which are increasing their industries fast, and a little slower in those having a more mature economy. Every country is doing its best to meet this increase and in New Zealand at present this can best be done by building some hydro-electric power stations and some powered by other means.

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This doubling of power demand every nine years means that new power stations have to be built at an increasing rate. This is placing an increasing strain on the country’s construction and financial resources so that it is increasingly necessary to develop the most efficient and economical power stations. It has been forecast that in the future the rate of increase will lessen, and indeed the Committee to Review Power Requirements forecasts a slowing up 10 years ahead, but it seems that this 10 years never arrives so that estimates are always being revised upwards. It is expected that by 1970, the increase in demand will be 240 mW a year, i.e. a power station bigger than Aviemore will be needed every year, and if this is not done, restrictions on the use of electricity will have to be imposed. By the end of the century, the rate of increase could well be 2,000 mW a year.

Last year, the New Zealand Electricity Department spent about £34,000,000 on building new generating stations, transmission lines, and main substations. In addition, the Power Boards spent possibly £9,000,000, so that annual public expenditure to meet the increase in power demand is at present nearly £20 for every person in the country, and the rate is rising.

Different Sources of Power

There are a variety of sources for the energy needed to drive electrical generators. Leaving out the more exotic and undeveloped methods, in New Zealand we hear mainly of water power, geothermal...
power, coal fired steam, oil fired steam, gas turbines, and atomic energy. Of these, coal fired steam stations and water power are the oldest.

Coal has never been very cheap in New Zealand and at an early date it was realised that water power would provide the most economical sources of electricity. Many small private and local body hydro-electric power stations were built at early dates and in the South Island the State commenced the bulk supply of electricity in 1914 following the commissioning of the Coleridge Power Station, the first large single station in the country. This was followed in the south by the construction of the Waitaki Power Station and others in different parts of the island. At the same time, the transmission system was extended and eventually linked to form a single grid.

In the north a similar pattern of development was followed. The State purchased the small Horo Horo Station in 1919 and then built Mangahao, Tuai, and Arapuni power stations and linked them with a transmission grid. Since the 1939-45 war the Waikato stations and others at Waikaremoana have been built. With completion of the current development on the Rangitaiki and the Tongariro many people think that most of the cheaply produced hydro power in the North Island will have been developed.

In the South the large Waitaki Station was sufficient until after the war. In 1947 it was decided to build the next station at Roxburgh on the Clutha, rather than on the Waitaki. I believe that this decision was based largely on the likelihood of it being easier to recruit the very large labour force necessary, near an existing town, rather than in the sparsely populated Waitaki Valley. However, Roxburgh was a large station and would take a long time to build so, to cope with
the immediate growth of load, it was necessary to build the Tekapo Power Station, and to control the levels of lakes Pukaki and Tekapo over a storage range which increased their maximum level. The necessity for providing water storage needs explaining. The demand for electricity varies throughout each day and throughout each year.

It is usually lowest in the early hours of the morning and highest at a little after 5 p.m. (Figure 2). It is found that the total amount of energy needed (kwh) supplied in a day is about 75 per cent of that needed if the peak demand of the later afternoon had been maintained steadily all day and night. Because of this most water is used by the turbines at a little after 5 p.m. and least in the early hours of the morning. With a normal power station supplied by a steady flow of water this means that storage has to be drawn on during the day and replenished at night. This happens at Waitaki power station, and many will have seen how the lake is drawn down by up to two or three feet in a winter evening and refilled by morning. If the station head pond is too small a power station cannot follow the system demand unless the extra water is released from storage. This may be done either through a special control works or through a power station upstream with a head pond big enough to provide the needed variation in flow.

Over a year the electrical load varies from a high in winter to a low at Christmas when the daily load can fall to about 30 per cent of the peak winter load and, unless a station is proportioned so that its peak water demand is no more than the lowest flow in winter, it is necessary to store water from periods of high flow for use when
demand is higher than the water available (Figure 3). If sufficient controlled storage can be provided then construction of a larger power station than would otherwise be economic will be justified. It will be remembered that Waitaki Power Station was originally built with space for only five generators. In summer a large amount of water passed over the spillway, even though there was a shortage in winter. After the level of lakes Pukaki and Tekapo had been controlled so that some of the excess summer flow could be retained it was worth enlarging the station to contain seven machines, i.e., the provision of 30ft of storage at Lake Pukaki and 25ft at Lake Tekapo increased the worth of the Waitaki dam by 40 per cent (Figure 4). Benmore and Aviemore benefit from the same storage. If the flow upstream had not been controlled, these stations would probably have been built with capacities of less than 400 mW and 150 mW respectively. As the dams and everything other than the structures directly connected with the generating equipment at a power station cost the same no matter how much equipment is installed, anything that increases the amount of usable water, and so justifies the installation of more generating equipment, means that the cost of the dam and associated structures can be spread over a greater production. Similarly, the cost of the control works can be spread more widely if there is a string of stations to use the extra water so that it is best to build control works at as high a level as possible. Having started on the development of a valley, it is desirable to build all the stations possible on the river rather than to dissipate money and effort over a series of valleys which are only partly developed.

The near exhaustion of sites for large, cheap hydro-electric stations in the North Island has meant that other means of supply have had to be resorted to. The large coal fired station at Mere Mere and the geothermal station at Wairakei were commissioned in 1958. Coal is dear and geothermal power, though competitive in cost, is inflexible to use. New Zealand has not enough coal to justify construction of more than one further large coal fired station, and oil has to be imported. Atomic energy is still inflexible to use and has yet to prove competitive in price, except in special areas. Its fuel is also a drain on overseas funds and there will be a problem in the disposal of waste products. Inferior hydro sites are becoming comparable in cost with thermal sources. The inter-Island cable has opened up the possibility of developing the South Island hydro resources at a faster rate. In general the larger the river the easier it is to develop power stations producing cheap electricity. The South Island has the four biggest rivers in the country and it is a matter for investigation whether the lower construction costs in the South can offset the cost of transmission to the North. It appears that at favourable sites costs are low enough for inter-Island transmission to be preferable to the development of steam stations in the North. The Waitaki is one of our biggest rivers, power stations can be built on it at an economical price, it is already partly developed, and the Mackenzie country is a part of the valley particularly suited to the development of its power potential.

As the system stands today the cost of generating hydro-electricity is less than 0.35 pence a kWh, compared with 0.75 pence a kWh for thermal power (steam and geothermal). About 80 per cent of our electricity is hydro generated. Only Norway, Tasmania and parts of
Western Canada are understood to rely on hydro power in a comparable manner, and in the rest of the world, where steam stations predominate, power costs are relatively higher than in this country. As inferior hydro sites have to be developed the margin between hydro and steam costs will narrow, but there are still many sites in the South Island where hydro power is capable of development at 0.5 pence a kWh or little more. The Mackenzie Country stations come into this category.

It may be added in passing that power is sold by the New Zealand Electricity Department at a uniform rate throughout the country. Until Roxburgh was on full load the cost of generating power was less in the North Island than in the South. In addition to the price they pay to the Department the Power Boards have to erect lines to get the power to the consumer from the points of purchase at the main substations. These secondary costs vary immensely and account for the wide variation in charges between the different Boards.

A hydro-electric generator is much more flexible than is one driven by steam. It can be brought on to full load in a matter of minutes whereas it takes hours to bring on a big steam station from cold. Steam generators have to be brought up to pressure long before they are needed and all this means the consumption of extra fuel. With an all steam system, it is far harder to find alternative equipment in an emergency. Diesel and gas-turbine-powered generators, which can be brought in quickly, are the most expensive of all large scale modern generators though in the absence of hydro power, they are frequently used as standbys.

The Generation of Power in the Mackenzie Country

After Coleridge the Waitaki was selected in 1925 as the next river to be developed because it was large, had a relatively even flow and small floods, and it was central (Figure 5). As explained earlier control of the outflow from the big lakes followed on construction of the Waitaki Power Station.

The natural lakes in the Waitaki have a great smoothing effect. It has been computed that without man-made controls the natural flood above Kurow which is likely to recur once in 500 years is 120,000 cusecs. This is about 10 times the mean flow. It may be compared with the Wanganui, a river with a mean flow of 8,000 cusecs, which has a 500 year flood of about 230,000 cusecs. The Buller, with a mean flow slightly higher than the Waitaki, has floods well in excess of 500,000 cusecs. Provision of means for controlling flood discharges is one of the largest items in the cost of a power station and it is entirely unproductive.

Control of the lake levels has meant that the maximum levels have been raised (Figure 6). Some farming land has had to be inundated, and the raising of Tekapo flooded the old Tekapo run headquarters and caused it to be split up. The wide beach left when the lakes are low is also hardly a thing of beauty. On the other hand, though floods discharged from the control gates have often been as they were in pre-control days, their frequency has been reduced to only 30 per cent of what they used to be. The remaining 70 per cent is absorbed in the storage range of the lakes because most floods occur when the lakes are not full and so can hold the water.
The biggest flood of which details are known occurred on 3 February, 1931, and is assessed at 92,000 cusecs. The 1878 flood is thought to have been a little less. The peak flow at Waitaki during the flood of Christmas, 1957 was 72,000 cusecs. This was reduced from about 90,000 cusecs by the measures of control at Lakes Tekapo and Pukaki. The recent flood of January, 1966, was reduced from about 60,000 to less than 40,000 cusecs by control measures at power structures.
The biggest day-to-day effect of the power stations on the Waitaki River and its tributaries is the variation in flows. Below Waitaki it was impossible for many years to avoid these “daily floods,” but as the system grows it will be possible for the flows to be kept more even. In the Tekapo changes of flow have at times been quite sudden. These have caused trouble in handling stock which has strayed on to the empty river bed. It is hoped that this will be eliminated in the future by removing most of the normal flow.

Construction of the Tekapo Power Station was started about 1941. It was interrupted by the war and the station did not come into operation until 1951. It is an interesting example of how ideas on the economical use of water for power purposes have grown. The station has a capacity of 25,200 kW and a peak water demand of 4,300 cusecs. This was proportioned from consideration of natural river flows. No control gates were envisaged and only a small drawdown of the lake would have been possible so that utilisation of available flow would have been low—below 70 per cent. The concept of lake level control came after the tunnel diameter was decided and construction was well under way. Control of the lake level enables far more economical use of the water and in theory it could exceed 90 per cent but in practice the diameter of the tunnel which controls the outflow makes this difficult. With the small output this did not seem a serious matter to the planners of the time, but it has a major bearing on the design of the Maryburn and Pukaki Power Stations to be built between Tekapo and the shores of Lake Pukaki.

Investigation into the best means of developing the remaining hydro-electric resources of the Mackenzie Country was started in 1957 and it is probable that construction will start this year. Diversions of the 4,300 cusecs outflow from the Tekapo tailrace into a canal some 100ft wide and 18ft deep leading across country past the Irishman’s Creek Homestead to the top of the 190ft high terrace above the Maryburn Basin will be relatively simple. The best way of dealing with the Forks River will be to divert it into Lake Tekapo. This will solve the problem of passing the river past the canal and will increase the water available to the Tekapo Power Station. The Maryburn power house will have a capacity of 62 mW. The Maryburn tailrace will cross the Basin, then pass by tunnel through the Mary Range to a canal leading to a forebay some 400 feet above the present level of Lake Pukaki. There will be a series of penstocks (big pipes) down the slope to a power house on the shore of the lake.

The treatment of Lake Pukaki is most important in developing the Mackenzie water. The flow into Lake Pukaki is the largest single contribution to the Waitaki River and the floods and variation of flow is the biggest too. The degree of control exercised by the existing control structures is not enough to enable the full economic use of the outflow. It will have been noticed that even in years when it has been empty in spring the lake is usually filled by Christmas. From then till the onset of low flows in the autumn water is almost always wasted over the spillway so that only about 80 per cent of the mean flow is used. The doubling of the storage volume would enable utilisation to be increased to above 90 per cent. This increase can be used in all stations downstream, both present and future. The extra power thus generated will provide an extra income.
of about £1,500,000 a year from the stations between Lake Pukaki and the tailrace of the Waitaki Power Station.

At present the outflow of Lake Ohau, the smallest in the area, is uncontrolled. Analyses made about 15 years ago showed that, with the existing range in Pukaki and Tekapo, it would be necessary to control Ohau through a range of over 50 feet to bring utilisation of the whole Waitaki to a reasonable figure. If the storage volume of Pukaki were to be doubled then the need for controlled storage in Lake Ohau would be much reduced.

It so happens that the topography adjacent to Lake Pukaki is such that is easier to take water out of the lake about 100 feet above its present level. This is equal to the present lowest level of Lake Ohau. Should the raising of Lake Pukaki be approved, a large new dam sited a quarter of a mile downstream of the existing control structure is planned. The Pukaki Power Station referred to above would be sited further into the hill than it would be with the lake at its present level. As the lake shore for some distance back consists of fine silty clay this will ease siting of the station. Raising the level of Lake Pukaki will almost double its area so that the same storage range as at present (30 feet) will provide the extra storage discussed in the preceding paragraph.

If the level of Pukaki is raised 100ft to match Lake Ohau the combined flow of the Tekapo and Pukaki rivers would be conducted by canal to the terrace above the Ohau River some three miles upstream of the Ohau Bridge. The canal would carry about 12,000 cusecs and be about 140 feet wide. The best point for leaving Lake Pukaki is through a control structure sited at about the present junction of the roads to the Hermitage and Omarama. The canal would cross the plain in front of Rhoboro Downs and pass behind Mt Ostler. A structure would be needed to stop normal flow from Lake Ohau and water would flow in a canal 90 feet wide from a gap in the moraine east of the present river to join the flow from Pukaki, and so to the Ostler power house which will have an installed capacity of about 235 mW and will discharge down a terrace into the Ohau River.

A concrete dam just upstream of the Ohau Bridge will back up water to the tailrace of the Ostler station. The lake formed will not spread over the terraces and is expected to be fairly stable in level (variation of less than five feet). Water will be diverted into a canal about 200 feet wide along the terraces below the eastern slopes of the Benmore Range to Benmore Lake. On the way it will be passed through two power stations generating about 420 mW in all through a fall of about 320 feet.

In all the water in the Mackenzie Country can be used to generate about 4,300 gWh a year and justify the installed capacity of 900 mW. This is about half the total amount of power sold by the Power Boards in 1964-5. On present-day charges this would provide an annual return of about £20,000,000 to the Boards for which they would pay the New Zealand Electricity Department a little under £13,000,000 a year. For comparison, it is believed that the present gross return from farming in the area is about £500,000 a year.

You may well ask, what effect will all this have on the use of the Mackenzie Country for farming?
FIGURE 6. EXISTING AND PROPOSED POWER DEVELOPMENT.
The biggest change in the country will be the removal of most of the water from the present Tekapo, Pukaki and Ohau rivers. They will all have to be maintained as flood channels, and fences will be needed to replace the rivers as boundaries. This will be at the expense of the New Zealand Electricity Department, and so, eventually, the consumer. Actually, the Tekapo River is expected to carry water from about the confluence of Gray's Stream. The Pukaki has no tributaries and can be expected to be dry for its full length. Except for the new lake upstream of the Ohau Bridge, the Ohau should be dry for its full length. If, as is expected, the Forks River is diverted into Lake Tekapo the present bed below the diversion will be dry except for local drainage.

The main rivers run on perched water tables for much of their courses across the Mackenzie Country. For instance a bore hole beside the Pukaki River, after passing through a shallow layer of silt, went down for over 50 feet through gravels before any more water was met. At times a draught of air comes up the pipe. It is unlikely that removal of water from the main rivers will have a significant effect on the water table beneath most of the plains.

There are, however, some reaches particularly along the middle Tekapo, where it is possible that the river provides water to the land close to its course. However, water from the Maryburn and Irishman's Creek, which are unlikely to be diverted, is also feeding the area. The availability of water to such special areas is being investigated and if removal of the main Tekapo flow does in fact cause the land to dry up, then steps will have to be taken to supply sufficient compensation water. Similarly as part of the construction activity it will be necessary to supply water to stock which have up till now been able to drink from the rivers. Tests on the best way of doing this have been in hand for some time.

About 12 runs will be affected in some degree if the level of Lake Pukaki is raised. For some it will be relatively minor. Others will lose land affecting the operation of the run, and in one or two cases it is probable that a major re-allocation of land will be needed. The canals too will cross land usually without following existing block boundaries. This may well upset the existing use of land and may mean some resubdivision of work blocks and holdings. Compensation for all this will be worked out between the landholders and the Government Departments concerned. There are definite forms established for assessing this compensation.

The competing uses to which water in the Mackenzie Country can be put is the subject of a report about to be issued by a Committee on which the Departments of Lands and Survey and Agriculture are represented. The committee has enquired into the amount of water needed for farming purposes and it is an open secret that it is unanimous that construction of the hydro-electric works must not be allowed to hinder the development of the farming potential of the area. Where there are interruptions to water being used now it will be necessary for a supply to be made available sufficient to meet present and short term future needs. If future development needing additional water becomes desirable then the hydro-electric works should be operated so that the extra water can be supplied to the
land at no greater cost than would have been necessary if the hydro works had not been there.

The ultimate development of the Mackenzie Basin should be for the benefit of New Zealand as a whole and at the present stage it is the writer’s opinion that this benefit will be greatest if both industrial and farming potential is allowed to develop side by side.

Conclusion

As part of the development of the resources of New Zealand, it is necessary to develop the land and other assets available. One of the country’s major assets is its abundant water power. Development of this requires large structures and often they become the most spectacular features of the neighbourhood. The Mackenzie Country, which has abundant water capable of supplying a large amount of power, is a case where farming and power development are closely related. It is realised that to many people the reasons why power development takes the form it does are very mysterious. When the development affects them personally it is also offensive. This paper has been prepared to collect scattered information and present it to people who might be affected by power development. If it has dispelled any apprehensions that the development is haphazard, unnecessary, done without any consideration of existing local usage, and mysteriously anonymous, then the writer will feel that his efforts have been worthwhile.
FARMING IN THE MACKENZIE—PRESENT PRODUCTION, TRENDS AND PRACTICAL POSSIBILITIES

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Introduction

In the last ten years high country, or more specifically the inland tussock grasslands, have emerged from being an area of relative insignificance on the national scene to one of considerable importance. This transformation has been brought about by several factors. The most influential of these was the discovery of the ability to establish legumes on a wide range of soils and under varying climates. As this knowledge was gained, the effects of the reduction in rabbits was becoming apparent. The advent of the aeroplane as an item of farm machinery was vital to both of these. To this list must be added the determination, faith and vision of a handful of people who were and are determined to see that the possibilities opened up are carried to their most profitable conclusion.

Inevitably when such momentous changes shatter long stable systems sharp divisions and expressions of opinions arise. These range from unrealistic antagonism to over-optimism. I say this as a plea for all those interested in high country to be much more careful when making statements on what is and what can be. It is we who create public opinion and thus business confidence. Erroneous information can only hinder the bright future that awaits this high country.

There is one matter in particular that must be mentioned. High country has a wide range of climate and soil which is farmed in a limited geographical area. Due to the extensive system of farming it has been fashionable, and probably reasonably practicable, to treat high country as a single entity. As development occurs differences are becoming increasingly sharply defined and it is obvious that much greater care is now needed in defining when and how aspects of development should occur. Already we have the pattern developing of some properties fattening stock and modifying their breeds of sheep while others develop surplus store stock with little or no change in breed.

The snowfall in July 1965 highlighted the advantages of development policies carried out in recent years. The advantages are such that they cannot readily have an accurate monetary value put on them. All you can safely say at present is that the value is well in excess of year to year realisations. True significance will require the results of many years. Previously, in difficult seasons, the poorer type sheep would have had a high death rate, lost what condition they had, and the wool clip would have been affected over a period of years. This must have been disastrous to any serious attempts at flock improvement.

Due to the higher rate of capital input over the last eight to ten years in machinery, fencing and provision for growing and storing hay, periods of extreme climatic stress can now be handled with comparative ease. Oversowing and topdressing have further ensured that
a better conditioned type of animal is receiving this superior winter management. This pattern of capital return to secure and improve the farming system is still in its early stages. Better returns can be expected as we gain more knowledge and perfect management systems.

This will only happen providing runholders continue to have their present security and reasonable freedom of action. A suggestion that capital gains be taken out of high-country farming would be disastrous to continued progress. The same effect would be had by any other action which limited the full exploitation of high-country potential.

The following economic considerations are each important to high country. They are of course inter-related and it is interesting to note that they have application to other areas in the process of development.

(i) Capital value increases must follow the trend of more improved farmlands. So far prices paid for tussock country have not been high when based on productivity.
(ii) The security of tenure and the soundly based rental of the Pastoral Lease are necessary for the application of sound business principles.
(iii) The increasing values paid for runs have important and necessary side effects. For example they create greater land consciousness in the community and focus attention on this type of property as a source of investment.
(iv) In an expanding economy capital is usually in short supply. If high country is to receive its fair share capital values must be high enough to compete with other sources of investment.
(v) A soundly based debt load encourages income re-investment to yield greater rewards and diminish the significance of the debt.
(vi) Prices for land must reach a certain level before development occurs. If this level is not reached then it is cheaper for farmers to acquire more land rather than develop what they've got.
(vii) Any restraint on capital values will usually lead to slower development.
(viii) The development gap between high country and lowlands is far too wide. The two regions could be much more inter-dependent.
(ix) Increasing capital values and their possible realisation give a necessary spur to development which may not otherwise be attempted and could be marginally economic in itself. This type of work creates a more stable and secure unit and provides a sound base for future improvement as our technology comes up with new ideas.

In short high country is stimulated by the same economic life blood that has built more productive, intensive and wealthy areas.

Geography and Area

The Mackenzie country has fairly sharply defined geographical boundaries. Starting at Burke's Pass it runs southward along the Rollesby range through the Mackenzie Pass along the Dalgety range to the Hakataramea Pass and from there extends in a straight line along the Kirkliston range to a point five miles above the Benmore dam. It then goes northwards up the Benmore Lake, Ohau River, Ohau Lake and Hopkins River to the main divide and then northeastwards
along the main divide to its junction with the Two Thumb Range which separates the Tekapo and Rangitata areas and extends along to Fox's Peak and then southward to Burke's Pass.

Contained within these boundaries are some notable land features — Mt. Cook, The Tasman National Park, Lakes Tekapo, Pukaki and Ohau and some impressive mountain ranges. All these have a large tourist appeal which can only increase in the years to come. Runholders could well use tourists as a sideline the way other farmers use pigs and poultry rather than allow such profits to go elsewhere.

The area of the Mackenzie Country is approximately 1½ million acres. Of this 300,000 acres is contained in the lakes, rivers and high mountains. The remaining 1,200,000 acres is all pastoral tussock country ranging from 1140ft at the Black Forest Homestead up to 7,000ft. in the high basins of the gorge runs.

This area of tussock country I would divide as follows:

- 60,000 acres good cultivable soil.
- 60,000 acres bare shingly flats — very dry.
- 380,000 acres undulating downs ranging from 1500ft. to 3000ft. much of which could be cultivated and all of which is capable of improvement.
- 400,000 acres steeper hill country also readily improved.
- 300,000 acres higher hills capable of improvement but unlikely to be done until other areas are developed.

Climate

The climate of the Mackenzie Basin contains some of the widest extremes in the country, in rainfall, in sunshine hours, temperatures and variation of these within months. The gorge country along the Main Divide has up to 200ins. of rain and the Haldon end at the bottom of the basin goes as low as 18ins. Temperatures range from 42 degrees of frost in the winter to 95 degrees of heat in the summer. Tekapo has amongst the highest sunshine hours in New Zealand while the Hermitage has amongst the lowest.

From a farming point of view the non-grass growing period extends from early to mid-May to mid to late September. During the remainder of the year growth conditions can be ideal except for a period of anything from two weeks to twelve weeks of summer drought. Snow can be a problem in the higher, wetter areas in some years. One aspect of the climate is that development work has caused it to become less of a hazard than it was previously.

Soils

The soils of the Basin are all of greywacke origin. Most fall into the classification of high-country yellow brown earths. From a practical point of view all the soils in the medium to high rainfall areas which can be reached by tractor or aeroplane are responsive to development techniques. In the low rainfall area there is a large area of thin skeletal soil which is too coarse and droughty to warrant attention in the meantime.

Fertility Levels

The soils of the Basin have a relatively high natural fertility and the corrective fertiliser treatments would be amongst the least costly.
in New Zealand. In common with the rest of Canterbury sulphur and phosphate are the main deficiencies with molybdenum necessary for good legume establishment in the higher rainfall areas. Lime will probably become a requirement as the level of farming improves but so far it has not been of any great significance. There has been no suggestion of any potash deficiency. A few trace elements on some of the more difficult soils have shown interesting responses but shortage of these is not yet affecting the level of development.

**Soil Erosion**

Between 1947 and 1950 the area reached its lowest ebb due to the depredation of rabbits and the combination of a number of undesirable management practices. Since that time there has been an ever increasing improvement and the spectre of any serious erosion problem is now well past. Systems of management now adopted and development techniques being evolved will ensure that erosion becomes an ever diminishing concern.

**Water Resources**

The water resources of the Mackenzie Basin are immense and far more adequate than even the most optimistic picture of agricultural development can utilise. From a farming point of view these resources suffer a serious drawback. They are not very well distributed. Under the largely extensive system of farming practised until now, stock water has been adequate, but in the immediate future, with additional subdivision, a well planned water supply will be essential. The development of irrigation will also require extensive races from present sources or those created for hydro development.

**Land Tenure**

In the basin at the present time are 35 runs held under Pastoral Lease from the Crown administered by Pastoral Land Officers of the Lands and Survey Department. These Leases are for a term of 33 years and guarantee permanent right of renewal. The Crown’s policy for its Pastoral Lease country is to encourage increased production wherever possible.

**Land Utilisation**

It is interesting to note in the early years of occupancy of the high country sheep numbers rose rapidly to high levels and were sustained for a long period in spite of occasional severe snow losses. In the Mackenzie stock numbers went up to 350,000. By the 1940’s this had fallen to 186,000. Since that time there has been a gradual improvement until by 1960 numbers had recovered to 200,000. Performance per animal today has improved considerably and numbers are just under 210,000. The present production from the area is worth just under £500,000 using present day prices. It is interesting to realise that just under 30 per cent of this is as meat production in some form or another. Ten years ago wool amounted to over 90 per cent of the income.

Ten years ago there were only three properties which had attempted any form of improvement work. Today there are only three who haven’t made a start.

The stage has now been reached where nearly all hoggets receive some form of supplementary feeding — mainly as hay, and reserves are such that if severe snow occurs ewes can also be maintained
for a period. There are very few runs which haven't a reasonable area topdressed and oversown for better summer grazing. More subdivision is also allowing more effective use of the better native grazing and this is reflected in higher per animal performance.

This almost sudden upsurge in both the quality and quantity of feed has encouraged greater emphasis on cattle. In the face of stock shortage and the abundance of comparatively low quality fodder cattle can have a very valuable part to play in the development of most runs. A certain proportion will always be necessary on all classes of country, but particularly in the higher rainfall regions, to maintain grazing for sheep. I don't believe however, that it is wise to carry cattle beyond this level. Capable management should use cattle only to prepare and maintain country for maximum sheep.

On the question of sheep breeds it would seem that present breeds are serving us reasonably well. The halfbred and Corriedale are rightly increasing their proportion in the medium rainfall country. As development is continued this trend will be followed in the drier and wetter areas. It is important that a class of sheep be run which has hardiness, fattening ability, and longevity. The trends in the March Tekapo Sale in recent years emphasise the value of versatile store stock. I rather wonder if for the future we should not already be evolving an even more useful breed. There is certainly room for better selection amongst present breeds but existing methods are woefully inadequate. It is strange how the fate of nearly 54 million sheep in this country is allowed to remain without a solid base of progeny testing when nearly all other aspects of our agricultural economy rely on it.

The size of Pastoral Leases concerns many people. It is almost taken for granted that they will be split up in the not to distant future. I think any suggestion of this is quite misguided for two good reasons. Not very long ago high country was at a discount and runholders existed through many lean years with the poorest of prospects. Now that the picture has changed they are fully entitled to the rewards of past perserverance. Secondly from a purely business point of view these enterprises need to be large by New Zealand standards. They must have the economic resiliency to absorb climatic stresses, and man-made shocks in market prices without any obstruction to sound management. To develop this country a large capital input will be necessary in the next 40 years and this can best come from large well-managed enterprises. This of course places a heavy responsibility on runholders to ensure that they and their sons are adequately trained and capable of administering the management methods necessary to intensively run a flock which in some cases will amount to 30,000 or 40,000 stock units.

Now what of the future. The encouraging start made in recent years is a very minor foundation to that which can follow in the next 30 years. Using practical examples only it is obvious that we can turn the present 210,000 stock units into 5 or 6 times this figure.

The move towards this figure has started but it is very much in its infancy and therefore vulnerable to influences which encourage or depress. Nationally Government must ensure that the multiplicity of necessary services is maintained at least at the same standard as other farming areas. The notion that ever increasing production can be
the most potent and successful soil conservation policy is quickly gaining ground. Rabbit control and weed control is much more likely to be adequately maintained on country which has increasingly high standards of management.

It is now appreciated that the time has ended when New Zealand can afford to ignore any potentially productive acres. At present high country offers the largest quick return in the South Island and rapid development on this class of country could have a useful influence on all adjacent farming areas.

The trend has started. It is soundly based. In the Mackenzie this foundation has about five more years to go before we could see spectacular stock increases. The pattern of the change could well occur in this order:

1) The establishment of a sound young stock feeding programme.
2) The maintenance of snow reserves for all stock. A build up in cattle numbers.
3) The subdivision of ewe blocks and then wether blocks.
4) Oversowing and topdressing of ewe blocks and a start on increasing the ewe flock.
5) A reduction in the wether flock replacing with ewes and topdressing and oversowing of previous wether country. A large build-up in feed reserves to secure future increases.
6) Intensification of topdressing and a rapid build-up in sheep numbers with a concurrent decrease in cattle as sheep achieve satisfactory feed control.

Naturally these stages will overlap and the emphasis they receive vary with the type of country.

Some mention must be made of irrigation. There is no doubt we have land capable of being irrigated. About 50,000 acres of it. Adequate water usage can be justified on economic grounds for agricultural rather than electricity production. Fortunately the design of the hydro systems makes its integration with agriculture no great problem. The demand for intensive irrigation is not likely to occur in the area for many years. When it does, there can be no doubt whatever, that an efficient irrigation system will be a great boon and safeguard to sustained high production in the area.

It is likely that small independent schemes on individual runs will be established to enhance full dryland development before the demand for an intensive district scheme is created.

It would be convenient to finish off by indicating just how fast stock increases are likely to occur. If everybody concerned was enthusiastic and put all farm cash surplus back into development and if labour is available and if prices remain as they are now, stock units could increase by a convenient 8 per cent per year. This rate of increases would still allow flock quality to be maintained but would require an increase in the proportion of breeding ewes — but this must occur in any case. On this basis our 200,000 stock units would become 435,000 by 1976, and 950,000 by 1986. The return per head will also increase so that gross income in this period could go from the present £500,000 to £3,200,000. All the knowledge necessary to achieve this we have now. The will should be there to do it, but the challenge has still to be accepted.
A SCIENTIFIC BASIS FOR POTENTIAL USE OF LAND IN THE MACKENZIE

Dr K. F. O'Connor, Grasslands Division, D.S.I.R., Lincoln.

"It is not too much to allege that more has been written and spoken during the last few months concerning the Mackenzie Country than probably of any other pastoral area in the Dominion. Local evidence as to the real character of the country is unreliable for it is contradictory. There are the pessimists and the optimists, the interested and the disinterested, both equally dogmatic in the expression of their views. As a matter of fact, the Mackenzie Country is not nearly so dangerous a place, nor nearly so good as it is represented to be. It is a deceptive country."

It may seem not so far from the mark, even though this judgment was laid on the table of the House of Representatives over fifty-five years ago (Commission, 1910). The Mackenzie has deceived us for a long time. With your sufferance, I would like to allow the Mackenzie Country, its soils, its sunshine and snow, its grasses and its sheep to speak for itself, answering the questions we have been putting to it in our scientific research over the last five years.

Progressive farmers the world over have the same questions in their minds as progressive rulers. Which of our land resources are capable of development? Which of them should be developed? For what use should they be developed and in what manner and at what pace should they be developed?

Energy Conversions in Land Development

Land development is like electric power development—it is increasing the conversion of energy from one form into another. The energy of our land resources is in several forms—the energy in water, the radiant energy appropriate to the climate, the energy of soils. New Zealand soils as dynamic systems are classified according to their main energy regimes, depending in part on the available energy derived principally from the sun and also on the effective moisture (Pohlen, 1962). In land culture, the basic objective is to make use of the complex of soil and water to support plants which can transform the light energy of the sun into chemical energy. The soil body, the climatic elements, organisms plant and animal within and above the soil, are integrated in what Montserrat (1965) has called agrobiosystems, ecosystems more or less closed and artificially equilibrated by man. The total energy level of an ecosystem, whether natural or cultural, is governed by the volume and rate of cyclic nitrogen. For this reason, do we introduce nitrogen-fixing legumes and rhizobia into semi-natural ecosystems to develop them as agrobiosystems. For this reason, do we graze such legumes, ensuring nitrogen return in animal urine.

Energy Resources of the Mackenzie

Now that we have a simple unified view of what land development is in fundamental terms, let us consider the energy status of resources in the Mackenzie. The soils of the Mackenzie are mostly
classified as high-country yellow brown earths. In the central southeast, yellow grey earths are found on hillsides. In the driest zone, the soils are brown grey earths. All soils of the basin floor and lower slopes, or mid altitude zone are probably lower in energy status than soils of the Canterbury lowlands but they are not as low as the true subalpine soils above about 3,000 feet. The light energy of the environment as a whole is high in comparison with most coastal areas. Tekapo enjoys about 2,300 hours of bright sunshine per year, 52 per cent of possible. Mt Cook has 49 per cent of a possible made lower by mountain shading. Rainfall is generally fair to good for grassland-farming. Only a small portion of the basin is semi-arid, and in that area evaporation rates may be high for four months.

Removing Soil Limitations to Energy Conversion

It is difficult to calculate the productive capacity of an environment when you have all the environmental data. When these are incomplete the difficult becomes painful. The quickest solution, but it is only a partial solution, is to ask the environment. In a series of experiments, we have had the summary answers shown in Table 1.

These results are from the third year of these experiments. Results from the fourth year indicate considerably higher yields from the first two locations and similar or slightly higher yields from the last three. The Dobson soil is important. It was chosen because of its good moisture regime. If water supply and nutrients were not limiting growth of grasses and legumes on other soils in the same light and temperature regime, they could be expected to produce similar yields of herbage.

TABLE 1 HERRAGE PRODUCTION FROM CLOVER-OVERSOWN GRASSLANDS UNDER PERIODIC HARD GRAZING ON SOILS OF UPPER WAITAKI CATCHMENT 1964-65

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SOIL</th>
<th>TREATMENT</th>
<th>YIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLENTANNER</td>
<td>CASS HILL</td>
<td>3 cwt S/Super/yr</td>
<td>7,710</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 cwt S/Super/yr</td>
<td>4,140</td>
</tr>
<tr>
<td>RIBBONWOOD</td>
<td>&quot;KAIKOURA&quot;</td>
<td>3 cwt S/Super/yr</td>
<td>5,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 cwt S/Super/yr</td>
<td>3,550</td>
</tr>
<tr>
<td>PUKAKI</td>
<td>TEKAPO</td>
<td>3 cwt S/Super/yr</td>
<td>11,050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 cwt S/Super/yr</td>
<td>6,380</td>
</tr>
<tr>
<td>BEN OHAU</td>
<td>DOBSON</td>
<td>3 cwt S/Super/yr</td>
<td>17,010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 cwt S/Super/yr</td>
<td>10,150</td>
</tr>
<tr>
<td>TARA HILLS</td>
<td>WAITAKI</td>
<td>3 cwt S/Super/yr</td>
<td>6,050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 cwt S/Super/yr</td>
<td>5,170</td>
</tr>
</tbody>
</table>

In short, the removal of mineral limitations to the growth of legumes and fixation of nitrogen and the effective cycling of nitrogen by grazing animals have resulted in high production of herbage from grasses traditionally looked upon as rubbish. The total production of
grass and clover on our best soil in eight or nine months has exceeded what is commonly obtained over the whole year in trials on improved pastures in lowland areas throughout New Zealand.

ANNUAL DRYLAND PRODUCTIVE CAPACITY IN THOUSAND POUNDS
DRIY MATTER PER ACRE

Figure 1. Dryland productive capacity of Mackenzie Basin at present state of knowledge. Area of each soil is shown on vertical axis and productivity of each soil is shown on horizontal axis. Soils for which development and safe pastoral use are not yet proven are not included.
What then can Mackenzie Country produce in winter? I refer you to the work of Clifford and Vartha (1966) who by removing nutrient limitations to rye corn growth measured approximately 3,600 pounds of dry matter from May to early October on the stony Acheron soils in one of the most severe winters of recent years.

Pooling what we have learned from these and other experiments on related soils in other mountain areas, and applying this knowledge with some caution to the area of soil resources of the Mackenzie, we have the picture of Figure 1.

The significance of the Tekapo soils both in area and productivity capacity is demonstrated clearly in the dry-hygrous zone. Adding the total area dryland productive capacities results in 3,727 million pounds of herbage dry matter annually from 570,000 acres used. At 1,500 lb of dry matter per ewe equivalent this represents 2.5 million ewe equivalents or 4.4 ewe equivalents per acre developed.

Removing Water Limitations to Energy Conversion

What are the possible gains from irrigation? For an area of 215,000 acres which could be commanded by water from the proposed canals the picture is shown in Figure 2.

Figure 2. Dryland and irrigated productive capacity of soils in Mackenzie Basin for area commanded by water.

For this zone, the productive capacity of the irrigated soils is indicated by the performance of Dobson soils without moisture limitation. Stony soils such as Acheron, Mackenzie and some of the Tasman are discounted somewhat because of their stoniness. Even when
efficiently irrigated, soils with a high proportion of stones suffer from the lack of volume of fine material. The total gain from irrigation is an additional 2,302 million pounds of herbage dry matter, representing an additional 1.5 million ewe equivalents. Alternatively, full irrigation could provide winter feed requirements for 4.5 million ewe equivalents. The water requirements for such full irrigation would be about 1,100 cusecs for 140 day irrigation season.

Potential Uses of Mountain Soils

I have not estimated the pastoral productive capacity of the remaining nearly a million acres in the Basin. Approximately half of this area is in Mt Cook National Park and in lakes, rivers and alpine areas outside the Park boundaries. These areas do not need an agricultural scientist to assess their potential uses. The human spirit, if not overcome by the millions of dry matters, and the smell of sheep dung and superphosphate, not to mention the thousands of deficient tourist beds, can make its own confession of man's need for water and for mountains for his own joy, his own peace and his own re-creation.

Below the truly alpine zone are some hundreds of thousands of acres of subalpine soils once mostly forested (Molloy et al., 1963) later in snow-tussock (Connor, 1964) and now in varying stages of disrepair. They may have a pastoral productivity that is compatible with soil stability. In some areas they probably have a potential use in regulating snow melt and water yield. These two kinds of use may be mutually complementary or mutually competitive. If we are to use these soils wisely we shall have to know them better than we do now.

Reducing Animal Limitations to Energy Conversion

Let us return to the potential use of all this potential herbage production in the mid-altitude or montane zone. The stock ration for four million sheep which I have described is within the capability of our present state of knowledge to produce. Have we the animals to use it? We have about 200,000 ewe equivalents, about half of them breeding ewes. The early runholders stocked the country up to about 300,000 fairly quickly. They restocked from about 90,000 sheep after the snow losses of 1895, to 220,000 in 1906, a gain of 130,000 in eleven years. What is biologically and economically possible in 1966?

To arrive at a possible answer, I have assumed the following conditions, probably not greatly different from the real:
(a) 100,000 breeding ewes of appropriate age classes based on input of 20,000 two-tooth ewes into the flock;
(b) 80 per cent lambing;
(c) wether flock of same age structure as ewes;
(d) wastage from all causes, such as deaths, sales, slaughterings at the following rates:
   lambs: 10 per cent;
   hoggets: 10 per cent;
   ewes and wethers up to 5 years old: 10 per cent;
   ewes and wethers 6 years and over: 60 per cent;
(e) total rams at 2 per cent of ewe numbers;
(f) conversion of all stock to ewe equivalents in line with the recommendations of Coop (1965).
These assumptions are in line with the overall picture of 26 high-country runs surveyed over 10 years by Ward (1965).

The calculated results of the above annual increments and wastages are shown by the crosses in Figure 3. From these data we calculated the curve which is represented by the quadratic equation:

\[ E = 201 + 2.26T + 3.07T^2. \]

In simple terms, for, say, the first 10 years, the population rises by 10 x 2.26 plus 100 x 3.07 thousand ewe equivalents, approximately 330,000 ewe equivalents. The longer the described policy is sustained the faster is the rate of increase.

Removing Economic Limitations to Energy Conversion

Would this be economically possible? On the basis of the earlier calculated livestock population I have constructed an economic model of development, with these assumptions, generally based on our experimental experience, Ward's (1965) survey and the financial analysis of Keen and Gow (1963):

(a) fertiliser costs at 10/- per ewe equivalent;
(b) clover seed, fencing to about 200 acre blocks, access tracks, stock water distribution, etc., estimated at £8 per acre or £2 per ewe equivalent;
(c) sheep withheld from sale at 30/- per ewe equivalent;
(d) winter feed at 20/- per ewe equivalent for each year's increment and at 12/- per ewe equivalent for earlier years' increments (since such sheep are already on improved grasslands);
(e) additional working costs including labour, shearing, etc., at 14/- per ewe equivalent;

(f) total additional income is based on 40/- per ewe equivalent in wool and 20/- per ewe equivalent sold as cull or cast for age.

Figure 4. Projected development expenses and projected additional income from 14 year development programme designed to match probable maximum increase in sheep population (shown in Figure 3).

Figure 4 shows the growth in development expenses over time. The annual total development cost is surpassed about the twelfth year by additional development income.

If we assume no debt repayment and compound the development expenses and the development additional income over the fourteen year period shown, then we get the two lines, E and Y, shown in Figure 5.

The compounded development income curve (Y) crosses the compounded development expenses line (E) only at about the thirteenth year. This is not an industry-profitable development programme over such a period because the compounded expenses sum exceeds the compounded additional income sum by £1.65 million. In such an accelerated programme the only benefits are capital gains, but these are substantial. A less rapid programme could yield more profit at the expense of capital gains.
Figure 5. Compounded additional income and development expenses for 14 year development programme (E? signifies likely compounded development expenses assuming increased efficiency in fertiliser, winter feeding and grassland management).

However, before we abandon this probable biologic maximum in development for some hoped-for economic optimum at a slower pace we should consider some technical possibilities. Over the last few years of this schematic development programme, the high per ewe equivalent winter feed costs and the high per ewe equivalent fertiliser costs made an appreciable effect on the shape of the curve for total development costs. These are two components in which we expect major economics to develop as a consequence of the transition to high fertility which is an essential part of the cultural transition to high productivity. The projection of the compounded expenses curve at a lower level (E?) represents the kind of situation which could develop, given sufficient research progress. It would render the schematic programme economic. A similar effect could be obtained from thorough improvement of the better soils in any zone to increase stocking rate above four sheep per acre, thereby reducing land development costs.

I want to emphasise that this is only an imperfect economic model. For help in compiling it, I am indebted to several members of
the Agricultural Economics and Farm Management Departments at Lincoln College. However, they should in no way be held responsible for it. It is the kind of analysis which could well be done on the basis of the best possible data for a regional industry such as pastoralism in the Mackenzie. I suspect that results of such an analysis would compare favourably with those from most other sectors of agricultural or industrial development in New Zealand.

Integration of Pastoral Development with Other Land Use Objectives

A *prima facie* case for pastoral development of the Mackenzie in the national interest is here established. It remains to consider whether different kinds of resource use are competitive or complementary. I have discussed only sheep. Cattle can be integrated successfully when they are complementary as in grazing control, but caution is needed lest they compete for scarce or expensive winter feed. Cropping can be introduced on suitable soils of built-up fertility, especially to augment income and reduce the need for accelerated increase in livestock numbers. Seed production of both cereals and small seeds, especially legumes, is an attractive prospect already being developed. Production forestry can be integrated with pastoral development in the marginal northern and western ranges. The superior ability of conifers to utilise low light on shady slopes indicates that the two objectives may be complementary.

Some competition for resources is likely to occur with the further development of electricity generation. The resources in contention are both land and water. If lake margins are raised New Zealand should realise that the soils which are inundated are generally among the best in the basin, with an eventual productive capacity equivalent to perhaps eight or more ewe equivalents per acre. Their lakeside situation means that they can best fulfil the role of winter and early spring feeding. Every acre lost in this way means a loss from development of two or more acres of potential summer country which cannot be securely developed without winter provision. Alternatively, every acre lost in this way demands the additional outlay for irrigation of from half to one acre of land not otherwise needed for development.

Competition for water is not likely to be serious in the short term. Full irrigation is not likely to be developed rapidly and water supply for stock needs only small quantities if piped supplies are provided and financial and technical services arranged for efficient distribution within each property. Eventual irrigation needs could be competitive with electricity generation but not for the full requirement of an 1100 cusec flow over approximately 144 days to supply 316,000 acre feet. The gain from full irrigation at 60 shillings per ewe equivalent would be approximately £4.5 million per annum in additional income. This represents a benefit of approximately £28/10/- per day cusec. In other more intensive agricultural land uses, this benefit value may be much higher. Since much of this irrigation water is likely to be otherwise wasted due to lack of available mid-summer storage, the development of water control and race distribution for electricity generation could be complementary to rather than competitive with agricultural and pastoral development.
The very acts of a large scale construction programme can have catalytic effects on the minds of members of a rural community. Races running where there was no water before, gravel beds where there were rivers before, milky lakes where there were pioneer homesteads—all these things mean that there will be no possibility of carrying on as before. The incentive to big thought and big action can come from the smells of diesel and big rubber. Let's hope that the sight of the present control gates at Pukaki going under water will tempt farmers, engineers, economists and scientists to think big enough.

To conclude, just as the pound is on the way out, so is the life on a five pound note. “Spend it here!” said the publican at Pukaki, “It belongs here!” No man is an island and no catchment should be watertight. The time is overdue for the Mackenzie to give coastal South Canterbury some of the lifeblood of which an accident of geology has deprived it, water for agriculture and industry. What could be more logical than to call such a 500 cusec race out through Burke’s Pass, the Liffey Canal with the hope that some of it be turned into Guinness!

Whether we, as a nation, act today or postpone to tomorrow we are only at the beginning, the rosy dawn where the forgiveness of grass is wrought by the intercession of sulphur, phosphate, molybdenum, legumes and fenced-in sheep. From this beginning where sheep may safely graze, our land can be turned to fresh woods and pastures new—trees that take their rightful place on dark mountain facings, pastures of tall plants that can use the light and conserve the water. The prospectus which I have prepared for you represents from full development on present knowledge more than £12 million overseas annual earnings. It would be a satisfactory beginning. Begin well and perhaps some Wordsworth of the future will walk in Michael Burke’s footsteps through Te Kopu Opihi and pen some more appropriate lines than those of the Trossachs:

“There’s not a nook within this solemn Pass
But were an apt confessional for One
Taught by his summer spent, his autumn gone
That Life is but a tale of morning grass
Withered at eve.”

References

*N.Z.J.Bot. 1*: 68-77.


HOW TO GET INTO FARMING

H. M. Caselberg, C.B.E., Company Director, Wellington.

There appears to be three main methods of entering the farming industry:

(i) By birth and the inheritance of either a farm or the cash to enable the purchase of a farm.

(ii) By marriage.

(iii) By wisely-planned study, training and experience designed to enable a trainee to become a senior farm employee, a sharemilker or a manager.

Those with little or no cash resources are unlikely to be able to save sufficient money to enable the purchase of an economic sheep farm. The prospective dairy farmer has a ladder through sharemilking and with the quite generous finance available to competent sharemilkers should be able to purchase his own dairy farm before he is say, 40 years old.

It is possible for all these classes to qualify by experience and to save enough money for the deposit on farms offered for selection by Government ballot.

Each of these groups of people require training and experience, but each of a somewhat different nature.

If any real help is to be afforded the trainee to become efficient then some knowledge of his past record, his character, ability and skills is essential in order to assist him to plan his training so that he can capitalise on his particular skills and remedy his weaknesses progressively during say a three-five year training programme.

Sympathetic assistance afforded a trainee to plan his training tends finally to the greater efficiency of any youth leaving school and throughout his first three to five years of farming life so that his time is continuously directed to agreed upon objectives.

There seems to be a curious lack of any formalised assistance available to youths wishing to make a career in farming in New Zealand. The growth in the volume of farm production—good as it may seem to some—is still retarded by farmers unskilled in a variety of ways. Nevertheless satisfactory gains in production have been attained and now even greater opportunities are available than ever before for personnel skilled in all aspects of farming—whether they are to be self employed or to be employees.

May we look at some training programmes that have been proven? Perhaps you will agree that many very successful farmers had, in fact, no formalised or planned training at all and will agree also that many of them have succeeded. Perhaps these are those who “beat the system” and how far further they might have gone is anyone’s guess.

The title of this talk leads me to wonder whether I was expected
to “cover the field” which would include farm finance. This I cannot possibly do in the time and therefore I am confining my attention mainly to training aspects directed to those youths who may be able to own their own farms and to those with insufficient capital to do so but who are determined to become managers, sharemilkers, and/or to enter into Government ballots.

My personal experience has been and still is with these groups, and if I may, I will deal with them especially explaining the training programmes I have used for each.

There is one thing common to all groups which should be firmly impressed on both the trainee and his parents. No matter how skilful he becomes as a tractor-driver, a fencer, shearer, or scrub-cutter it is likely that a hired man would be available who is equally, if not more skilful in performing these tasks. What can NOT normally be hired is a man with sound knowledge of animal and field husbandry sufficient to enable him to make the decisions essential to the proper management of livestock. It is a difficult matter both for the trainee and anyone interested in his welfare and training to judge his competence in this field. A good employer can usually give a sound opinion regarding the ability of a young employee to perform normal farm tasks—but decision making in respect of the selection, the feeding and the care of livestock is usually for the owner alone, who rarely discusses the underlying reasons for his decision with a young employee. This then is not only the trainee’s most essential equipment, but is also the most difficult for him to acquire.

Now may I deal in some detail with three main groups.

1. The lad who is to inherit a farm or an economic part of a farm. This lad starts with a great advantage. He knows he is to come back to a particular farm in a particular district and on which particular type of farming is practised. His training programme is partially dictated before he even starts.

When should he leave school?

Should he spend the first year after leaving school on the home farm?

There can be no rigid rules for these two questions. Most of us believe School Certificate to be a “must.” I encourage anyone with average scholastic ability to go on to U.E. The changes that have come and are going to come so much more rapidly in the future of farming, demand a broad educational basis. At this stage then the trainee is 17-18 years of age.

Normally I discourage a lad to spend his first year on the home farm.

I believe this first year after school leaving to be the most important and most formative year of a boy’s life.

In it he commences decision-making even though in only a minor way. This process can be retarded by his being at home where many more decisions will be made for him than is the case if he is away from home. This is the year in which he should “grow up.”

His behaviour and enthusiasm are the product of his past training; training by his parents and by his school, and coddling at this stage can be harmful.
I also believe that anyone going into sheep farming is the better for at least one year of store sheep experience.

This is the real basis of sheep farming in New Zealand and even if the trainee is to go back to an intensive fat lamb and crop farm, the experience and understanding of this basic farming is essential. I believe in moving a trainee from the extensive to the intensive so his first year is spent on store sheep with a carefully selected employer and where the lad will be the only employee. There are many reasons for this decision which time does not permit me to amplify.

What is the object of this first year's training?

Assuming the lad has some little farm knowledge then he has to:
(a) Keep a diary and get it into his mind. When do things happen and why?
(b) Become proficient in farm tasks.
(c) Watch the techniques of rearing hoggets on hill country or grass alone.
(d) Watch the effect of aerial topdressing and oversowing and learn to identify grasses and weeds.
(e) Take a correspondence course dealing with all these and other matters.
(f) Buy a dog and learn to work it.

His second year moves him progressively into a more intensive field.

For a North Island boy, I usually send him to Southland for reasons that I hope are obvious. South Islanders, not from Canterbury, are usually advised to go there. Again the trainee is with a selected farmer as his only employee.

Objects—Second Year:

(a) A diary and the reasons why it does vary from his first year's diary both in timing and content.
(b) Cropping and Care and Maintenance of Machinery. This farm will have, say, 100 acres under the plough mostly fodder, but possibly some cash crop and grass seed. Normally the lad is 1,000 hours on tractor work.
(c) Obstetrics and Gynaecology. To marvel at, and to take part in a normal lambing of 120-130 per cent compared with the 80-90 per cent of his previous year.
(d) To observe the difference in animals reared under the somewhat uneven plane of nutrition normal to the summer dry and winter conditions where no crops are grown (first year's store sheep farm) compared now with the even plane of nutrition normal to his second year intensive farm. The body and wool weights, the lambing, the weight of lambs fattened, etc.
(e) To do a correspondence course personalised to the trainee and the particular farm. When does he do certain things? Why does he do them? What other methods are there of doing these things and why this particular method?
What are the costs of normal farm stores, etc.,?
In other words begin to "think farming."

Third Year

At the conclusion of this second year the trainee should attend a Diploma Course at Massey or Lincoln.

Objects

(a) To bring together his practical knowledge and advance his academic knowledge and theory.
(b) To meet other students from all over the world, make friendships and broaden his outlook.
(c) To study under professors and lecturers—specialists in their field—to whom, if he so desires, he can refer later in his farming life.

For a dairy farmer's son the same programme is followed except of course, that the first year is spent on a selected dairy farm with a progressive farmer and where he is the only employee. The lad goes to Southland for his second year and then does a Dairy Diploma instead of a Sheep Diploma.

Now his Fourth and Succeeding Years

Any intervals between farms or agricultural college can be spent in woolstores, freezing works or dairy factories and this is advantageous both to mind and to pocket.

May we pause now and look at our product. He is 21-22 years. He should now be a competent all-round farm worker—but nothing more than this. He has a knowledge of theory learned during the Diploma Course. He must now concentrate on animal and field husbandry in a practical way—in other words, stock—their care and feeding. To do this he must select employment on a property with a programme as nearly like the home farm as possible and where he can obtain stock work as a first essential. This goes for those who are to be either sheep or dairy farmers.

After one to three years of further planned experience he should be capable of taking over a farm at say the age of 25-27 years.

2. The son of an Urban dweller with sufficient cash to purchase either a sheep or dairy farm.

Just as for 1. above but this exercise is slightly more difficult because no one, not even the trainee, knows whether he is going to like store sheep, fat lamb or cropping, town milk or other type dairy-ing, or in what district he would prefer to settle. This should be determined probably in his third or fourth year and after this decision employment should be obtained on the type of farm selected—preferably in the district he prefers.

The would-be dairy farmer should have worked on a town milk as well as on a farm supplying a factory.

This type of training obviously fits by their experience all those trainees who wish to enter ballots.

3. Those with little or no money and who are determined to make a career in Farming.

This is the most difficult exercise. These lads rarely know what
kind of farming they want to specialise in nor where they really want to settle. All they do know is that they are determined to go farming. Their training must be planned to give them a wider experience. Nobody knows what type of farm they may be appointed to manage or where they can obtain a sharemilking contract.

Any training plan for this group—by far the largest group I've been privileged to advise—is similar to the others but perhaps more personalised—I need to get to know them better—to talk with their parents more in order to be able to help them.

This is done by assisting them to obtain a wider range of employment in districts it is wise for them to work in to ensure a range of experience particularly in respect of differing soil types and climates so as to fit them especially for ballots or to obtain a good position as a manager or sharemilker.

What is their future?

Some drop out, usually early, but very few do so, and these upsets can normally be traced to lack of farming experience at school age or perhaps just after leaving school they may have commenced to work in town.

Some get the farming urge by a “shooting-hunting-fishing” farm holiday spent at a school friend's farm or with a relative, and from this experience they conjure up a “starry-eyed” image of farming life.

Some, too, are failures academically and are encouraged by parents to take up farming instead of the profession they originally aimed to follow. This early sense of failure has to be overcome if they are to really succeed in farming.

The question is often asked whether the city bred boy has a reasonable chance in farming. I have proved that it is a little more difficult for him in the first two or three years but after that there is really no way of telling any difference between the skills of the city boy and country-bred boy.

The future earning power of a trained man in farming is reasonably good today. There is not the slightest doubt that the commencing award wage is low and bears no relationship with that paid in other industries but viewed as an apprenticeship wage it is not so bad. Where it has failed so dismally is that it is NOT an apprenticeship and no easily obtained assistance towards experience or study has been available up to now for the farm learner. This is most curious. Anyone with the good of the farming industry at heart will watch the Federated Farmers' new scheme with the greatest interest and wish it well. However, it will need much more than good wishes.

Once a normal lad has progressed beyond the first two or three years and has acquired a reasonable competence it is easy to find a farm job at wages comparable with those in urban life. If or when he has progressed still further, there are sufficient jobs at quite high wages available for him. Albeit not as many as there could have been, had skilled farm workers been in better supply. The unfortunate over-employment situation and the dearth of skilled farm workers in New Zealand has forced farmers into expensive labour-saving mechanisation.
In general the farmer has neither wanted to train or to employ an unskilled boy or man and his wife after so many years of selfless effort has recently staged a minor revolution, and now, does not wish to cook for hired help. For the same reason it is difficult to place a town boy to work on a farm during the school holidays.

So the present farm labour situation has arisen largely through the farmer's own attitude towards his labour problems.

May I summarise this way?

As in any other industry there is always room at the top for the efficient experienced man. The key to entry to farming is sound training. It has been more difficult for the average lad to become proficient in farming in contradistinction to the professions and trades because of the lack of any formalised training available to him.

In our established farming industry with farm debts amounting to only 25 to 30 per cent of a conservative valuation of farm assets it is difficult to purchase land at a figure which will give a comparable return on capital invested in other fields.

Purchasing a farm, then, is in effect purchasing a "way of life," perhaps in the belief also, that land values will continue to rise and compensate him for the probable low return on his capital investment.

Because there is no provision of medium term finance in New Zealand specially available for approved farm development projects, a purchaser requires a greater deposit of cash if he is to avoid the danger of owing too much "On Demand" moneys.

Finally the correct blend of practical and academic training is essential in order that the trainee understands that:

Soil type, climate, contour and amenities are the prime factors determining the best economic use of New Zealand land using known techniques. That this knowledge and the ability to handle livestock are the tools of trade of the efficient farmer.

If he is efficient there is a farm or a good farm job for him giving him the best "way of life" in the world.
HOW I GOT INTO SHEEP FARMING

C. W. Weir, farmer, Pourakino Valley, Invercargill.

In August, 1958, I was the successful applicant for a block of 650 acres of undeveloped Crown land in the Pourakino Valley which is 40 miles west of Invercargill, or 14 miles inland from Riverton. The block attracted 19 applicants who went before the Land Settlement Committee. Four were selected as qualifying for the ballot and I had the luck to draw the winning marble.

With this brief introduction I propose to give my story in the sequence with which events took place. Firstly my personal history up to the time of the ballot, conditions and requirements of the ballot and terms of offering for the property and the story of development to the present day.

I was brought up on my parents' property at French Farm, Banks Peninsula and am the youngest in a family of three boys. While still at school I had decided that I wanted to be a farmer. I joined the Canterbury Youth Farm Training Council's scheme and spent my fourth year of secondary schooling as a farm cadet at the Rangiora High School.

The next three years were spent working on Canterbury farms. For two years I worked on a 900-acre sheep and mixed cropping property at Fernside near Rangiora and the third year I was on an irrigated town supply dairy farm at Waikuku.

I think it was a factor of considerable importance that both of these employers were well known and respected members of the farming community. They were very successful farmers in all respects and were constantly striving to improve the production of their properties and stock. In their efforts to increase production, tests and trials were carried out and advisory officers were often consulted.

In my mind these were excellent men to work for as I gained a wealth of experience and information while working on these properties which were being farmed under really efficient management. I was also assisted by my employers in other ways by being encouraged to save and also to take part in the activities of the Young Farmers' Club.

I took an active part in all Young Farmers' Club activities and in 1956 was secretary of the local club. My association with Young Farmers' Club activities was largely responsible for my success in gaining the Canterbury Frozen Meat Company's Scholarship in November, 1956. This scholarship covered all the fees for a year at Lincoln College and in 1957 I attended the College and took the eight months' Intensive Course.

After leaving Lincoln I decided to have a look around New Zealand in some of the areas where development was taking place and there were opportunities offering to young men.

I took a job on a sheep and cropping property at Lumsden in Southland and it was while I was working there that I saw the Lands and Survey advertisement inviting applications for the block of unimproved land which I had the good fortune to secure.
My financial position at this stage was that I had £2000 in cash and assets plus the promise of limited assistance from my parents.

A brief description of the property in its original state was: 650 acres flat to undulating, broken by gullies, originally in heavy bush, mostly Southland beech. Three hundred and fifty acres fire-swept and surface-sown after saw-mill operations in the early 'thirties now reverted to bracken-fern and scrub, covered in stumps and logs. Three hundred and fifty acres ploughable by wheel tractor, 150 acres by crawler tractor and 150 acres unploughable gullies and swamps.

The soil is a medium clay loam of 6 to 10 inches deep on a good clay sub-soil, rainfall 60 inches and an altitude of 200 to 500 feet.

Power was not available, being six miles away.

The main points in terms and conditions of offering of the property were these:

The section was offered for the benefit of persons who had sufficient capital and experience in the development of unimproved land to bring it quickly into a satisfactory state of production.

It was a requirement that the successful applicant effected certain improvements within a period of four years and this was made a condition of the lease. These minimum improvements to be effected were that an area of not less than 150 acres (not less than 50 acres per annum) be bulldozed and cleared, cultivated and sown down in permanent pasture following a root crop and the area fenced.

Before being admitted to the ballot applicants were required to appear personally before the Southland Land Settlement Committee and satisfy the committee that they had sufficient finance, ability and experience to comply with the terms of offering and that they were in a position to carry out the initial development required without borrowing or depending solely on the property for an income during this period.

Preference was given to suitable applicants who were landless or whose properties when developed would not be an economic unit.

Now this next paragraph is as taken from the Schedule of Offering and I think that as far as I was concerned it was the pot of gold at the end of the rainbow.

It read: "If the successful applicant complied in all respects with the terms and conditions of offering and develops the property up to the stage where in the opinion of the Land Settlement Board it will carry 800 breeding ewes and essential cattle the State Advances Corporation will be prepared to give favourable consideration to a loan application for up to £12,500 for further approved improvements or for stock and plant. If an advance is made the applicant will be required to work under supervision and under a budget to a predetermined plan of development for such a period as the State Advances Corporation determines."

I saw this as a virtual promise of State Advances Corporation assistance in three to four years time and I think we would all agree that what one needs most to get into farming is a source of credit. I considered that this source of credit was well worth pursuing especially as it was offered with interest concessions for the first three years.
Subsequently when I did borrow from the State Advances Corporation these interest concessions gave me time to get the money spent on development and have the new pastures carrying stock and producing an income with which to meet the full interest charges.

Initially the tenure of the property was on a 33 year lease with right of renewal but no right to freehold. However after the completion of the minimum improvements I was given the option to freehold for cash: freehold on deferred payments or a 33 year lease with right of renewal and right to freehold.

I think at this stage it would be fair to say that while I have enjoyed perhaps more than my share of luck I have always tried to engineer things and prepare myself so that my chances of success would be better than average.

My first two employers were progressive farmers and the experience gained with them has been of much value. I wanted to take a course at Lincoln College and my association with Young Farmers' Club activities enabled me to gain the scholarship to Lincoln instead of having to pay my own way through the College.

Over the past years this course at Lincoln has proved to be invaluable and without the knowledge gained at Lincoln I am sure that I would not have qualified for the ballot.

Sometime after the ballot I learned that of the nineteen applicants I was the only one to go before the committee with a proposed plan of development and estimated costs for the initial four-year period so in this respect alone the training received at Lincoln had really paid off. Another fact emerging from the course at Lincoln is the value of the contacts made while there.

The story of development of the property starts from the date of the ballot 19th August 1958, when the only improvements on it were a boundary fence on one side with my only neighbour. The other boundaries were a survey line between my property and the State Forest.

A contractor with a D.6 bulldozer was engaged and clearing operations commenced the next week. I continued with my job at Lumsden for a further three weeks and during this time I bought a second-hand wheel tractor and other essential plant. I was given an old but useful set of discs.

I moved to the property on the 11th of September and for the first nine months I was living in a caravan let to me by my previous employers at Lumsden.

Initially an area of 70 acres was cleared at a cost of £5 per acre and a fire-break was made around a further area of approximately 100 acres.

The first 70 acres were fenced, ploughed and cultivated, given one ton of lime per acre and ridged in swedes, eight ounces of seed being sown with four hundredweight of reverted super per acre. The resultant crop was quite reasonable considering the dry conditions that summer.

Store lambs were bought in and fattened on the swede tops and 110 old ewes were bought in the autumn. The majority of these swedes were sold as grazing for cattle—the deer also helped themselves to their share without paying any grazing fees.
For the first three seasons I grew about two acres of potatoes with reasonable returns, which helped to supplement my income.

I was also most fortunate in having a neighbour who gave me every assistance and during my bachelor days their place was like a second home. I was able to spend quite a bit of time working for them helping with their seasonal work and this money earned off the property was a considerable help. I also went back to Lumsden and helped friends with the harvest of their grass-seed and was well rewarded by being given enough ryegrass, white clover, cocksfoot and dogstail to sow down my first 100 acres of pasture.

During the first autumn when burning off prior to bulldozing a strong wind caused the fire to jump the fire break, get out of control and burn off about 200 acres of fern and scrub fortunately doing no damage to neighbouring property.

This burnt area was oversown by aeroplane at a total cost of £1 per acre for seed and spreading and although I did not have the stock and fencing to effectively control regrowth it did at this early stage of development give me a useful area of grazing until I had pastures established.

During this first winter an implement shed of 800 square feet was constructed. I also moved out of the caravan into a rented house one and a half miles away. I lived in this house for four years until a house was built on the farm.

The second season saw another 25 acres developed and sown in swedes and the previous year's swede ground cultivated, given another ton of lime and four hundredweight of super and sown in grass, the mixture used being:

- Perennial ryegrass . . . 15 lbs
- H1 ryegrass . . . 10 lbs
- Cocksfoot . . . 3 lbs
- Timothy . . . 2 lbs
- Dogstail . . . 1 lb
- White clover . . . 3 lbs
- Red clover . . . 2 lbs

36 lbs per acre

In subsequent years the development has been much the same with 20 to 30 acres of new ground being cleared and sown in swedes and the previous season's swede ground sown down in pasture. For three seasons I had the young grass undersown with oats which were harvested for milling, for two seasons it paid off with a 60-bushel crop and a profit of £500 but the third year the weather beat me and I barely recovered costs.

The end of the third season saw me with 100 acres in grass, 25 acres in swedes, 600 bales of hay and 480 ewes out to the ram plus 150 hoggets.

At this stage I was able to get a change in title to the property from Lands and Survey and I was then granted the loan from State Advances Corporation for further development and improvements plus stock and plant.
Since receiving the State Advances Corporation Loan I have been required to work under a budget and although personal spending has been limited it has been an excellent arrangement and one has been able to get on with the job with no immediate worries about falling market prices and seasonal finance.

The State Advances Corporation loan was used to build a house and wool shed on the property, buy a new crawler tractor plus other stock and plant and also to finance a steady programme of development.

I have now been on the farm for eight seasons and have 240 acres in pasture and 35 acres in swedes and turnips. Stock to be carried this winter is:

1050 ewes
350 hoggets
50 rams and killers, etc.
40 breeding cows
12 calves.

The ewes are Romneys mated to Romney rams and I have always kept my own ewe lambs. For the past three seasons I have had surplus young sheep to sell as well as cast for age ewes. Wether lambs are shorn, fattened and sent to the works.

For the first four years the Hereford cows were mated to a Black Poll bull and all calves sold after weaning in the autumn. A change was made to a Hereford bull and this year I am keeping his first crop of heifer calves for replacements and to increase the present herd.

All pastures are topdressed with two hundredweight of super in late winter and young grass receives D.D.T. super in the autumn. Pastures also receive one ton of lime in their fourth year.

In conclusion I would say that I think the main points emerging from this paper are:

1. The gaining of experience both practical and theoretical.
2. Save as much money as possible.
3. Develop contacts and establish oneself as being worthy of credit.
4. Be prepared to look about the country and try one’s luck wherever opportunity presents itself.
HOW I BECAME A DAIRY FARMER

I. Weston-Macpherson, Norsewood, Hawke's Bay.

Introduction

Last year I realised an ambition of owning my own farm and I have been asked to discuss with you the manner of achieving this. I sincerely hope that what I have to say this morning will help to convince young men that there are opportunities for them to purchase their own farms.

I propose to treat my subject as follows:
(a) Personal background.
(b) Farming experience.
(c) Finance.
(d) Factors I consider important to farm ownership.

Personal Background

I am what you might term a city boy. I lived with my parents and younger sister some 12 miles from Wellington in one of the city's less hectic suburban areas. My parents gave me the encouragement and guidance needed when I was in doubt and indecision. They helped me to help myself. Not by monetary means but by understanding and taking a direct interest in my endeavours in life and as a young farmer. My father taught me to recognise the value of money, to discipline my spending and save conscientiously without entertaining meanness. My mother is responsible for introducing me to farm life and thus opening an avenue of adventure hitherto unknown to a city boy. I endured three years of secondary education at the Hutt Valley Technical College.

Farming Experience

In the year of 1958 and at the age of 16 I left Wellington and headed north to Morrinsville—worked at this particular 100-acre dairy farm for 13 months. It proved to be a tough introduction to dairying compared to my enjoyable holidays spent on my uncle's farm. It was at the Morrinsville farm that I realised farming involved work, real hard work, often boring, unimaginative work and in return my weekly wage was £3/17/6 net.

I returned to Wellington and worked in a freezing works and in a tin making factory. These jobs proved substantially more remunerative than farm labouring and they fell far short of providing any sustained interest.

My next job was on a 150-acre dairy property in Southern Hawke's Bay. This particular farmer was young and keen in his work and progressive in outlook. He expected a similar attitude from his employee. I was given responsibilities of my own which proved challenging and rewarding. My first season there gave me renewed interest in continuing to strive to farm ownership.

Unfortunately I spent my entire savings, some £450 at this stage, on a second-hand car. After a Y.F.C. barn dance one night I rolled the vehicle over and then vacantly realised that I had not bothered to insure the vehicle. I was left in the unenviable circumstance of find-
ing £120 to foot the repair bill. My £6 per week was not going to allow me any opportunity to save this sum of money so I again packed bags and headed for my home town.

At this stage of my adolescence I was very indecisive towards whether to continue farming at all. I still believe this attitude is commonplace amongst a large percentage of farm labourers today.

I found work in a biscuit factory and ended up working there on night shift for nine months. I also worked during the day time in neighbours' gardens—cutting hedges and lawns—doing any type of work offered. Factory life was painfully monotonous yet profitable. However I was determined to achieve some success in life other than just piling up cold notes. Finally the approaches of rather desperate looking green-eyed factory girls towards adolescent young men sent me scurrying back to the pastoral scene and cows.

I worked on what I considered was a poorly-managed dairy farm in the Wairarapa. The stockmanship was satisfactory but I had the impression the farmer lacked an appreciation of business principles. This gave me the opportunity to make comparisons between my idea of progressive and negative farming methods, and therefore formulate my own standards and opinions.

I returned to the Hawke's Bay dairy farm I mentioned earlier for another season. On this farm I was accepted as a member of the family, not purely the farmer's worker. I was encouraged to take an active part in Young Farmers' Club activities. The principle benefits of Y.F.C. membership has been the confidence gained in debating various farming topics with other club members.

I then ventured north to the land of grass and butterfat, the Waikato. I worked for a farmer who had been given his property but could do no more than grumble and moan of his unfortunate circumstances. Our temperaments clashed and his farming methods were not in my opinion of any noticeable merit.

At the end of that season I applied for a 50/50 sharemilking position at Te Awamutu. I had saved £1,000 plus £800 tied to the body of a fully-insured car. A point of interest to note is that from a total of £3,000 net income over the preceding five years I had saved 60 per cent of all money earned. As a farm labourer I had saved £1,050 in four years, compared to £750 saved in nine months of factory work.

I bached and milked 70 cows on 70 acres for the first season and produced 21,000 pounds of butterfat. The second year I started on more homely grounds as a married man. It may be noted that production during that season rose to 22,500 pounds of butterfat. My wife has always given a sympathetic hearing to my farming problems. Her companionship has proved invaluable and her presence constantly enlightens an otherwise dull farming day.

Finance

The essence of sharemilking is the financial side to it. We bought 72 cows, tractor, implements and sundries including one pet goat for £2,400. With our deposit of £1,000 we borrowed £1,400 from the Dairy Company. The £1,400 was repaid within 18 months and we sold the herd and machinery for £3,400. This represents a net non-
taxable gain of £1,000 on the stock. From a herd of 70 cows we were able to accumulate assets totalling £3,000 in the two years we were sharemilking.

We had reached a freehold state as sharemilkers. We had also fully developed the productive capacity of the farm. The term of our contract expired at the end of that season and since the farm was managed as an estate with a group of very conservative trustees telling me where to draw the spending line we were confronted with two alternatives:

(a) To look for a larger sharemilking proposition and continue to build up our assets in this field, or (b) To look towards getting into our own farm with a very slim chance.

I eagerly chased up every potential farm sale within the £12,000 to £20,000 going concern range. In all cases we ran a short race for funds. State Advances Corporation only lend their full £10,000 dairy loan on well-producing farms which were priced beyond our limit. However we were able to locate a 104-acre farm in Hawke's Bay producing 25,000 pounds of butterfat. This farm was producing well and the financial returns were sufficient to allow us to purchase our farm with 80 per cent of mortgage money. We paid £16,500 going concern for our farm, the finance being as follows:

- Our deposit £3,500
- S.A.C. loan £10,000
- Second mortgage money £3,000

The latter included a Dairy Company loan of £1,500. The balance of £1,500 being borrowed from two individual private sources.

Our first season is nearing completion and we are able to survey our rate of progress with satisfaction. We have increased stocking numbers and production has risen 15 per cent from 25,000 pounds to 28,000 pounds of butterfat.

Factors I consider Important to Farm Ownership

I have given you an indication as to the way we managed to get into farming. I believe there are some basic factors required to get into farming quickly and successfully.

(1) Firstly, and of the greatest priority, we must be convinced that we want to go farming. It is no use being haphazard about the job. If our attitude is right mentally then our physical efforts will respond accordingly. Therefore I suggest we all make a personal appraisal of our own individual attitudes to farming. Farming is not merely a job, farming is a career. It demands a keenness of mind and intellect. If we want to become farmers, well let's be enthusiastic about it.

(2) Secondly, knowledge of one's occupation is an invaluable asset. The man who deliberately makes the effort to learn as much about his profession as he can will ultimately succeed.

I suggest we make a point of listening rather than chattering, yet form opinions about things and take part in farming discussions. Membership of the Y.F.C. is more desirable than membership of the golf or motor-cycle club if the objective is farm ownership. Cer-
tainly take leisure and don’t become too keyed up towards farming—
instead a sound balance between work and play is desirable.

I believe we ought to undertake our farm work with a sense of
responsibility to ourselves. The attitude in my opinion should be
“Well, why does the boss do that job in such a manner?” Constructive
thought brings forth suggestions and when one starts to criticise
constructively a farm is not too far away. Always keep an open ear
to increase and absorb knowledge. This I am convinced will benefit
all of us in our own modest endeavours to succeed at farming.

(3) A well known fact amongst the farming community is that
all the knowledge in the world isn’t sufficient to purchase a farm. To
buy, one must have money. The more initial capital a young man has
the better his bargaining position for financial assistance.

Now let’s take a look at the possible efforts of a farm employee
when it comes to accumulating enough £ s. d. to get into farming. Consider the average wage earned by farm workers. Base their
income at £10 net per week over a five-year period (I believe this to
be a conservative figure). If the young man saves half of his income
it would amount to £260 per year. £260 isn’t a significant sum when
we talk of farms for sale at £20,000 to £30,000 or more. The important
point to note here is that provided he saves between £200 to £300
he has made a good start. Over a five-year period his savings would
have amounted to £1,300 and he would have established a useful credit
rating with the banks and other financial institutions.

£1,300 is enough money to put down as a deposit on a herd of cows
and go sharemilking. Thus taking the next step towards farm ownership. We are all capable of saving a few pence; all that farming
demands is extra effort on one’s behalf to save a few pounds regularly.

Conclusion

Finally, ladies and gentlemen, I believe the opportunities to get
into farming in New Zealand are unlimited. There always has been,
there is now and always will be openings available to young farmers
who are prepared to equip themselves in readiness for opportunity.

I am convinced after my own experience that any young man who
works hard, learns keenly and saves well can have his own farm by
the time he is 28.

He can achieve this ambition without large amounts of private or
family finance, which means that every young farm worker in New
Zealand has the opportunity to obtain a farm of his own.
PASSING MANAGEMENT RESPONSIBILITY ON TO THE YOUNGER GENERATION

A. C. R. Robinson, Farmer, Rotherham.

The title of this talk as printed in the programme is most misleading. It says, "How to retire gracefully from farming." This title does not suit what I'm going to talk about. I have no intention of retiring from farming for some time yet—it is my main interest in life and I'm still fit and active. What I do intend talking about is the question of passing on the responsibility of the management of a farm to the next generation.

Now this is an important topic both from the national and individual point of view. Looking at it from New Zealand's point of view, it is just as important that young men get into farming and old men get out, as it is for us to replace our flocks with young sheep. While there are many exceptions, one's physical strength declines imperceptibly at first and more rapidly from the fifties onward. I am, incidentally, 61. Then, in general, as we get older we tend to become more conservative—we become less receptive to new ideas. Changes on the farm seem more of a hurdle. Finally, our ambitions for farm development are not as strong as they were when we were in our thirties. We tend to become less interested in progress and more interested in security.

However, that's all very well for the country but what about individual farmers—young and old alike. Now the betterment of both young and old generations depends on co-operation. Both have things to offer to a partnership from which father and son can benefit.

On the one hand father has the assets, the reputation and the experience to develop the farm, and son has the ambition, drive and physical strength. By co-operation there can be no better team on a farm. On the other hand if both parties go it alone neither will do it so well.

But all this is much easier said than done. There are many problems in delegating management responsibility.

In this talk I will tell you something of the difficulties faced by the younger generation when they are given very little opportunity to share the responsibility. This was my lot before my father died. Then I want to tell you how we have tried to organise Mt. Palm so that my son Brian shares in the running of the farm.

But first let me tell you something about the history of Mt Palm. It was originally part of St. Leonard's Station. It was then called Mount "Pam" after Lord Palmerston—the famous early Victorian Prime Minister of Great Britain. It was bought by Mr R. Chapman in 1872. T. and E. Chapman were joint owners in 1882. My father bought Mt. Palm from Mr T. Chapman in 1919. It originally consisted of 16,000 acres but the portion bought by my father was 1900 acres. He previously purchased 3000 acres called the Wart from Mr Chapman in 1911.
The present area of Mt. Palm is 4900 acres of which about 800 acres is agricultural and the balance is tussock hills up to 2,200 feet. In my father's day we ran about 2500 ewes and 1800 dry sheep—a total of 4300. We fattened about 1500 lambs. We used to shear 110-120 bales of wool. Also there were 40 breeding cows and we fattened 80 head of cattle.

My own story goes like this. I was at Christ's College for four years, leaving at the end of 1920 at the age of 16. I went straight home on to the farm—beginning at the bottom. My wages were 10/- a week. In 1935 I got married and we have one son, Brian, and two daughters. I served overseas with the 20th in Italy from 1943 to 1946 and came home to Mount Palm.

Over a considerable period I had no managerial responsibility at all. My father belonged to the old school. He believed it was "not done" to discuss financial matters either inside or outside the family. This was a very common attitude amongst his generation. It was not until a few years before my father's death that I ever met our accountant, stock firm manager and bank manager. Consequently, I knew very little about the financial side of farming. Working out a budget was a closed book to me because my father didn't think it proper to talk about family money matters. Further, he didn't do anything about death duties. He had no insurance policies. I wasn't keen to discuss these matters with him—one didn't want to appear grasping. In fact my stock firm manager suggested I have a word with my father and when I asked him to do the talking—he said he didn't see why he should do it either. I found out later that my father believed there was some dishonesty about the legal method for avoiding death duties.

He had always said that I could sell the Wart to pay probate as it was too late to take out life insurance on this account. I was therefore confronted with the possibility of selling this part of the property and keeping the balance of Mt. Palm. No doubt this would have been the easiest way out but I realised that this hill country gave the highest returns for the least labour and as I had a son who was keen on this type of country if I could only hang on to it our future would be assured. I have not regretted my decision and we are now in the process of developing this country and I am more than satisfied with the results.

My father also believed in the autocratic idea of a boss—the man who made all the decisions rarely consulting me or anyone else.

For instance, while we discussed the farm more and more in later years, I merely relayed his orders on to the farm staff. He decided which stock we'd sell and so on.

I don't want you to think for a moment that I'm belittling my father. That's the last thing I would do. In fact if it hadn't been for him I could never have owned a station like Mt. Palm. He was just one of the older generation and they had different ways of doing things from what we do today. They were more conservative and were more reserved. They were less influenced by what others did and thought. They made up their minds for themselves and stuck to their opinion. But actually my father was a really great friend of mine—he always was.

However it did have these repercussions.

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Firstly, I felt a sense of frustration. I would have liked to have seen the pattern of farming change on Mt. Palm but my father would not agree to this. For instance, when I bought a Land Rover out of some insurance money of mine which came to hand, he asked me what the devil I was going to do with it.

As a grown man I still felt a sense of still being a boy—my life and the life of my family being governed by someone else.

Secondly, when he died in 1957, I found that I hadn't the experience and financial training to run the farm properly. You see I knew very little about the financial side and I hadn't got the business contacts you need to run a place like Mt. Palm. I did know the stock firm manager fairly well and he is still a very great help and adviser to both me and Brian. But when my father died, the bank manager was almost a total stranger. I had to start off from "square one" with him. He was most helpful but he could not help me pay probate. I can't say I blame him, he didn't really know me and I didn't know him.

At this time I swore that it would be different for my son Brian who was 18 years old at the time and wanted to join me on the property.

I have tried to delegate responsibility to him so that we can work as a team. He's become the manager and I am the chairman of directors and farm worker. He's responsible for tactical planning and I'm a consultant on overall strategy with the right of veto at any time. The situation has its problems many of which we are still in the process of solving. For instance, which of us has the final say when it comes to selling stock, etc.?

First of all I have tried all along to give Brian the opportunity to make decisions. Soon after he first came home from school he took over the sheep and now is in complete charge of all stock. He's better and keener at stock work than I am—I prefer machinery and agricultural work. However, by taking over the stock it gave him a place on the farm and gave him a sense of responsibility. This gave him the opportunity to make decisions and the odd mistakes—mistakes where it didn't matter too much—and learn by them.

I must give him credit—he didn't make many—that is none with any serious consequences as far as I could see.

It is important for young people to take on responsibility step by step after the necessary training. I still find it extremely difficult to keep my nose out of the activities which I have delegated to Brian.

I've found it most difficult not to give orders to the men especially when I see them doing something in a different way from the way that I'd do it. I usually ask Brian for an explanation.

Brian is the farm staff's immediate boss. There is nothing more demoralising for a man than working for two bosses.

When I went overseas in February last year for seven months I left Brian a power of attorney giving him full power to make decisions on the whole place and this was the opportunity for him to take control of the farm staff.

He managed very well in all phases. For instance, a cottage was burnt down. He had the responsibility of arranging alternative accommodation for the married couple. He organised the construc-
tion of a new house with the help of a very good neighbour of ours. He sent the plans to me. I okayed them with slight alterations and he went ahead and built the cottage. In a very short time the married couple were installed. I thought that wasn't too bad an effort.

When I came home my friends, my bank manager and my stock firm manager said, “Brian seems to have done a pretty good job.”

Incidentally, while I was away, I had a letter from a friend who wrote that he thought it would be pretty hard on Brian if he had to hand his authority back to me again. I thought this over for a time and came to this conclusion, “Why dammit, why should he hand over this responsibility. I'm quite prepared to let him have it. He seems to be getting on all right so why not let him go ahead?”

So at the present time Brian does all the work in engaging men, and giving the orders. He comes to me if he's not sure and I give him my opinion. He doesn't have to take it but I notice that he usually does. In general he's responsible for the running of the whole property.

Brian has taken over the financial control. He keeps a complete record of all receipts and expenditure, writes the cheques and signs them. We decide on a budget and he makes sure that our expenses keep within the limits we have set. However we both discuss the overall plan for the place.

Fortunately we've both got a pretty clear idea of our responsibilities though we're not rigid about them. For instance I usually give advice about the machines and help with their maintenance. I still drive tractors and if I'm asked to plough a paddock I take great pleasure in doing it and still help with mustering when required. I work the tractors when we're heading and things like that. But I'm just as likely to find myself drafting sheep or sorting out fat cattle, especially when I had hoped to have a day in the garden. I would hesitate to shift a mob of sheep without asking him about it. Equally he'd be just as hesitant about selling a machine or altering it without asking me.

The handing over of responsibility is much easier if you've got other interests in the community. But when you have these interests you must have someone to carry on with the farm—an outsider as manager or your son. If your son's had the training—and in the long run the training's up to you—surely he must be the best man to look after your interests and incidentally his long term interests, too. I have always encouraged Brian to have outside interests especially those concerning our own district.

It's probably best that sons get experience off the home farm before they come home. This was my intention when Brian left school. But with the death of my father, the heavy death duties, and the scarcity of labour, I decided to keep him on the farm.

After a year at home Brian thought he'd like to take up commercial flying and went to a training school at Wanganui. As he already had a pilot's licence and as I'm keen on flying myself I couldn't altogether blame him. When he rang me after a few weeks and said he'd decided to come home, I can't say I was sorry.

Working together over the last few years we have made many changes such as increased subdivision; mob stocking on the paddocks
instead of set stocking; greatly increased topdressing; the building of an airstrip in the hill country which enables us to carry out a topdressing programme on the tussock country. This is under the direction of the Tussock Grasslands Institute. This programme is giving outstanding results. I believe it will ultimately double the carrying capacity on this type of country.

Our carrying capacity is steadily increasing. This year we shored over 6,000 sheep and sold nearly 200 bales of wool. We fattened nearly 3000 lambs and now have 400 cattle including run cows and calves. We've 130 acres of lucerne and make 10,000 bales of lucerne hay besides using the lucerne for fattening lambs. Part of our policy is to erect at least a mile of fencing each year either in further subdivision or in the replacement of existing fences which have come to the end of their useful life. Practically all our fencing is done by our own staff in the winter months.

Our present staff consists of a tractor driver and shepherd and in the summer we usually have a Lincoln College student for a few months.

In conclusion may I offer this advice.

Firstly, pay your son a decent salary. Pay him at least as much as you would pay an outsider in a similar position. Endeavour to make him feel independent and not feel that he wants you out of the way.

Secondly, endeavour not to interfere, but act in an advisory capacity. This is not always easy, especially the interference part.

And most important, make sure that if your son takes over the property, your affairs are in such order that he'll be able to carry on without having to pay crippling death duties.

I would say you are well on the way to achieving your ambition when your son comes to you and says, "What do you think, Dad?"
I want to discuss with you the financial side of passing assets to your family.

**Gift Duty**

When you pass or transfer assets from one member of the family to another member, or even to an outsider, you either sell the assets for an agreed upon figure or you gift them to the party concerned.

If you make a gift you must comply with the requirements of the Estate and Gift Duties Act, 1955, and the amendments to that Act which is administered by the Duties Section of the Inland Revenue Department. A gift duty statement must be filed for all gifts of £1000 or more. It is even advisable to file a statement for small amounts.

Gifts made on or after the 20th July, 1961, in excess of £1,000 attract gift duty according to the following rate of gift duty:

<table>
<thead>
<tr>
<th>Not exceeding £1000</th>
<th>NIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>£1,001—£1,500</td>
<td>9% of excess over £1000</td>
</tr>
<tr>
<td>£1,501—£2,000</td>
<td>£45 plus 10% of excess over £1,500</td>
</tr>
<tr>
<td>£2,001—£3,000</td>
<td>£95 plus 9% of excess over £2,000</td>
</tr>
<tr>
<td>£3,001—£4,000</td>
<td>£185 plus 11% of excess over £3,000</td>
</tr>
<tr>
<td>£4,001—£5,000</td>
<td>£295 plus 13% of excess over £4,000</td>
</tr>
<tr>
<td>£5,001—£6,000</td>
<td>£425 plus 15% of excess over £5,000</td>
</tr>
<tr>
<td>£6,001—£7,000</td>
<td>£575 plus 17% of excess over £6,000</td>
</tr>
<tr>
<td>£7,001—£8,000</td>
<td>£745 plus 19% of excess over £7,000</td>
</tr>
<tr>
<td>£8,001—£9,000</td>
<td>£935 plus 21% of excess over £8,000</td>
</tr>
<tr>
<td>£9,001—£10,000</td>
<td>£1,145 plus 23% of excess over £9,000</td>
</tr>
<tr>
<td>£10,001—£11,000</td>
<td>£1,375 plus 25% of excess over £10,000</td>
</tr>
<tr>
<td>£11,001—£12,000</td>
<td>£1,625 plus 27% of excess over £11,000</td>
</tr>
<tr>
<td>£12,001—£14,000</td>
<td>£1,895 plus 23% of excess over £12,000</td>
</tr>
<tr>
<td>£14,001—£16,000</td>
<td>£2,355 plus 25% of excess over £14,000</td>
</tr>
<tr>
<td>£16,001—£18,000</td>
<td>£2,855 plus 27% of excess over £16,000</td>
</tr>
<tr>
<td>£18,001—£20,000</td>
<td>£3,395 plus 29% of excess over £18,000</td>
</tr>
<tr>
<td>£20,001—£22,000</td>
<td>£3,975 plus 31% of excess over £20,000</td>
</tr>
<tr>
<td>£22,001—£24,000</td>
<td>£4,595 plus 33% of excess over £22,000</td>
</tr>
<tr>
<td>£24,001—£26,000</td>
<td>£5,255 plus 35% of excess over £24,000</td>
</tr>
<tr>
<td>£26,000—£28,000</td>
<td>£5,955 plus 37% of excess over £26,000</td>
</tr>
<tr>
<td>£28,001—£30,000</td>
<td>£6,695 plus 30% of excess over £28,000</td>
</tr>
<tr>
<td>Over £30,000</td>
<td>25% less £25</td>
</tr>
</tbody>
</table>

A gift is a gratuitous or partly gratuitous disposition of assets other than by will. When the disposition is partly gratuitous it is regarded as a gift to the extent of the inadequacy of the consideration received by the donor.

The term disposition has a very wide meaning. It covers not only the normal means of disposition, that is, by transfer, payment...
release, creation of trust and so on, but also any transactions entered into by any person with intent to diminish the value of his estate and to increase the value of another's estate. Allowing a debt to remain outstanding until it cannot be collected by normal legal action also comes within that definition.

Gift duty is payable on gifts of all property situated in New Zealand and gifts of personal property and chattels, life insurance policies, bank notes, etc.

The value of any land included in a gift may be determined by agreement between the donor and the Commissioner of Inland Revenue Department otherwise a valuation will be made by the Valuer General.

Assets other than land may be valued by persons competent to value the assets concerned.

If a donor makes a gift in which he reserves a benefit for himself the value of this gift would still be included in his assets for Estate Duty purposes.

The duty on a particular gift depends on the value of that gift when added to the value of all other gifts made by the same donor to one or to more than one person within a period of 12 months, either before or after that gift.

Duty is not payable when the value of the gift or that value when aggregated with the value of other gifts within the period does not exceed £1,000. A donor may therefore make a series of duty-free gifts of £1,000 if he is careful to see that the individual gifts are separated in time from each other by not less than 12 months.

Here are a few examples of Gift Duty:

<table>
<thead>
<tr>
<th>Gift Value</th>
<th>Duty Payable</th>
</tr>
</thead>
<tbody>
<tr>
<td>£1,000 or less</td>
<td>Nil</td>
</tr>
<tr>
<td>£2,000</td>
<td>£95</td>
</tr>
<tr>
<td>£5,000</td>
<td>£425</td>
</tr>
<tr>
<td>£10,000</td>
<td>£1,375</td>
</tr>
</tbody>
</table>

Ten gifts of £1,000 each at yearly intervals over a ten-year period would thus save £1,375.

A gift is not complete until the donor has put himself in the position where he is unable to revoke it; on the date a cheque is cashed; or the date of execution of a legally effective deed of release or forgiveness of the debt.

Gifts made within three years of death still form part of the dutiable estate of the donor. So for a gift to be taken completely out of the estate of a donor the last gift must be made at least three years before the death of the donor.

Gifts made during the lifetime of the donor to any charitable organisations or the creation of charitable trust are effective from the date of the gift and do not attract gift duty.

**Estate Duty**

In these days of high taxation it is essential that farmers are conscious of the value of their assets and how death duties are imposed.

A man who dies domiciled in New Zealand, is liable for death duties on all his personal property wherever situated and on all his real property situated in New Zealand.
Real property is land and all the improvements situated on it. For the basis of estimating the duty position, land should be taken at the figure for the last Government valuation.

Personal property includes everything else a man can own such as livestock at market value, money, furniture, stocks, shares, vehicles, jewellery, etc.

In addition to the assets a man owns at the date of his death, he may have to pay duty on numerous other assets including:

(a) Gifts made within three years of date of death.
(b) Gifts whenever made if the donor has reserved any interest whatever for himself.

All the assets are totalled up and the liabilities for which the deceased got money or money's worth are deducted. The figure finally arrived at is known as the Final Balance. On this balance, Estate Duty is levied at the rates laid down.

Since 25th June, 1964, the following scale of Estate Duty has operated:

<table>
<thead>
<tr>
<th>Final Balance of Estate</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>£4,001-£5,000</td>
<td>5% of excess over £4,000</td>
</tr>
<tr>
<td>£5,001-£6,000</td>
<td>£50 plus 7% of excess over £5,000</td>
</tr>
<tr>
<td>£6,001-£7,000</td>
<td>£120 plus 9% of excess over £6,000</td>
</tr>
<tr>
<td>£7,001-£8,000</td>
<td>£210 plus 11% of excess over £7,000</td>
</tr>
<tr>
<td>£8,001-£9,000</td>
<td>£320 plus 13% of excess over £8,000</td>
</tr>
<tr>
<td>£9,001-£10,000</td>
<td>£450 plus 15% of excess over £9,000</td>
</tr>
<tr>
<td>£10,001-£11,000</td>
<td>£600 plus 17% of excess over £10,000</td>
</tr>
<tr>
<td>£11,001-£12,000</td>
<td>£770 plus 19% of excess over £11,000</td>
</tr>
<tr>
<td>£12,001-£14,000</td>
<td>£960 plus 15% of excess over £12,000</td>
</tr>
<tr>
<td>£14,001-£16,000</td>
<td>£1,260 plus 17% of excess over £14,000</td>
</tr>
<tr>
<td>£16,001-£18,000</td>
<td>£1,600 plus 19% of excess over £16,000</td>
</tr>
<tr>
<td>£18,001-£20,000</td>
<td>£1,980 plus 21% of excess over £18,000</td>
</tr>
<tr>
<td>£20,001-£22,000</td>
<td>£2,400 plus 23% of excess over £20,000</td>
</tr>
<tr>
<td>£22,001-£24,000</td>
<td>£2,860 plus 25% of excess over £22,000</td>
</tr>
<tr>
<td>£24,001-£26,000</td>
<td>£3,360 plus 27% of excess over £24,000</td>
</tr>
<tr>
<td>£26,001-£28,000</td>
<td>£3,900 plus 29% of excess over £26,000</td>
</tr>
<tr>
<td>£28,001-£30,000</td>
<td>£4,480 plus 31% of excess over £28,000</td>
</tr>
<tr>
<td>Rising in steps to</td>
<td></td>
</tr>
<tr>
<td>£80,001-£85,000</td>
<td>£28,800 plus 53% of excess over £80,000</td>
</tr>
<tr>
<td>£85,001-£90,000</td>
<td>£31,450 plus 55% of excess over £85,000</td>
</tr>
<tr>
<td>£90,001-£95,000</td>
<td>£34,200 plus 57% of excess over £90,000</td>
</tr>
<tr>
<td>£95,001-£100,000</td>
<td>£37,050 plus 59% of excess over £95,000</td>
</tr>
<tr>
<td>Over £100,000</td>
<td>40%</td>
</tr>
</tbody>
</table>

The family exemptions from estate duty apply:

(a) Widow—£15,000 Or there shall be deducted from the total duty an amount bearing the same proportion to the total duty as the value of the
(b) Infant  £500 interest bears to the final balance.

The exemption can be partly in the capital of the estate and partly from a life interest in the capital.

The Case for Planning

By carefully planning his affairs a farmer can reduce the amount of his annual tax bill and also so arrange his affairs during his life-
time that he reduces the final balance of his estate on which duty is levied.

Just how far one should go depends on the individual circumstances and it is here that the wise farmer arranges to discuss his affairs with his accountant and his solicitor. Most arrangements require very careful planning and that the arrangements be legally documented.

There is nothing improper in any person so ordering his affairs that there is paid by him in his lifetime and by his executors at his death as little as is legally possible to the Inland Revenue Department.

Lord McNaughton said in 1911: "No one may act in contravention of the law but no one is bound to leave his property at the mercy of the Revenue Authorities if he can legally escape their grasp."

In Commissioner of Stamp Duties V Card in 1940, Mr Justice Johnstone said: "Every man is entitled, if he can, to order his affairs so that the tax attaching under the appropriate Acts is less than it otherwise would be. If he succeeds in so doing then however unappreciative the Commissioner may be, he cannot be compelled to pay more."

In Marquiss of Devonshire V Royal Bank of Scotland, 1953, the House of Lords decided: "That a scheme having one of its main objects the limitation of Death Duties was approved."

In this case Lord Justice Denning said: "People of full age and understanding are entitled to arrange their affairs so as to reduce the incidence of Death Duties on their successors." Lord Denning has only recently been to New Zealand.

Examples of Estate Duty

On an estate of £25,000 the duty without exemptions would amount to £3,630. If the widow's interest qualifies for the £15,000 exemption, the amount of duty is reduced by £2,178, to £1,452.

On an estate of £30,000 the duty without exemptions would amount to £5,100. If the widow's interest qualifies for the £15,000 exemption, the amount of duty is reduced by £2,178, to £1,452.

On an estate of £40,000 the duty without exemptions would amount to £8,800. If the widow's interest qualifies for the full exemption of £15,000 the amount of duty is reduced by £3,300, to £5,500.

This exemption would only apply if arrangements were made with the solicitor to take full advantage of the widow's exemption of £15,000 for as long as possible by a periodic review of your will.

The point of retirement or semi-retirement, would depend on many factors, including health, age, family, responsibilities, etc.

When purchasing a house, consideration should be given to making it a joint family home. An existing home can also be converted into a joint family home. Under this Act if one of the joint tenants dies in the lifetime of the other joint tenant the value of the half interest in the home of the joint tenant who dies is excluded from his or her dutiable estate except to the extent to which that value exceeds £4,000.
If the estate was £25,000 and this figure included a joint family home valued at £8,000, and the full widow’s exemption of £15,000 applied, the amount of duty would be reduced by £1,241 to £211.

If the estate was £30,000 and this figure included a joint family home valued at £8,000, and the full widow’s exemption of £15,000 applied, the amount of duty would be reduced by £1,640 to £910.

If the estate was £40,000 and this figure included a joint family home valued at £8,000, and the full widow’s exemption of £15,000 applied, the amount of duty would be reduced by £2,440 to £3,060.

Retirement

After a period of years, retirement should provide sufficient for a house, furniture, car, a regular income from mortgage or other investments to give a reasonable to good standard of living during the years of retirement.

Where a taxpayer retires from the business of farming, the excess income arising from the sale or other dispositions of livestock may now be spread either forward or backward for three years.

If he sells his farm and buys a smaller holding he cannot be said to have retired and excess income from sale or other disposition of livestock could only be spread backward for three years.

A Typical Example

Let us now take a typical example of a medium sized farm of say 300 acres with a

| Government valuation of | £25,000 |
| Stock and plant          | 12,000  |
| Life insurance policies, including bonuses | 4,000 |
| Motor car, furniture, effects, etc. | 2,000 |
| Investments and cash in bank | 3,000 |
|                         | 46,000 |

| First mortgage | £5,000 |
| Other liabilities | 1,000 |
|                 | 6,000 |
|                 | £40,000 |

Average annual income including interest investments of £50 | £3,500

Let us assume that personal exemptions are as follows:

Farmer, wife, son aged 17 and daughter aged 15.

Annual insurance premiums £150.

Taxation and Estate Duty payable in various situations are set out in Tables A and B (pages 115, 116). Together these show the effect of the planning possibilities discussed in the sections which follow.

Redistribution—Wages and Bonus

If wages of £500 per annum were paid to the son their total taxation would be reduced from £926 to £757. If in addition, the son received a bonus of £500 total taxation would amount to £656.
Partnership

If instead of a bonus the son received a wage of £500 and as part of his remuneration was able to purchase the ewe lambs or heifer calves which were required for replacing the flock or dairy herd. If this stock changed hands at birth or at a young age, the value would be low. Inside four or five years the son would own most of the farming stock. The farmer and his son could enter into partnership, the farmer contributing the land and the son the stock. After providing a fixed return for the effort of each partner the balance of the income could be distributed on the basis of the capital contributed. Under this method of partnership the stock is transferred but the value of the land for transfer is not fixed and the son would have to purchase later, possibly in increased capital value.

If the farm is in two blocks, sell one block to either your wife or your son at Government valuation and take a mortgage back for the full consideration. The farmer can then proceed to gift the mortgage from time to time in such amounts as he decides provided that each gift is properly evidenced. The sale fixes the value and prevents the estate growing in value.

The farmer and his wife or son could enter into partnership—this has the advantage of sharing the income and easing the tax burden. It also shares the estate assets. To be effective the assets introduced by the wife must be substantial and the hours contributed must be reasonable.

Other variations of partnerships include bailment of livestock, leasing of defined areas for cropping, rearing of pedigree stock.

Company

It may be advantageous to sell the farming property to a company. A trust may be started by a relative or friend settling say £10 for the benefit of your wife and family. There should be two or three trustees who accept responsibility for the due performance of the trust. There can be more than one trust if necessary. The trustees can arrange to take up the whole or part of the shares in the company. The company can then lease the property back to the farmer.

Where properties are held by different members of the family, this land can be leased to a partnership, each member receiving a rental to cover a return on the value of the property, plus outgoings of rates and insurance. After allowing the member of the family working the property wages for his effort, the partnership profits are then shared between the owners of the land on an agreed basis. You could also provide in the partnership agreement that in the event of death the surviving partner could purchase the interest of the deceased member in the partnership at the book value shown in the last balance sheet prior to death, plus interest at say five per cent from the date of the last balance sheet. Such a clause would avoid the necessity of taking special accounts and would give the survivor an advantage on taking over the property.

Trusts

Schemes involving trusts are most apt where the paramount consideration is the protection of a wife, and for infant children. There
is an infinite variety of trusts and these can bring into the picture both partnerships and company formation.

If the company purchased undeveloped land from the farmer it could give the mortgage back for the full amount of the purchase money, interest free if the mortgage is to be repaid at call. There would have been an actual sale—the mortgage could be gifted to the trustees over a period of years depending on the urgency of the situation. The farmer may prefer to make a cash gift each year to the trustees and they could decide to reduce the mortgage—each transaction would need to be a separate one.

Having finalised the purchase of part or all of the property the company could then arrange with the farmer to either—

(a) Rent the property back to him and avoid any disturbances of the farming operations.

(b) Enter into partnership with him sharing profits in relation to the value of the assets introduced.

(c) Acquire livestock at a young age and derive the income from farming the property after paying the farmer a salary for his services.

If there is a likelihood of the income of the trust becoming high, there should be a provision to enable the trustees to retain income and if necessary, use capital or income at their discretion for the purpose of setting up reserves, for debt reduction, or making improvements for education maintenance of any one or more of the children to the extent decided by the trustees.

Take shares in companies whose objects are allied to the farming industry. Make advances to beneficiaries with or without security or interest. Take up life policies on lives of beneficiaries or the settlor or any other person.

Life insurance premiums are good exemptions for income tax. They make an attractive investment but not too good for estate duty purposes because they increase the duty.

The trustees could arrange either to take over existing life insurance policies or arrange new policies on the life of the farmer. The debt for the purchase price of the existing policies could be by way of mortgage and this could be either gifted or paid off over a period of years. The insurance cover would provide funds outside the estate which would be available in case of need to pay death duties.

Either retained income or a capital gift from the farmer each year could provide cash to pay the annual premiums.

If more than one trust is set up with different trustees and different beneficiaries, additional exemptions are available.

The disadvantage of a trust can be that you have to part with the control of your asset. As unless the donor divests himself of all control of the asset there is the risk that it could be brought back into the estate on his death and at the value as at the date of death.

Advantages and Disadvantages of a Company

In certain cases advantages can come from the formation of a company to hold the land. The property would be sold to the company at Government valuations or a special valuation if required by the Duties Division, thus fixing the value of that part of the estate.
Shares are issued for say half the value of the property and a mortgage taken for the balance. Should the farmer die, an outside mortgage can generally be raised and the proceeds applied to repay the mortgage to the deceased estate, thus making cash available to meet Estate Duty.

The farmer is also in the position to gift shares in the company or he may elect to gift part of the mortgage to reduce his estate for the ultimate benefit of his family. Any cash repaid in reduction of the mortgage can provide cash for living expenses if required in the later years of a farmer's life.

If a gifting scheme is to be spread over a period of years the value of the shares will vary with the increase or decrease in the value of the land. An amount due under a mortgage is a debt and does not fluctuate.

The shares in the family company can be taken up by members of the family or by a trust for the family.

The capital of the company can if necessary, be divided into ordinary and preference shares. The latter shares would return a fixed rate or dividend. Their value would not increase. If retained by the farmer they could be gifted or left as he wishes under his will to say, daughters in the family. On the other hand the ordinary shares will fluctuate in value and if held by a trust would be a means of transferring assets that would otherwise have increased the value of the farmer's estate.

If there were more preference than ordinary shares and the farmer held the preference shares and all the shares had a vote, he could retain control of the affairs of the company at the same time as transferring a most valuable part of his estate. The growth in value of the property would all go to the ordinary shares.

Over a period, the farmer can sell some or all of the stock to the company depending on the difference between his standard value and the market value.

It would also be possible for the company to lease the land to the farmer or to a partnership or to a trust. The company would receive a rental for the property; this would spread the income received from the farm and reduce the total taxation paid.

The main advantages of company formations are:

(a) Limited liability for its members.
(b) Continuity of business need not be affected by the death of a farmer.
(c) Transfer of shares is easier than partitioning off the land.
(d) Simple means of reducing estate and at the same time retaining control of the farming operations.
(e) You can still create a trust and transfer shares to the trust.

The main disadvantages are:

(a) That there is more work for your hard working accountant to attend to. The company is a separate entity. Minutes of meetings are required and returns have to be filed with the Registrar of Companies as well as with the Inland Revenue Department.
(b) Liquidation of a company can be costly, whereas on the devolution of a partnership, estate or trust, there is not the same difficulty or expense that arises on the dissolution of a company.
(c) Company structures as well as being rigid can be carried on too long. Changes in legislation, in tax patterns and in personal circumstances are difficult to forecast. A trust deed through clauses giving discretionary powers to trustees can provide a greater measure of elasticity.

(d) Legal fees and disbursements are payable on the transfer of a property to a company.

What Are Your Aims?

Depending on whether you are seeking a livelihood or creating an asset to pass on to your children, know where you are going. Farming is a big business and should be planned and managed as any successful city-business has to be.

Family happiness is much more valuable than the financial impact of death duty, so in reviewing your position also review your will and exercise care to see that personal values are not set aside merely to reduce estate duty.

Never put yourselves in the hands of your children. However devoted and united a family may be there are such things as marriages, early deaths and difficult in-laws.

After taking all the above factors into account it is always advisable to fully discuss with your accountant and your solicitor any contemplated scheme to pass assets on to your family.

<table>
<thead>
<tr>
<th>TABLE A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example Cited</strong></td>
</tr>
<tr>
<td><strong>Net Income</strong></td>
</tr>
<tr>
<td><strong>by Farmer after Taxations</strong></td>
</tr>
<tr>
<td>£</td>
</tr>
<tr>
<td>1. Farmer receives all income</td>
</tr>
<tr>
<td>2. Farmer pays son £500 wages</td>
</tr>
<tr>
<td>3. Farmer pays son £500 wages plus £500 bonus</td>
</tr>
<tr>
<td>4. Farmer and son in partnership. Profits farmer £2,000, son £1,500 (Code “S”)</td>
</tr>
<tr>
<td>5. Farmer pays £500 wages to son and £1,000 rent to company</td>
</tr>
<tr>
<td>6. Farmer holds all shares but 1 in company. Receives £2,000 salary and £1,072 dividends</td>
</tr>
<tr>
<td>7. Farmer and wife each hold 50 per cent shares in company. Salary £2,000 and dividends 2 x £536</td>
</tr>
<tr>
<td>8. Farmer holds all 5 per cent preference shares (£1,000) and trust all ordinary shares (£500). Salary £2,000. Dividends £1,072</td>
</tr>
</tbody>
</table>

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**TABLE B**

**Estate Duty Payable in Example Cited**

<table>
<thead>
<tr>
<th>Duty payable</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In examples 1-4 in Table A:</td>
<td></td>
</tr>
<tr>
<td>(a) Estate duty on £40,000 (widow's and infants' exemptions)</td>
<td>5,280</td>
</tr>
<tr>
<td>(b) If Government valuation had increased to £29,000 at death, estate duty on £44,000 (widow's exemption only)</td>
<td>6,960</td>
</tr>
<tr>
<td>2. In example 5 of Table A, where the property has been sold to a company at the Government value of £25,000 subject to the existing mortgage of £5,000 and the farmer has accepted a mortgage for the debt due of £20,000.</td>
<td></td>
</tr>
<tr>
<td>(a) If farmer dies after sale was made</td>
<td>5,280</td>
</tr>
<tr>
<td>(b) If farmer dies five years after sale and trustee holding shares in company has applied net dividends of £750 per year and farmer has gifted £1,000 per year in reduction of the mortgage. Estate duty on £31,250 (widow's and infants' exemption)</td>
<td>3,587</td>
</tr>
<tr>
<td>(c) If farmer dies thirteen years after sale was made and trustee has applied net dividends of £750 per year for 13 years and farmer has gifted £1,000 per year for ten years in reduction of the mortgage. Estate duty on £20,000 (widow's exemption only)</td>
<td>972</td>
</tr>
<tr>
<td>3. In example 6 of Table A the position is similar to No. 1 above.</td>
<td></td>
</tr>
<tr>
<td>4. In example 8 of Table A where the property has been sold to a company in which farmer holds all the 5 per cent preference shares of £1,000 and a trust all the ordinary shares of £500.</td>
<td></td>
</tr>
<tr>
<td>(a) If farmer dies after sale was made</td>
<td>5,280</td>
</tr>
<tr>
<td>(b) If farmer dies five years after sale was made and the farmer has gifted £2,000 per year in respect of the debt due by the company he has paid gift duty of</td>
<td>475</td>
</tr>
<tr>
<td>Estate duty on £30,000 (widow's and infants' exemptions)</td>
<td>3,815</td>
</tr>
<tr>
<td>(c) If farmer dies thirteen years after sale was made and the farmer has gifted £2,000 per year in respect of the debt due by the company he has paid gift duty of</td>
<td>950</td>
</tr>
<tr>
<td>Estate duty on £20,000 (widow's exemption only)</td>
<td>972</td>
</tr>
</tbody>
</table>