

PASTURE MANAGEMENT AND ANIMAL PRODUCTION

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I have had the privilege of attending this Conference for 30 years. I treasure the Association as it has enabled me to be associated with many of New Zealand's pastoral farmers, researchers and extension workers.

The soil/plant/animal complex of pastoral farming is not an easy topic to cover under the heading of "Pasture Management and Animal Production", especially when I have been asked to cover developments and progress since the formation of the Association.

For convenience, a review of this large topic for New Zealand may best be dealt with in three sections -- first, a look at farming 50 years ago, then at the present situation with a discussion of some of the developments that have occurred over the past 50 years, and lastly a brief look ahead.

THE SCENE AROUND 1930

In the early 1930s there were 23 cows milked on the average dairy farm. Per-cow production "at the pail" was approximately 90 kg. Of significance, there were nearly 72 000 dairyfarmers in the 1933-4 season who milked about 1.67 million cows.

In terms of pasture management, set-stocking was the rule over most of the farm, as were night paddocks. Paddocks were large and few in number. Hay and root crops were the main winter feed and in some districts maize was grown for summer feed. These were often hand-harvested or pulled or cut, then sledged to the cows. Horses were still in their hey-day. Silage was a new thing. Half the herds were still hand-milked and all were hand-stripped. As well, the farmer frequently took his own milk to the factory, although collections were organized for some factories. Many cows were covered in the winter. Concrete was not common and for most electric power was just around the corner. Stock water came mostly from natural sources or dams. Dairy cattle quality was not high and improvements had not really started. Stock problems such as mastitis and abortion were very prevalent. There were no income taxes.

The average sheep farm in 1930 is a much more difficult entity to describe. Sufficient to say that the average number of sheep (all classes) per farm was 1027, and average fleece weights were about 3.47 kg. About 8% of all stock were lost annually and lambing percentages averaged about 85%. There were approximately 17½ million breeding ewes.

Obviously there were marked differences in size and complexity of sheepfarming operations from one region of the country to another, with a wide range of carrying capacities and production levels. Importantly, the level of technology in sheep farming was similar to that in dairying, especially in pastures and stock management. As a general rule, pasture quality was low because of uncontrolled spring and summer growth. Pastures were often weedy, especially with blackberry, gorse, ragwort and manuka, and legume contents were also generally low. In the farming journals of the day there were records of partial control of ragwort by the release of the cinnabar moth, and insect control of weeds such as piripiri was also under study. Poor legume contents and low quality pasture growth led to some major stock problems, not the least of which was autumn ill-thrift in hoggets. Again stock quality was not high. A couple of other statistics of interest: The number of shearing stands around 1930 was 21 500 or about 30% of the present-day total. The tractor was also in its early days, there being nearly 4 000 in farming. Compare this with nearly 100 000 to-day.

Cropping farmers in 1930 had more than half a million hectares in field crops. Much of the land cultivation was by horse-drawn implements; harvesting was by reapers and binders, then hand-stooking and threshing, usually with the steam-driven mill. Most of the 26 000 ha of grass seed in 1930 was harvested by strippers, then hand-bagged and dried on fences.

Yields at that time (tonnes/ha) were:

Wheat	2.08
Barley‡	2.34
Maize	2.66
Ryegrass*	0.47
White clover	0.19

This, then, was part of the farming scene in the early 1930s. Since then there have been tremendous developments that have resulted in large advances in production. Interestingly, many of these began to take shape around 1930 when the N.Z. Grassland Association was formed. It was probably because of this, together

with the need for a forum for discussion, that prompted the Association's formation. The early proceedings and similar volumes of other farming journals of the last 50 years outlining these developments make fascinating reading. Some are briefly outlined in the following.

SOME SIGNIFICANT DEVELOPMENTS SINCE 1930

A couple of years either side of 1930 saw the introduction of strain development in pasture plants by people such as William Davies and E. B. Levy, and seed certification by J. W. Hadfield and others. These developments quickly caught on and have been strongly supported by most involved in pastoral farming ever since.

However, strain development was not accepted readily by all. For example, controversy over the value of white clover quickly started. The late Dr H. E. Annett, a stalwart of this Association, in 1935 wrote, "White clover is a much over-rated plant which does not greatly increase soil nitrogen". There were others and they provoked E. Bruce Levy (1935) to write an article entitled "Mr White' Clover on Trial". In it he strongly defended white clover and its place in farming. These days there is certainly no argument.

Sir Bruce's interest in white clover and its value in soil fertility build-up continued until he retired in 1950. He interested people such as the late P. D. Sears in soil fertility studies, and, in co-operation with others, they quickly put white clover in perspective. This work also showed the undesirable aspects of day and night paddock grazing and the value of dung, urine, fertilizers, and the clover plant in fertility build-up under grassland farming (Sears et al., 1955).

A little earlier than 1930 there is a record of controlled pasture growth being used in farming in New Zealand — in fact, in 1921. However, the first results outlined in the *Proceedings* of this Association were those reported by Connell (1931), although Scott and Hudson published elsewhere in 1928 on the value of rotational grazing. Connell quoted the results of some English research which showed the relative differences in yields resulting from weekly and monthly grazings as 100 and 269, respectively.

As stated by Connell, this occurred without affecting the nutritive value of the feed from the monthly spelled pastures.

Questions being asked at that time were:

- (1) Just how closely should pasture be eaten before stock are removed?
- (2) What should be the length of the period of 'spelling' between periods of grazing?

Many are still asking these questions, especially for pastures of different botanical composition.

It appears that rotational grazing was first put into practice in New Zealand in 1928 on a Mr Ward's property at Manawaru. In 1931 on J. Spall's property at Whakaronga, Manawatu, production went from 159 to 216 lb of butterfat/acre by the introduction of rotational grazing (about 30 grazings a year).

Between then and now there have been major developments in systems of pasture management with the advantages of rotational grazing over set-stocking finally being accepted as of value to animal production following the paper presented by the late Dr McMeekan (1960) at the International Grassland Congress at Reading, England. Significantly there are strong interrelationships between systems of management and stocking rate. It is usually only at higher stocking rates that rotational grazing becomes important, a finding that is again being illustrated in hill country pasture development (Fitzharris and Wright, 1981).

In 1930 there were approximately 450 000 tonnes of superphosphate and 180 000 tonnes of slag applied to approximately 950 000 ha of pasturelands. The need for these elements was then beginning to be widely recognized.- Compare this with present-day trends where approximately half the sown grassland receives fertilizer annually to a total quantity of around 2.4 million tonnes (1978). Approximately one half of this annual amount is now applied by the aero'plane, a post-war development.

Interestingly, in reading back through farming journals and annual proceedings of various conferences, the need for lime was regularly advocated. Statements such as "Insufficiency of lime in the soil is responsible for the partial failure of many crops" . . . or . . . "The absence of clover and the presence of poor grasses indicate a deficiency of lime in the soil" (*Exporter*, July 1929) are regularly featured. In the October 1934 issue of the *Dairy Exporter*, the need for lime and phosphate to solve the pakihī problems of the West Coast as demonstrated by the Cawthron Institute was being strongly advocated. As well, the virtues of lime for better animal performance were regularly stated, not the least noteworthy being the late Lord Bledisloe when he spoke

to the New Zealand Grassland Conference in 1934. He strongly advocated the need for more lime.

There are still many unsolved areas of understanding with respect to phosphate and lime and their value and use in pastoral farming. Perhaps more successful has been our appreciation of the value of trace elements in animal production. The use of copper and cobalt, through the work of Aston, Filmer, Underwood and others around 1930 to cure bush sickness, was a dramatic example. Equally successful has been the introduction and use of other elements such as potassium, magnesium, molybdenum, and selenium for enhanced pasture and animal production.

Around 1930 there were about 7.5 million hectares of sown grassland. To the present time this has increased by about 15 to 20% to near 9 million. Thus about 1.5 million hectares of land have been developed for farming this past 50 years and probably just as much or more redeveloped from secondary growth of manuka, fern and scrub. It seems to be a continuing cyclic process in some regions, especially North Island hill country frequently dependent on subsidy or incentive schemes. The technology around this development as outlined by Sears *et al.* (1955) and Cullen (1958, 1966) has been of major significance, especially the understanding of the principles of pasture establishment in relation to legume inoculation and fertilizer requirements in difficult environments such as the central pumice regions of the North Island and the Te Anau regions.

Many other developments could be commented upon, such as those that have occurred in conservation of surplus feed to hay or silage; in weed and pest control; in electric fencing; in water reticulation systems on farms; and in farm irrigation and drainage. Similarly, there have been major developments in animal management. To name a few: artificial breeding; non-stripping of the dairy herd; the use of penicillin and other drugs in stock care; planned and synchronized mating; and so on. In farm management, farm plans have become very sophisticated and efficient in terms of labour, etc., economic planning has evolved well beyond a few figures on the back of the tobacco packet, and farm mechanization has become very sophisticated, in some situations perhaps too much so.

There have been some "fizzers". A.I.V. silage was being strongly advocated after World War 2, as was sodium bisulphite as an additive. The buck-rake came and went and the usefulness of practices such as harrowing and topping has received backing at different times. One interesting quote reads as follows: "Har-

rowing spreads bacteria carrying soluble animal manure over the sward and keeps roots healthy". Similarly one was a little surprised to see the following being advocated as cures for bloat in the 1930s:

"2 tablespoons of kerosene in a pint of milk."
or "2 oz of hydrochloric acid in 400 gals of water."
or "Dab the back of the throat with tar."

Grass drying also came and went. At one time it was being seen as an export earner (Callaghan, 1935). While reading back, some impressive product prices were observed — e.g., cows selling for £7, a 140 acre dairy farm near Feilding at £22.10.0/acre, a 1939 Morris "25" at £495, an electric fence charger + batteries at £10.15.0, or one that took my eye, an instant sanitary hygienic and odourless CASCO lavatory for £4.15.0. Also enjoyable was an advertisement in a 1939 issue of the *Exporter* by the Clydesdale Horse Society which read: "Petrol Price Up — Farm Costs Up Again — There's No Tax on Horse Feed." Shades of today! There were many others.

In the late 1940s and early 1950s there was considerable concern at our abilities to compete with synthetic fibres and margarine. Many expressed these fears. In the *Exporter* of 1 July 1954, the late Dr C. P. McMeekan stated that "in the long run New Zealand's ability to compete against synthetic fibres and margarine depends not upon economic and social palliatives but upon her overall efficiency of production". He went on to say, "As I see the position the New Zealand farmer has three major efficiency cards to play in any competitive struggle with synthetics. These are:

"(a) The untapped potential in the application of existing knowledge.

"(b) The inter-changeability of the major types of animal production.

"(c) The untapped potential in the application of future knowledge".

How true this has turned out to be. Significantly these three cards, supplemented by further research and practical knowledge, are still available to be played in our competition not so much with synthetics now but with our competitors in the production of animal products.

These, then, are but some of the developments in pasture and animal production that your organization has been associated with this past 50 years. They have led us to our present production levels.

THE PRESENT SCENE

Today the average dairy farm comprises about 70 to 80 ha on which 123 cows are milked. Per-cow production "at the pail" is 149 kg (about a two-thirds increase). Of significance there are now only about 17 000 dairy farmers, or less than quarter the number in 1930, milking more than 2 million dairy cows. It is a sophisticated operation and one with which you are all familiar. It needs no further amplification here.

The average sheep farm is again just as difficult to describe as it was for 1930. Expressed the same way as previously, the average flock size per farm is roughly 2 750, with average fleece weights of around 5.0 to 5.5 kg. This year the national lambing percentages are projected to be a high 98.5%. Since 1930, the national ewe flock has increased by nearly 30 million, an impressive development. More detailed breakdown of sheep production in different regions of the country is readily obtained from New Zealand Meat and Wool Boards' Economic Service publications.

Cropping farmers in 1977 had nearly 274 000 ha in field crops, of which 39 000 ha were in grass seed. Cultivation and harvesting methods are now very sophisticated and yields of different crops (tonnes/ha) are:

Wheat	3.67
Barley	3.65
Maize	7.34
Ryegrass	* 0.78
White clover	0.17

These data are significantly higher than those ruling in 1930, although the area in crop is now only about one half.

The data presented in Fig. 1 also give an indication of production trends this past 50 years in dairying. Each point on the graph is a top dairy farmer's production level at the date shown. They were obtained by reading back over national farming journals and noting the highest production levels of "success story" write-ups of "top farmers" at intervals over the last 50 years. It was not an exhaustive survey. Some of the farms were self-contained units, others were not quite so self-contained. In spite of the misgivings some of you may have on the approach taken to get the figures, the relationship shown, if real, is of interest.

In spite of these large increases in production from livestock farming and cropping this past 50 years, there has been some

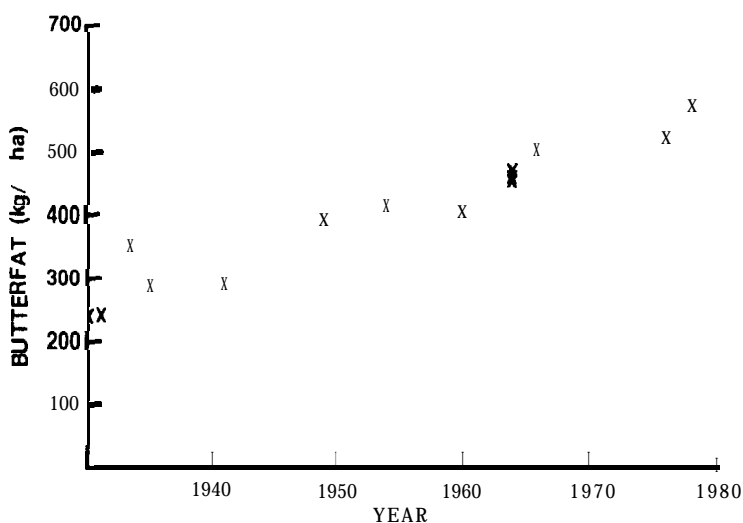


FIG. 1: Differences in production levels (kg butterfat/ha) of "top" commercial farms with time.

concern expressed at the apparent lack of production increases obtained in farming during the 1970s. The analysis produced by Taylor (1979) explains some of this apparent lack of progress through a diversion of land away from pastoral farming, equivalent to 9 million stock units, over the period 1967-1977. Based on these calculations, he argues that stocking rates on existing properties have increased by almost 12% during the 10-year period.

Climate also had an impact as climatic conditions were much less favourable during the 1970s than in the previous decade (Taylor, 1980). Just as significant would have been the withdrawal of DDT from pastoral agriculture, with a complete ban on chlorinated hydrocarbons by 1970. The cumulative effects of dry weather and grass grub and porina, especially in periods of feed shortage, for example, have had major effects on animal production in some regions.

During the 1970s some farmers made dramatic progress. This has already been illustrated at this and recent conferences by the production levels obtained by the farmers awarded Grassland Memorial Trust prizes.

These examples illustrate that, whereas national levels were almost static, some of the best farmers were obtaining substantial increases in production, significantly at the highest levels.

In the early 1970s considerable doubts were also being expressed by "authorities" and especially some economists, on the future sales potential of some of our farm produce. Of a consequence many farmers changed their farming patterns, at the expense of production increases. Some went from dairying to dairy beef, from sheep to dairy beef, from dairying to maize, and so on. It was a real mix up and bad advice. Let us hope it does not happen again so dramatically. The better farmers (perhaps the more stubborn) were not swayed and continued to increase production, as already outlined.

THE FUTURE

So much for the past and the present. What of the future? The scope for increased animal production over the next 50 years is very high. It will occur through the introduction of a wide range of management factors, some of which will apply existing knowledge, whereas further increases will be dependent on the application of future knowledge. The next section of this paper gives some examples of management factors likely to be involved in future developments of pastoral farming.

IMPROVED CULTIVARS AND NEW SPECIES

It is only at the highest production levels presently being recorded in farming that improved pasture cultivars are being shown to be of value in increasing production. The genetic potential of improved plants can only be expressed when management enables this to occur. That it will is illustrated by the data in Table 1. Experimental layout and details were as described by Brougham (1975). Two treatments were compared: (1) Old permanent pasture, and (2) 4- to 5-year-old pasture with Pitau white clover and Pawera red clover as the clover base.

TABLE 1: NET HOT CARCASS MEAT YIELDS (kg/ha) OBTAINED FROM OLD AND NEW PASTURES

<i>Year</i>	<i>Old Pasture</i>	<i>New Pasture</i>	<i>Difference</i>
1977-8	908	1052	146 (16%)
1978-9	844	938	94 (11%)

The grasses sown were Nui ryegrass and an experimental tetraploid perennial ryegrass.

All facets of management were the same for both farming systems.

Some very significant increases in meat production per hectare are shown, attributable mainly to the use of the improved clovers.

In other regions of the country other species could contribute to increased productivity as these cultivars and new species have in the Manawatu. But it is emphasized that this will only occur at higher levels of productivity where management systems allow the improved plants to express their genetic potential.

PASTURE MANAGEMENT

In our farming systems, the leaves and green parts of pastures trap and use up to 4% of incoming visible light in the photosynthesis process. It is a small percentage, with the amount utilized being influenced by many factors, including leaf canopy structure, chlorophyll characteristics, CO₂ concentrations in the leaf canopy, leaf temperature, and so on (Brougham, 1956). These in turn are influenced by the combination of species in the pasture, stage of growth and physiological stage of development, all of which are markedly influenced by grazing frequency and intensity and the impact of the grazing animal. Yet in nature some associations of organisms or plants trap up to twice as much.

There is plenty of scope, therefore, to devise systems of pasture management or to bring together combinations of species that will utilize higher proportions of incoming sun's energy and thus produce more feed per hectare for farm animals. To make such progress it could help to look back. Some of the work of the late Sir R. G. Stapledon (1924) and many others reported in the Series H publications of the Welsh Plant Breeding Station, together with the work of some of New Zealand's early ecologists, including the Cockaynes, could form the basis of some of this new research. It will involve the integration of a wide range of factors and interactions as they influence plant and pasture growth in the way Harris (1968) is demonstrating.

The application of such findings to farming practice will not be easy. There will be many facts and principles that will need to be put together in packages that can be readily understood by the practitioners (the farmers).

NUTRITIVE VALUE

Attendees of early conferences of this Association regularly discussed the need for increased nutritive value in feed obtained from pastures. Professor Riddett was one such person at the 1938 Conference. Facts are that in those days pastures were often poorly managed, and there was often much dead material

in the bottom of pastures. During the late spring and summer there was often much stemmy material and species in the pastures were often the less palatable low fertility demanding ones. Legume contents, as previously stated, were usually low.

We have come a long way since. Through systems of pasture management and species usage in many regions of New Zealand, the quality of feed eaten by animals throughout most of the year is now much higher. It could be higher when one compares the nutritive value of, say, white clover against the grasses, but especially when one compares the nutritive value of hili and high country pastures against lowland pastures. Major areas of progress are possible, provided adequate research is encouraged and is associated with the sensible application of management systems incorporating the best of results obtained from such research. There is little doubt that over most of New Zealand at any time of the year the feeding value of our pastures could be appreciably improved. Such improvement will be associated with major increases in productivity.

UTILIZATION

We do not utilize a high proportion of the feed grown each year on the average farm. The results in Table 2 show this. They are data presented by Hodgson (1977).

TABLE 2: ESTIMATES OF THE WEIGHT OF HERBAGE (kg DM/ha) BELOW WHICH HERBAGE INTAKE HAS BEEN SHOWN TO BE DEPRESSED IN CATTLE AND SHEEP

<i>Animal Type</i>	<i>Sward Type</i>	<i>Sampling Height</i>	<i>Intake Depressed Below (kg DM/ha)</i>
Lactating cows	Cocksfoot	Grazing height	1100
Lactating cows	Kentucky bluegrass/ clover	2 cm	1450
2-year steers	Perennial ryegrass	Ground	1900
Calves	Perennial ryegrass	Ground	2300
Merino wethers	Phalaris/clover	Ground	1100
Corriedale ewes	Phalaris/clover	Ground	1750
Wethers	Ryegrass/clover	Ground	1800

Data like this in relation to the problems associated with utilizing pasture on farms at different times of the year under all sorts of favourable and unfavourable conditions have prompted the advocacy of forms of cut-and-carry systems of utilization. If we are to obtain increased utilization of pasture on farms, we will

need to understand better and evaluate more thoroughly the many factors associated with utilization. These include assessments of physical factors of feed on offer to animals as influenced by length of spelling, species composition of pasture, size of individual components of the feed (leaf size), etc., the physical conditions of the soil at grazing, the duration of grazing in relation to mob or herd size at grazing, the physiological stage of development of the pasture, and the interactions between these and many other less obvious factors. All influence utilization. Once understood we will need to develop systems of management that obtain increased utilization of feed grown.

PLANT NUTRITION AND SOIL FERTILITY

Mention has already been made of nitrogen fixation, nitrogen cycling, phosphate and lime usage, and the significance of these on pasture management practices and hence animal production. Our understanding of these and other aspects of soil fertility and plant nutrition in pastoral agriculture are improving all the time. Some of Roger Ball's (1979) recent work has shown, for instance, that the grazing animal is not really an aid in soil fertility build-up as previously thought (Sears *et al.*, 1953). Rather it has a strong influence on the leaching and volatilization of nutrients through concentrating these in dung and urine. The impact of results such as these on methods of utilization of grass and their interaction with grazing, flock or herd management, and fertilizer usage, could be very large indeed.

Based on these and similar results, one can envisage the day when the level of fertilizer usage, for instance, will be more closely linked to the level of production desired. In other words, for given soil and environmental conditions growth responses from given amounts of applied fertilizer will be readily gauged. Within limits we can do it now for fertilizer nitrogen. With more research we should be able to achieve it with phosphate, lime and other nutrients. Because of the costs of fertilizers in farming these days, this should be high priority research.

PASTURE PESTS

What has the removal of chlorinated hydrocarbons from New Zealand agriculture cost us in terms of production? Grass grub, porina, stem weevils, beetles and flies of different names and types all act against farmers' productive efforts. These effects are not new, but their effects are large, in some regions very large

indeed, especially when the population of bugs becomes the limiting factor to production during periods of feed stress in droughts as occurred in the early 1970s or during periods of extreme and uncommon winter cold. At other times their effects can be strongly masked, as, for example, in years of abnormally good growth. As far ahead as one can see, control of pasture pests and for that matter pasture diseases will be by the integration of the different methods and approaches to control, as outlined by Kain (1978). Control through **the** development of pest-tolerant plant species will be a longer-term approach.

IRRIGATION

It is stating the obvious to say that plants need water to grow. It is also stating the obvious to say **that** in some regions of New Zealand there are through the year marked and sometimes prolonged periods of water deficit — e.g., the east coast regions of both Islands. In all regions, water limits growth during some period of the year. Yet New Zealand has only a relatively small area under irrigation, and in systems of irrigation that some consider are extremely wasteful of water. Our irrigation procedures and methods of application of water will improve. Some of the research being undertaken in different regions of the world and within New Zealand by groups such as Plant Physiology Division and at Winchmore highlights this. Importantly for many regions of New Zealand, the annual water deficits are only 150 to 250 mm (see *N.Z. Met. Service Misc. Publ. 141*, 1973). The challenge is to overcome these deficits with minimum losses, so that only small amounts of water will be required to sustain plant and pasture growth at high levels through the year. It is being achieved in some countries of the world — e.g., Israel. It could also be achieved in New Zealand (Kerr, 1977).

PLANT BREEDING

The' development of plants with better photosynthetic capacities, better and more efficient water and nutrient use (including phosphorus), higher and more regular nitrogen fixing capacities, increased nutritive value, and better tolerance to pests will occur through the efforts of geneticists and plant breeders. As they are produced they will need to be incorporated into farming in the different regions of the country under management systems that allow them to express their genetic potential. Unless this occurs,

there will be little point in introducing them.' But the better farmers will ensure it does happen and as in the past **they** will lead such developments.

ANIMALS

I was asked to talk to the topic "Pasture Management and Animal Production", and in doing so look back and also to the future. Most of the comments have been confined to factors influencing pasture production. However, when one looks ahead at possible developments in animal production in New Zealand farming, it is equally exciting. In the dairy industry we have seen major developments in milking practices and shed design. Does the future see completely automated milking parlours a reality?

Similarly we have seen tremendous developments in better feeding of livestock and in genetic improvement. The per-cow production data produced by the N.Z. Dairy Board over the past 50 years as shown in Table 3 illustrate this.

TABLE 3: CHANGES IN PER COW PRODUCTION (kg) WITH TIME

<i>Period</i>	<i>Per-cow Production 'at the pail'</i>
1930-35	102
1940-45	112
1950-55	116
1960-65	130
1970-75	128
1978-79	149

The Waihora Romney Flock Improvement scheme (Gibson and Craig 1980) is another good example of the possibilities of increased animal production through genetic improvement. The scope for further improvement is very large indeed because of the pool of high merit stock available in the sheep flocks and cattle herds of the country and the relative ease there is these days of obtaining desired semen from any country in the world, admittedly at a price.

Many other facets of animal production could be mentioned, including synchronization of mating and induced lactations, to better match feed supply, mineral supplementation for better stock performance, and improved stock health. All will have their bearing on future production levels. Similarly, there will be major developments in farm mechanization and automation that will have equally large impacts on future production levels. In the

next 50 years who knows what production levels will be achieved in the different farming activities? They will probably be at least twice present levels, and possibly much more. They will be achieved through much less physical effort but probably through greater mental effort, backed strongly by more intensive research and extension. The amount of information available, however, will be difficult to put together in one package for improvement. Perhaps this is a limiting factor even today and perhaps this is where the computer will have its major impact.

Although social and economic factors have not been mentioned, they have and will influence production levels in New Zealand farming. Facts are that, in reading back this past 50 years in the different farming journals, one is struck by the repetitive nature of comments around these factors. For example, in the *Exporter* in July 1929 it was interesting to read that machinery was displacing labour and that the right to work was being advocated as a basic right. And the silicon chip had not been developed then. Again, in the 1945 March and May issues, Sir Bruce Levy was advocating guaranteed prices for farm products and stabilized land values.

One that I appreciated is the one on which I shall conclude. It was from one of the late Dr McMeekan's addresses (1955). Commenting on product prices, farm costs, marketing and distribution of agricultural products in relation to increased production and incentives he said:

"By 1985 our leaders and those of other countries will either have solved the problem of distribution and marketing or no-one will be here to worry. There will be no dairy industry. We, our cows, and our farmers will have become victims of our own stupidity and will be slowly circumnavigating the globe as fine particles of radio-active dust".

1984 is not far away. Mac had obviously been reading George Orwell's book. The quote, I believe, expressed his frustration not at the prospects of increasing productivity — he was an enthusiast and born optimist — but at the world leaders' inabilities to rationalize global policies on marketing, distribution and pricing of agricultural products — sentiments we all share to this day, and look likely to for many decades ahead. However, in spite of them, our agricultural production will continue to increase and its development will be exciting. It will increase in all regions of the country and some of the major increases will come not only from the hill and high country but also from the lowland where there are tremendous potentials yet to be tapped.

There is also tremendous scope for the majority of farmers to reach the levels presently being obtained by today's top farmers. Looking at Fig. 1 again, if the relationship shown is meaningful, then today's average farmer (dairy farmer, at least) is producing at about the level of the top farmer in the 1930s — i.e., fifty years ago. So there is plenty of opportunity for further development of our livestock industries. Within limits these developments will not need too much planning or assessment, nor will they require too much target setting. All that will be necessary will be some independent and creative thinking, some hard work, and the right incentives.

SOURCES OF DATA

Most of the data presented in this paper were obtained from Farm Production Reports of the N.Z. Dairy Board, from publications of the N.Z. Meat and Wool Boards' Economic Service and from N.Z. Official Yearbooks. The incorrect values are mine.

REFERENCES

- Annett, H. E., 1935. *Exporter*, April: 41.
 Ball, P. R., 1979. Ph.D. thesis, Massey Univ., 217 pp.
 Bledisloe, Lord, 1934. *Proc. N.Z. Grassld Ass.*, 3: 22.
 Brougham, R. W., 1956. *Aust. J. agric. Res.*, 7: 377.
 ——— 1975. *Proc. Ruakura Fmrs' Conf.*: 65.
 Callaghan, F. R., 1935. *Proc. N.Z. Grassld Ass.*, 4.
 Connell, R. P., 1931. *Ibid.*, 1: 12.
 Cullen, N. A., 1958. *Ibid.*, 20: 68.
 ——— 1966. *N.Z. Jl agric. Res.*, 9: -363.
 Fitzharris, M. J.; Wright, D. F., 1981. *Proc. N.Z. Grassld Ass.*, 42: 213-6.
 Gibson, A. E.; Craig, E. L., 1980. *Proc. Ruakura Fmrs' Conf.*: in press.
 Harris, W., 1968. *Proc. N.Z. Grassld Ass.*, 30: 143.
 Hodgson, J., 1977. *Proc. int. Mtg on Anim. Prod. from Temp. Grassld*, Dublin: 70.
 Kain, W. M., 1978. *Proc. 2nd Australasian Conf. in Invertebrate Ecd.*: 172.
 Kerr, J. P., 1977. *Proc. N.Z. Agron. Soc.*, 7: 1.
 Levy, E. B., 1935. *Exporter*, Feb. 29.
 ——— 1945. *Ibid.*, March and May.
 McMeekan, C. P., 1954. *Ibid.*, July 1.
 ——— 1955. *Dairyfmg A. (Massey)*, 8: 7.
 ——— 1960. *Proc. 8th int. Grassld Congr.*: 21-6.
 N.Z. Met. Service Misc. Publ. 141 (1973).
 Riddett, W. M., 1938. *Proc. N.Z. Grassld Ass.*, 7.
 Sears, P. D.; Hyde, E. O. C.; Greenwood, R. M., 1955. *N.Z. Jl Sci. Technol.*, 37d: 110.
 Sears, P. D., *et al.*, 1953. *Ibid.*, 35A: Suppl. 1.
 Stapledon, R. G., 1924. *Welsh Plant Breed. Sta. Bull. Ser. H. No. 3*: 5.
 Taylor, N. W., 1979. *N.Z. Meat & Wool Boards' Econ. Serv. Paper No. 1818*.
 ——— 1980. *Ibid.*, Paper No. 1823.