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FARMERS' CONFERENCE '78








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AGRICULTURAL RESEARCH - PAST, PRESENT AND FUTURE

I.E. Coop
Professor of Animal Science, Lincoln College

Over this last week we have been celebrating the first hundred years of Lincoln College; in four years' time we will celebrate the centenary of the first shipment of refrigerated meat to Britain - a feat which revolutionised pastoral farming in this country. If there were any agricultural scientists in those days we do not know who they were; we do know there were no research stations. History repreated itself 60-70 years later, in the postwar years, with the white clover, superphosphate, high stocking rate revolution but this time there were both scientists and research stations.

Farmers, businessmen, and engineers - intelligent, observant resourceful and willing to risk provided the ideas and technological developments a century ago and indeed still provide the main thrust of our development. But now there are agricultural scientists especially trained to assist industry solve its problems and develop new techniques.

The provision of scientific services to agriculture on any reasonable scale began about 50 years ago in the 1920's when the D.S.I.R. was established to study plant breeding and soils, supplementing the Department of Agriculture's responsibility in soils and animal diseases. In the 20 years up to the War, the solution to bush sickness was found, new varieties of wheat were produced and there were important developments in the dairy industry but the most important of all was that the significance of the superphosphate/white clover, and the soil/plant/animal interations began to be understood. In the 1940's Ruakura devoted to animal research, was established as the M.A.F.'s major research station, since plant research was a D.S.I.R. responsibility.

The 20 years following the War, that is until the mid 1960's saw the great leap forward in pastoral production - a doubling of stock numbers and output. By great good fortune the two ingredients necessary for development were on hand - first, a new pastoral technology based on pasture improvement and full utilisation of herbage by the grazing animal, and second, good prices providing an adequate return sufficient to allow considerable on-farm investment. By the end of this period research had established improved systems of sheep and dairy cow nutrition and these were coming into practice to complement the developments in pasture production.

This happy state of affairs came to a fairly abrupt halt in the late 1960's, since when pastoral production has been relatively static. The causes of this have been discussed at length and at many levels. An inevitable offshoot of the self-examination has been a questioning of whether agricultural research is still a worthwhile investment by the nation. It is said that farmers are no longer taking up existing advanced technology and it is argued that therefore money spent on research could be better spent elsewhere.

THE PRESENT COST

At this stage we should examine how much research does cost. The total cost of government funded research in New Zealand is, in round figures, \$60 million per annum, of which agriculture accounts for \$27 million or 43%. Virtually all of the \$27 million is spent within M.A.F. and D.S.I.R. By the time expenditure in the Producer Board Research Institutes - Dairy Meat and Wool, and the universities is added the overall cost of agricultural research is probably about $30 million. The number of staff (scientists, technicians, clerks, farm staff etc.) involved in this expenditure is 2,000 (2031 in 1976) of whom approximately 600 are scientists. If we assume that there are 45,000 farms then there is one scientist for every 75 farms and the total cost per farm is $600-$700 or 30¢ per stock unit.

WHERE DOES TECHNOLOGY ARISE ?

In assessing the New Zealand research effort it is important to understand that technological developments on the land arise from a number of sources - from farmers themselves, from overseas and from our own research stations. For every New Zealand scientist there are around 100 farmers or farm managers each with a brain and a pair of eyes and these constitute a massive resource of observation, experience and initiative. While their role in the highly scientific area such as soils, plant breeding, animal nutrition and disease is minor they do make major contributions in farm mechanics, animal breeding and stock management. The introduction of prelamb shearing and double shearing,and the recent establishment of deer farming are examples of farmer initiative.

SCIENTIFIC RESEARCH IS INTERNATIONAL

We rely a great deal on research findings overseas especially in the United Kingdom and United States of America and Australia which have far greater resources. Weed and pest control chemicals, sheep and cattle drenches, farm motorbikes are examples of overseas research imported directly. But we also import scientific research knowledge and we must have a scientific service capable of interpreting this and capable of identifying any possible application in New Zealand. The use of selenium, which is worth millions to us each year arose from a discovery in the United States that selenium assisted in the prevention of white muscle disease in chickens. Within 12 months our scientists had correctly interpreted the significance of this and had demonstrated that selenium deficiency was a prime cause of ill-thrift in lambs and hoggets. The flow of technology is two-way. New Zealand scientists have been responsible for discoveries in artificial breeding, group breeding programmes and in sheep nutrition - developments which have now been adopted in overseas countries. If New Zealand is to be other than a South West Pacific backwater it has got to be in the field.

Lastly, we must have research services here in New Zealand to adapt overseas findings and to discover our own answers to the peculiar problems of this country. Our soils, climate, breeds of stock, our whole farming system, products, quality control and markets are unique to New Zealand and these problems can only be solved in New Zealand. While farmers can and do help, it is the scientists who must provide most of the answers. This is what the annual investment of $30 million is for.

I return now to the post-war boom and the relative stagnation of the last decade. If science is to take some of the credit for the boom, and I believe it should, then it cannot avoid taking some of the blame for the current stagnation. I believe that the two decades post war, which saw a two fold increase in pastoral output, constitute the greatest period in our history. Without the basic knowledge of the interactions of soil, plant and animal, and the part which molybdenum and sulphur as well as phosphate played we would certainly not have the pasture responses to aerial topdressing and the conversion to meat, wool and dairy produce which were in fact achieved. The returns from the application of agricultural research are so obvious that a cost benefit analysis is unnecessary. But I would be fooling myself if I did not attribute the major credit for the boom to favourable prices, the aeroplane and to men and women prepared to enter a new pioneering area.

WHAT WENT WRONG ?

I think we would all agree that the basic cause is the cost-price relationship. As far as the scientist is concerned he does not work in a vacuum. Enthusiasm is infectious, so is depression. He is now serving an industry from which some of the enthusiasm has departed. When farmers had money to reinvest in their farms they clamoured for technology, wanting to know how best so spend their money. When they have no money to spend they still seek technology but it is a different technology not the western style high-input high-output technology but more an Asian or African technology of how to survive with nothing. We have been geared to an expanding economy of continually increasing output, so research in general aims at greater knowledge, greater sophistication, greater inputs and increased outputs. It was assumed that the industry can accommodate greater input because the output will pay for it.

The scientist was even less prepared for this than the farmer. But he was not entirely unprepared. New breeds of sheep and new strains of existing breeds requiring less shepherding were already in sight, as were all-grass systems of pasture production and utilization. It is here worth reminding our critics that if pastoral output has not increased much of late at least it has been performed with considerably less manpower input - on the farms that is, but regrettably not true in the processing sector.

We must make allowances also that both the farmer and the scientist have had to contend with one of the aftermaths of pasture improvement during the 1950's - pasture pests and the withdrawal of the use of DDT. Both have also had to contend with new hygiene regulations, the scientist in the sense that considerable research funds have had to be diverted into meat and dairy produce hygiene.

I would not want to whitewash the immediate past and the current research service. There are quite a number of deficiencies. Any research organisation has research directors, or in the case of universities - professors, who are below expectation and have to be carried by the rest. Some research directors are in my opinion not sufficiently motivated towards the real problems facing the industry, some research workers hide behind more fundamental research work which one cannot prove will not ultimately be useful. I do not think that on average they are worse than in other countries, and we are at least fortunate in having some directors and research staff who are first class in any company.

There are deficiencies too in organisation. The splitting of agricultural research between two different departments, while it may have some advantages, does not create conditions for easy co-operation and for the creation of a multi-disciplinary attack on problems.

There is nothing new in these criticisms. They could also be levelled at other countries and organisations. The point is that there is room for improvement.

REDUCED REWARDS FROM RESEARCH

I believe that we have got to adjust our thinking to the fact that the dividends from research and not just agricultural research are likely to become less rewarding than hitherto. This is not to say that it will not still be rewarding but rather that it will be less rewarding than the exceptional dividends of the pre-1965 period, and that we cannot expect the scientists of today to continue the rate of progress of 20 years ago.

The first reason for this is that the easy things have been done and progress now demands much greater effort and sophistication. The obvious and easy things were done in the 1940-1970 period. If one pasture did not obviously have more dry matter than another, or if one group of sheep did not look better than another, then it didn't and that was that. A few measurements might be made to confirm visual appraisal. The 10-30% increases are now no longer there for the taking. Instead one is looking at 5-10% increases and these require more sophisticated methods to identify, observations have to stand up to statistical analysis or be put through a million dollar computer which, for reasons which still elude me confer upon the results a glamour young scientists find irresistable. This is of course an exaggeration but it does concern me that most important discoveries are in essence simple and that there is a trend towards thinking that equipment and money are a substitute for brains.

The energy crisis, and the possibility of an impending phosphate crisis, has also altered the economic feasibility of a sophisticated western style technology. Some research effort is therefore being diverted away from the 'more fertiliser - more grass - more stock' concept into alternative land use, forestry and farming plus forestry. This diversion must slow the rate of progress in the former, as well as lead into areas about which less is initially known.

A third factor is concern for the environment. The methods of our grandfathers are no longer acceptable in a society which has witnessed varying degrees of exploitation and is now placing greater emphasis on the inherent value of our mountains, forests and rivers. Concern for human health is also siphoning funds away from agriculture on a massive scale. One has only to think of what the banning of DDT has meant to us, and even worse what hygiene in the freezing industry is costing agriculture - an exercise which is incomprehensible to those of us reared on farm killed mutton.

The growth of manufacturing industry and the needs of this sector of the economy are also increasingly competing with agriculture.

For all these and many more reasons the relative singlemindedness of the research effort into pastoral production in the two decades following the War is being eroded, research effort is being diverted into simply maintaining the status quo and progress is being made more difficult. In as far as there is diversion into the processing of our primary produce this is good, and many here would hold the view that research into processing and transport may return greater dividends than research into producing more meat, wool, and dairy produce.

While I have painted a rather gloomy picture the same can be said of other areas of science and research. The rate of progress in for example synthetic fibres, plastics, steel, timber preservation, jet engines, motor cars is not what it was. They are equally caught up in the energy and environment problems and break-throughs do not occur with the frequency of 20-30 years ago. Further, the experience of the last 18 months has demonstrated that the manufacturing industries, forestry and other alternatives to agriculture are just as vulnerable as agriculture to the problems of access and political interference in marketing.

Let me return to the suggestion that if current technology is not being taken up by the farmers, then we can afford to reduce expenditure on agricultural research and transfer the money to research in other areas. This suggestion has been made in the agricultural press and I can assure you there are people just waiting for the transfer to be made. Firstly let us make quite sure that the statement of technology not being taken up is true. In my opinion it is only partly true. What is not being taken up as readily as before is the high input technology concept. Instead, in my experience, farmers are seeking those aspects of research which reduce or at least do not increase inputs. Secondly the farming sector and agricultural research have been under closer scrutiny and self-examination than other sectors. While self-examination is a necessary and healthy exercise, we must remember that in the absence of similar criticism in the other sectors the result is to penalise the virtuous and reward the self-satisfied. Agriculture should get its fair share of the total research monies whatever that is, - no more, no less, - and we are doing ourselves an injustice by repeating a belief that agricultural research is no longer a good investment.

Expenditure on research is both an act of faith and a gamble - an act of faith because we do not know for certain that there will be a return, a gamble because possibly only one project in ten yields a dividend and hopefully this dividend is sufficiently great to cover the cost of all the projects. Research is also long-term for it usually takes 10-20 years for the impact of research done now to be felt in industry. Consequently the transfer of research effort from one sector to another presumes that one can predict the relative importance of the various sectors 10-20 years ahead. It would be nice to pretend that we can put all our eggs into a smaller number of baskets, we cannot take the risk. What we can and should do is put more in some baskets than in others.

If this paper sounds like an apology for research and agricultural research in particular, it is not. It is an expression of my belief that we are going through a period of adjustment to an entirely different set of circumstances from those that pertained 20-30 years ago.

THE FUTURE

It is the view of my scientific colleagues in M.A.F. and D.S.I.R., and my view also, that if economic conditions would permit an adequate investment in farming, current and future developments in agricultural research could ensure that pastoral output could be increased by 50-100% within the next 20 years equivalent to over $1500m at present day prices. What other industry in New Zealand has this potential? There are many areas of promise - more efficient fertiliser application and utilisation, improvements in pasture utilisation especially on hill country, an understanding of the role of fungi in plant production and animal disease, breeding more productive breeds and strains of sheep and cattle, and plants with greater pest and disease resistance, increases in deer farming, development of low energy demanding systems to say nothing of improvements in products preparation and marketing.

CONCLUSIONS AND SUMMARY

* Most of the problems arise from the non-expansion of agricultural production and the general malaise of the country. This impedes the uptake of research findings which in turn leads to a questioning of whether further expenditure on developing new technology is justified.
* Research is becoming less rewarding in relation to the costs of research than in the past, but this is not peculiar to agriculture and extends over most fields of endeavour.
* The non-expansion hides the fact that research has made a considerable contribution to enable the farmer to maintain levels of production with less labour and less inputs.
* An adequate, highly trained research capability is an essential ingredient of a modern progressive State, not only as an insurance in solving problems as they arise, but also in giving a lead to future development.
* Although research may be less rewarding than hitherto there are many areas which show significant promise and justify a continuing research input. It is in times of difficulty that in fact it may be wiser to increase the input into research than to decrease it.

ENERGY USAGE IN AGRICULTURE

Sir Kenneth Blaxter
Director, Rowett Research Institute, Aberdeen, Scotland

In any walk of life it is sometimes a good idea to pause and think about some of the broader aspects of one's activities, and this applies particularly to farming. Farming, whether it results in the production of crops or livestock, is basically a process of harnessing the energy of sunshine through the photosynthetic machinery of the green leaf. When we talk about yields per hectare we are talking about the efficiency with which we use the sunshine that falls on that area. All the devices we use to increase output - irrigation, fertilizer application, tillage, crop improvement and adjustments of stocking rates - are designed to increase the efficiency of the capture directly by crops and grass, and indirectly by animals, of the solar energy that impinges on each and every hectare and to do so at economic cost.

SUPPORT ENERGY

In times past virtually the whole of farming's resources and inputs depended on the productivity of the land. Now however, inputs depend in addition on industries which service it and which use resources other than land and its associated sunshine. Time was when the power source on farms was the farm horse kept on farm land and the manure used represented the nutrients taken up by crops, fed to animals and conserved in yard manure. Now the tractor, artificial fertilizers and other agrochemicals are brought to the farm entailing the use of resources entirely outside farming. These resources are diverse but all involve the consumption of what may be called support energy. This term must be explained. Every good involves the expenditure of energy derived from the primary sources, coal, natural gas, oil, hot springs, hydroelectrical installations and uranium ores. Replacement of a horse by a tractor obviously entails an energy cost in terms of the annual requirement of diesel and lubricating oil to run it. In addition, it depreciates, needs repair and has to be replaced. The energy cost of building a tractor is considerable. Ores have to be mined and smelted, the steel forged, machined and fitted, rubber has to be harvested, processed, vulcanized and moulded, plastics have to be synthesized from hydrocarbons, extruded and moulded or machined. The energy cost of building a conventional tractor is equivalent to that present in about five tonnes of oil. Similar considerations apply to fertilizers. Phosphate and potash have to be mined and the rock ground. Manufacture of superphosphate involves the energy expensive step of sulphuric acid manufacture while nitrogenous fertilizers the even more expensive step of synthesizing ammonia from the nitrogen of the air. Every kilogram of nitrogen applied in fertilizer is equivalent to about two kilograms of oil.

The many goods and services reaching farms can thus be expressed in terms of support energy content rather than monetary cost. Accounting in terms of support energy is indeed similar to monetary accounting in being able to summate a whole series of resource inputs in a common way. Energy accounting is, however, free from vagaries in price due to market forces and inflationary changes and so is in some ways a better method of assessing long-term implications of technologies, and indeed does suggest what components of technologies warrant careful consideration if energy prices change.

SUPPORT ENERGY COSTS

Many studies have now been made of the use of support energy on farms in various parts of the world, in the United States of America, the United Kingdom, Australia, New Zealand, Israel, Canada, the Netherlands and elsewhere, while F.A.O. has recently taken a very broad look at the world as a whole (F.A.O. 1977). Dr. Pearson, at the Joint Centre for Environmental Sciences here at Lincoln College, has summarized many of the specific studies (Pearson, 1977) and he and Corbet (1976) have also examined energy in relation to New Zealand agriculture. I would like first to give a general account of our analyses of support energy use in farming in the United Kingdom, then deal with the broader issues of the overall cost of producing food, and lastly pose some questions about the future.

Table 1 summarizes the input of support energy into farming in the United Kingdom (Blaxter 1977; White 1977). The units used are no doubt unfamiliar - Joules times 10 raised to the power 15 per annum. The Joules is the watt-second, and each of the units thus represents 25,000 tonnes of oil.

The total expenditure of energy on our farms is between 3.5% - 4.0% of our overall United Kingdom consuption of fuel for all purposes. It will be noted that direct power and fertilizers contribute equally to the total. These consumption figures are extremely high. New Zealand's are considerably lower, largely due to the absence of a reliance on nitrogenous fertilizers and on intensive types of animal production. The same is true of Australia where per unit of product, support energy inputs are about a tenth of ours in the United Kingdom.

The analysis can be taken further to look at the whole system of producing food, that is taking into account the expenditure of energy in processing farm produce, distributing it and eventually cooking it in the home. This is given in the second table.

TABLE 1. ANNUAL SUPPORT ENERGY INPUT INTO UK AGRICULTURE

	Total *J x 10^{15}*	*Per hectare of Agricultural land* *(J x 10^9/ha)*
Direct power including coal, oil products and electricity	121	10.2
Fertilizers, lime and agrochemicals	129	10.8
Machinery repair and depreciation, feed processing	51	4.3
Transport of products to and produce from the farm	16	1.3
TOTAL	317	26.6

United Kingdom farming accounts for only 14% of the total cost of food provision in the United Kingdom, and overall the support energy required to provide food for our people accounts for about a quarter of our energy consumption as a nation. This fact alone shows that energy analysis does not create a gross exaggeration of the economic situation for food purchase accounts for about 20% of our gross domestic product.

TABLE 2. ANNUAL SUPPORT ENERGY REQUIRED TO MAINTAIN THE UNITED KINGDOM FOOD SYSTEM FOR 54 MILLION PEOPLE

	Annual cost $J \times 10^{15}$	
United Kingdom farming	317	
Import of animal feed	60	
Food industry	527	
Food distribution	451	
Import of human food	208	
Sub-total to retail outlet		1,563
Home expenditure and transport from retail outlet	728	
Garbage disposal	26	
Sub-total from retail outlet		754
GRAND TOTAL		2,317
Energy required as food by the population		241
RATIO Support energy input : energy consumed by man		9.6 : 1

SUPPORT ENERGY USAGE

Much concern has been expressed about the other fact that emerges, namely that it takes nearly 10 Joules of support energy to produce one Joule of the food we eat. This situation is not unique to the United Kingdom; it applies to most of the highly industrialized countries of the world where highly sophisticated secondary food processing, storage and distribution systems have developed. In the United States of America it would appear that the figure is even higher

(Steinhart & Steinhart, 1974). Concern arises because of the realization that the major sources of energy are the reserves of oil, natural gas and coal - the fossil fuels which are the products of photosynthesis on the earth millions of years ago - and that these reserves are finite.

The United Kingdom is but one country and it is worth while to look at the world as a whole. Here I rely on the F.A.O. analysis of the farming sector and insert the United Kingdom figures for comparison. A summary is given in Table 3.

TABLE 3. ANNUAL SUPPORT ENERGY USED IN DIFFERENT REGIONS OF THE WORLD IN THE AGRICULTURAL SECTOR

	Total consumption by region ($J \times 10^{18}$)	*Consumption by agriculture* ($J \times 10^{18}$)	*% of total energy in farming*	***Support energy per agricultural worker*** ($J \times 10^{9}$/ man)
N. America	77	2.1	2.8	556
W. Europe	43	2.1	4.9	82
Australasia	2	0.1	5.6	247
E. Europe & USSR	50	1.6	3.3	29
UK	8.9	0.3	3.6	453
Developed countries	186	6.3	3.4	63
Africa	1.6	0.1	4.5	1
Latin America	8.1	0.3	3.8	9
Far East	7.0	0.4	5.3	1
Near East	2.6	0.2	6.4	4
Asian Centrally Planned	14.3	0.4	2.9	2
Developing countries	33.6	1.3	4.0	2
WORLD	219.1	7.6	3.5	10

What is surprising is that farming accounts for a fairly similar proportion of the total consumption of energy in both the developed and developing regions. The discrepancy is in the amount of energy consumed for all purposes by those people within each of these two great divisions of humanity. It is equally clear that every worker on the land in the developed countries is backed by considerable support energy in terms of machines, fertilizers and other energy-dependent resources. Indeed, men have been replaced by machines in these regions, and in so doing yields per hectare of both crops and stock have been increased. The massive use of support energy has enabled a better use of solar radiation to be achieved and a vast economy of man power to be made.

The question immediately arises about whether the course of economic growth in the developing countries and in particular the growth of their food production will mimic that in the developed countries. Will man power on farms be displaced by machines and land productivity augmented by similar large-scale industrial inputs? At present the solutions to most problems of low farm productivity in developing countries have certainly involved adoption of support-energy intensive techniques, the green revolution being an example. Were all countries to operate at the same level of energy intensity as the United States of America and the United Kingdom, the farming sector of food production would probably account not for 7.6×10^{18} Joules per annum but for five times this amount.

FUTURE DEVELOPMENT

This raises problems about energy supplies. Table 4 estimates the total support energy used by the world for all purposes. The total differs from that in Table 3 based on F.A.O. data. Both are estimates. This simply makes the point that water power and wood fuel account for only 10% of our total consumption, that nuclear power accounts for less than 2% and that nearly 89% depends on fossil sources. The reserves are more difficult to estimate. Proven reserves are those that are known to be extractable with modern technology. Ultimate reserves are those estimated by extrapolation of current rates of discovery and with due allowance for advances in methods of extraction. Table 5 summarizes these estimates made by different authorities who, for oil at any rate, now appear to converge in their estimating procedures on the figures given.

TABLE 4. ESTIMATE OF THE ANNUAL CONSUMPTION OF SUPPORT ENERGY BY THE WORLD'S POPULATION (BLAXTER, 1978)

Source of energy	*$J \times 10^{18}$*	
Oil	120.5	249.4 Fossil
Natural gas	47.7	
Solid (coal, lignite)	81.2	
Water power	15.5	Current
Wood fuel	12.0	
Nuclear fuel	4.2	
TOTAL	281.1	

TABLE 5. CURRENT CONSUMPTION OF FOSSIL FUELS, PRESENT PROVEN RESERVES AND ULTIMATE RESERVES AND ESTIMATES OF THE YEARS THAT RESERVES WILL LAST AT PRESENT RATE OF DEMAND

	Current Consumption	*Proved Reserve*	*Ultimate Reserve*	*Years the Reserve will last* Proved	*Ultimate*
Oil barrels x 10^9	59	652	2,000	11	34
Gas $ft^3 \times 10^{12}$	47	2,325	10,000	45	212
Coal t x 10^9	3	8,600	15,000	1,400	2,500
Energy J x 10^{18}	281	117,000	217,000	416	772

These figures, which do not allow for any growth in world energy consumption, show that there is room for immediate concern about oil as a fuel but that if coal can be exploited fully there is no major problem for several centuries. Currently, however, world fossil fuel consumption is rising at the rate of about 5% per annum, implying that by the end of the century it will be nearly four times its current rate and the span of years that the reserves represent so much the less. It may be pointed out in passing that 60% of the world's reserve fuel of the future, namely coal, is in the Soviet Union.

Guessing the future is, of course, subject to as much uncertainty as the future itself. Nevertheless, the data surely indicate that the monetary cost of energy in general and liquid fuel in particular is likely to grow. There will then be a search for substitutes for oil and these will necessarily be as or more expensive than the convenient liquid fuel it replaces. Biological production of liquid fuel through fermentation of cassava as in Brazil (Goldemberg, 1978) or the production of the gaseous fuel, methane, by anaerobic fermentation or the cropping of fuel wood are all possible technologies, but as Gifford (1976) has shown, hardly at present economically competitive. These biological alternatives, however, all entail using land and in the highly populated countries of the world, land surplus to farming needs is scarce. In the United Kingdom, for example, if we cropped all land for biological fuel production we would meet only 7% of our national fuel needs and would simultaneously produce no food at all; hardly a solution to the energy problem but no doubt a technology that a food exporting country like New Zealand might like to see adopted.

Other alternatives to the continued increase in the use of support energy in farming have been suggested, such as an increase in man power on the land or rather a reduction in the rate of rural depopulation. Substitution of labour for support energy is hardly a solution for the developed countries if the level of yield per hectare is to be maintained. In the United Kingdom our farm labour force is now very small but to increase it at the expense of mechanization is not feasible. If we wished to halve the present support energy consumption in farming by substituting labour, some approximate calculations suggest nearly half our labour force would have to be deployed on farms if yield were to be maintained.

There remain solutions based on sensible economy of resource use. The incentive to economize is usually an economic one; expensive resources and inputs are applied with care. The advantage of energy accounting is that it points the nature of problems by dealing with them in absolute terms. The incentive to act on them, however, is determined by conventional economic forces. Certainly there are many ways in which economy can be made even to the extent of re-location of certain types of production. Thus, in the United Kingdom at present owing to the high cost of heating glass houses, that industry is in serious difficulty. New developments involve the construction of glass houses next to sources of what industry calls low-grade heat. The first houses of this type have been erected to make use of waste heat from distilleries in Scotland. Economies in fertilizer application, minimal cultivation techniques and the matching of tractive power resources to the jobs in hand are equally sensible.

The serious problem emerging in the developing world remains. Of all the support energy used in farming 90% is deployed in the developed countries and at present we have no technologies which will enable people in the developing countries to augment yields and attain higher nutritional status for themselves other than by using greater industrial inputs. In the immediate future there is no alternative to increased use of fertilizers, agrochemicals and application of mechanical power to increase farm production in the developing world, but in the longer term these practices will accelerate depletion of world fuel reserves. The longer term solution is to develop new technologies for farming which result in improvement of solar radiation capture but which are less dependent on an exploitative approach to non-renewable world resources. Such approaches are already beginning in research laboratories and it is essential that they are given every encouragement.

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ENERGY USAGE IN AGRICULTURE - A COMMENTARY

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I found Sir Kenneth's paper a very informative and stimulating review of the energy situation in agriculture. An appreciation of this aspect is of critical importance to the future of agriculture, and it is in recognition of this fact that the organising committee for this conference both asked Sir Kenneth, a world authority on the subject, to address us, and placed this paper at the forefront of the conference agenda.

New Zealand would be well advised to carefully note Sir Kenneth's comments on the high energy intensity of agricultural production and the limitations on future world energy supplies. This country's ability to export her agricultural production, in fact, her ability to survive in the future, depends critically on maintenance of a low cost input structure in farm production relative to that in her major trading partners. It has been this comparative production advantage that has enabled New Zealand to develop her agricultural markets, and is reflected in the energy intensities of the agricultural systems of New Zealand compared with other countries. Sir Kenneth noted that in the United Kingdom, for instance, it takes three calories of input energy to produce one calorie of product energy at the farm gate. Our work at the Agricultural Economics Research Unit indicates that for New Zealand farmers, the comparative figures at farm gate are an input of approximately 0.3 calories for a similar output of one calorie, or around 10 times less energy input to derive the same output. The reason for this difference is the heavy use of nitrogenous fertiliser and the high proportion of farm output produced under controlled environment situations in the United Kingdom.

But although New Zealand has this comparative advantage in production, we have a comparative disadvantage in marketing in that all our exports have to be transported long distances to our consumers. Transport has a high fossil fuel requirement and is, therefore, very energy intensive. It is likely that as the real price of energy rises, the costs of transport will show parallel increases. If we are, then, to maintain an overall comparative advantage in international markets it is essential that New Zealand maintain a low cost and low energy production regime in her agriculture relative to the production systems in those countries which are the major consumers of her agricultural produce. Only then will we be able to market the extra output which Professor Coop maintains we are capable of producing.

NEW TECHNOLOGY, AGRICULTURAL PRODUCTION AND PEOPLE

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I want to look at the impact of new technology in agriculture, an impact that allows farm production and farm productivity to increase, but which often leads to lower prices for farm products. Consumers benefit from cheaper supplies of food but farm incomes become depressed unless new markets can be found for the expanding farm production. Alternatively, some farm people move into other occupations leaving fewer people earning their living off the land. This process of change causes major economic, social and political pressures as people - and countries - adapt to their changing circumstances.

Changes in farming methods and the introduction of new developments are not of recent origin. The "Farmers' Calendar" written in 1805 by Arthur Young, the first Secretary of the Board of Agriculture, described the remarkable developments taking place in the practice and science of crop and animal husbandry in Great Britain. Progressive landowners and farmers such as Coke of Holkham, "Turnip" Townshend and Robert Bakewell were introducing new techniques in the growing of crops and breeding of livestock about 200 years ago.

Many of the earlier successes were developed by particularly enterprising innovators. Even today, with large-scale national research institutes, many of the developments have depended on individual initiatives. A good example was the development of tractor hydraulic systems by Harry Ferguson and now used on almost all tractors throughout the world. The traditional cowshed is rapidly disappearing in Western Europe following the development of loose housing and, in particular, cow cubicles by a dairy farmer - Hywel Evans - in the United Kingdom. The adoption in many countries of the metabolisable energy concept - the ME system - for calculating rations for livestock owes much to the efforts of Kir Kenneth Blaxter both in the necessary experimental work and the promotion of the ideas to farmers and farm advisers generally.

The new technology - whether developed individually or as the product of many people in large research establishments - certainly increases farm yields and production. One variety of winter wheat introduced in the United Kingdom in 1972 - Maris Huntsman - increased yields by no less than 17%. Within three years of its introduction it represented more than one third of the United Kingdom wheat acreage. This type of development coupled with increased fertilizer use, especially nitrogen, improved cultivation and more effective chemical control of weeds, pests and diseases have resulted in a doubling of average wheat yields from 2.5 tonnes per hectare in 1950 to 5 tonnes per hectare in 1977. Similarly, in the United States of America, the widespread adoption of improved strains of hybrid maize and improved cultural practices have doubled the United States maize production in the last 20 years with no increase in acreage. Soya bean production in the United States has increased three and a half times in the last 20 years from 10 million tonnes to 35 million tonnes. Nitrogen use has increased five fold - from two million tonnes annually to 10 million tonnes - in the United States during the same period.

Improved plant varieties can be introduced quickly on many farms, since - apart from buying the new seed - farmers are involved in little trouble or expense. Even when some additional inputs are needed - usually nitrogen - the return is clearly seen. This type of increase in production is particularly efficient in resource terms because no major increase in inputs is necessary. The five fold increase in maize acreage in New Zealand in the last 10 years - and the seven fold increase in production - is a good illustration of the value of this type of agricultural innovation.

Real improvements in the economic efficiency of egg and broiler production have resulted from advances in breeding, housing and nutrition. During the last 20 years the feed requirements per unit liveweight gain have declined from 2.8:1 to 2.1:1 or less. The time taken to rear a broiler to slaughter weight has declined by 18 days or 25%. Resulting from these and other improvements, the farm- ate price of broilers in the United Kingdom has been reduced by 55% in real terms. Small wonder that production has increased twelve fold in the last 20 years; and poultry meat now accounts for 24% of total meat consumption in the United Kingdom compared with 2% 20 years ago. In contrast, lamb consumption has declined from 27% to 17% of total meat consumption in the same period - because, amongst other things - there have not been similar advances in the technology of sheep production in the United Kingdom.

These improvements in yields have occurred with reductions in labour use in producing the crops and livestock. The labour used in growing a crop of wheat in the United Kingdom has fallen from 82 hours per hectare to 16 hours in the last 25 years; for sugarbeet the reduction is from 445 hours to 81 hours per hectare; and for potatoes from 482 hours to 137 hours per hectare. In milk production the labour used per cow in the average dairy herd of 45 cows have declined from 109 hours per cow 20 years ago to just over 50 currently, while at the same time average milk yields have risen from 3,000 litres per cow to 4,500 litres per cow, with stocking rates increasing substantially to the present level of 2.5 Fresian cows per hectare on many farms. During the same period in New Zealand, the average dairy herd size has increased from 52 to 115 cows, with reduced labour input and increased stocking rate: but, unlike the United Kingdom average milk yields have increased only slightly.

I have gained the impression that the rate of increase in yields and the growth of total agricultural production in New Zealand has been somewhat slower in recent years compared with the United Kingdom and the United States of America. Milk yields have been relatively static, as have the lambing percentages and the weight of wool clip per ewe. Much of the increase in production the the last two decades has resulted from the increase in the size of the beef herd throughout the 1960's and early 1970's.

There are probably many reasons for these different rates of development, and room for a good deal of debate and discussion about the relative importance of high returns and a strong research activity in developing increased production and productivity. But one feature does appear to be significant. Much of the new technology which has yielded these large increases in production in Europe and the United States has involved the greater use of energy in the form of fertilizers - especially nitrogenous fertilizers which require enormous quantities of energy in their manufacture - fuel, herbicides and pesticides, feeding stuffs and insulated farm buildings.

Much of the research and development activity in Europe and the United States has related to increasing the energy input into agriculture whilst reducing manpower requirements. The production of milk per hectare in the United Kingdom may be high relative to New Zealand, but it demands the housing of the cows for six months, machinery and buildings to ensile half the total grassland production, about one tonne per hectare of a 34% nitrogenous fertilizer annually, as well as phosphate and potash, and one and a half tonnes of concentrate feed for each cow to supplement the grass - a far cry from many New Zealand farms where cows are outwintered, receive no supplementary concentrates, and where little or no nitrogen is used on the grass.

In terms of energy input, New Zealand agriculture is still very efficient compared with other temperate agriculture: increases in production, whilst modest compared with some other countries have required little extra energy input. If, therefore, energy prices rise significantly, in real terms, in the years ahead, the competitive strength of New Zealand agriculture will increase further. It is in those areas of production with relatively low levels of energy input - permanent pasture and sheep production, for instance - that technological developments have been slow both in Western Europe and, it appears, in New Zealand.

I suggest that improvements in low energy technology provide the key to the further development of farming in low-cost areas of production such as New Zealand. Improvements in existing lambing and calving rates, higher wool weights and better weight gains from the existing livestock populations could add significantly to total production with little increase in energy use. The research scientists may well increase production with little increase in farm purchases. Dr Powell has just described research work on mycorrhiza in agriculture with a potential phosphate fixing capacity. Work at home, and in other countries, is concentrating on mycorrhiza and other natural forms of nitrogen fixation. Developments along these lines could have a major impact on New Zealand agriculture.

Improvements in yields and labour economy are the products not of any single research success, nor of any particular research programme. They have resulted from the gradual and continuing adoption by tens of thousands of farmers of new ideas and techniques developed equally gradually at many research stations, experimental centres and on individual farms.

It has, however, only been the early adopters of this new technology who have benefitted in terms of increased profit. Product prices are affected as more and more farmers adopt the improvements and output increases. So the average farmer then has to increase his production in order to maintain his income as prices continue to fall in real terms. He does not benefit from the new technology: he adopts it merely to survive. This effect has been aptly described by the American economist Cochrane as the "treadmill" of farming technology.

Many of these developments, particularly in farm mechanisation, enable one man to farm increasingly large areas, whilst the proportion of the population engaged in agriculture has declined. In the United Kingdom, only 2.7% of the population are now working on farms. In New Zealand the proportion has declined from 14% to 10% since 1960. In the United States the proportion of the population engaged in agriculture has fallen from 12% to 5% in the last 20 years; and similar reductions could be quoted for many countries in Western Europe where, because farms are still relatively small, further reductions in the size of the farming population are likely.

Although fewer people are working on farms, and farm sizes are increasing, the conclusions of many studies in Western Europe and the United States are that the two-man family farm, well mechanised, can have virtually all the economies of scale of a larger unit.

This does not mean that there is an ideal size of farm for all types and conditions of farming. The skills and activities of farmers vary widely: some farmers can effectively manage thousands of acres whilst others cannot cope satisfactorily with a smallholding. But I do think that the evidence supports the view that family farming will continue to be predominant in many countries, certainly in the United Kingdom, Western Europe, the United States and here in New Zealand for the foreseeable future. This does not mean that all farms will be staffed wholly by family labour. But the management of the farms - the day to day farming decisions and the longer term business decisions on stocking, cropping and investment policies - will remain in the hands of the family.

There is one area of farming activity where the advantages of scale are likely to become increasingly important. This is in the marketing of farm products. The family farmer is not usually able to provide sufficient quantities of a required quality from his own business for the long production runs of standardised products required by processors and packing plants. The technologies of production and processing are drawing closer together, so that individual farmers will need to work more closely together and increasingly with marketing specialists to meet the increased market specialisation of the future. This development is, of course, much further advanced in New Zealand with the marketing authorities controlling export supplies than in the United Kingdom where farmers have benefitted from the close proximity of markets. But in both countries I foresee an even closer linkage of production and marketing operations.

"Market orientated production" is not a term I like, but it does describe the increasing need for attention to be paid to marketing when planning farm production programmes. This is of particular importance to New Zealand farmers when production has to be reorganised to meet the needs of more diverse markets as less of their production is taken by the United Kingdom market.

Let me draw together the various strands of my arguement.

The development and adoption of new technology has resulted in food production keeping up, and in some cases, exceeding demand causing prices to fall in real terms. This, in turn, has forced out many of the less efficient and smaller farmers resulting in fewer people working on the land. The future well being of those remaining in agriculture, both in the United Kingdom and in New Zealand will depend upon their rapid adoption of new technology and farming practices - which emphasises the importance of advisory services and other organisations involved in the development and dissemination of new ideas and knowledge.

I have suggested that the family farm - where the business decisions are made by the farmer and his family, will continue in both the United Kingdom and in New Zealand. But the size of the family business will continue to increase, both in terms of area and turnover to take advantage of the further improvements in labour productivity which we can expect.

For farmers there are two major factors to consider. The first is the need to find and adopt new technology ahead of one's competitors. The second is to move ahead in size of business - in area where possible - to take advantage of the new technology. How rapidly farmers can do this will be determined by the level of farm profits, which depends in part on the state of the market and in part on the decisions of the government.

For farming administrators there are also two major implications of this scene. The first is the need to press ahead with further research, development and advisory activities to ensure that agriculture in our respective countries remains in the forefront of progress. The second is to redouble their efforts to resolve the social and economic problems of rural communities resulting from increases in farm size and labour productivity.

It is the populace generally who benefit from the impact of new technology in agriculture through real reduction in food prices. It may therefore be appropriate that society generally should pay the social costs resulting from the introduction of new technology. We have not yet succeeded in devising effective means of doing this. Solutions which maintain producers' incomes at acceptable levels lead to surpluses which have to be disposed of by methods which are proving unacceptable socially and politically. Solutions which would avoid the accumulation of surpluses would in many countries lead to farm incomes so low as to be politically unacceptable.

As in so many aspects of life, there needs to be a middle way. A degree of market price support is needed to maintain incomes at acceptable levels on farms which are of a reasonable size and efficiency. In addition, some form of direct support is needed for those farmers whose production is no longer required. The principle of redundancy payments is now well established within the United Kingdom economy generally. Perhaps this principle should be more closely examined - both in scale and mode of operation - as one means by which society might share the social costs of developing new farm technology.

In the longer perspective one of the increasing needs will be to develop new activities in the countryside and small towns if the social fabric of many countries is to be maintained in a recognisable form. The technological revolution of the last century or so undoubtedly improved the material well-being of most people. But the social costs have been enormous. The decay of inner cities and the common urge to live in the country or away from the conurbations illustrate that society has not yet come to terms with the consequences of its own technological skills.

This reconciliation needs much further study. The solutions will be found in the hearts and minds of those affected by the changes. The political and economic problems in agriculture caused by the impact of new technology will continue until much more progress is made towards developing new concepts of living and working in small communities. The social fabric of the rural community would then be maintained and the social heritage of the countryside would still be enjoyed by those whose labour is no longer required on the land.

THE IMPORTANCE OF MYCORRHIZAL FUNGI IN NEW ZEALAND FARMING

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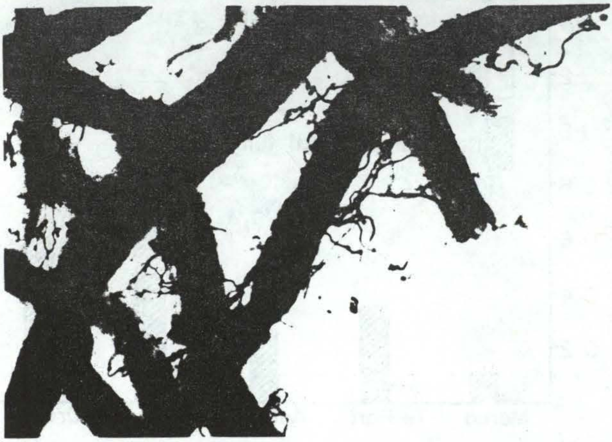
HOST RANGE AND LIFE CYCLE

Mycorrhizal fungi have been found in all pasture soils so far examined in New Zealand, with legume and grass roots invariably infected. These mycorrhizal fungi originally lived in the roots of native forest, scrub and grassland plants. When this native vegetation was cleared and converted into farmland in the last 100 years, these soil fungi remained, and now infect the introduced pasture plants.

The fungal life cycle is very simple. Fungal filaments (hyphae) grow out from an infected root into the soil, (Figure 1) where they may produce resting spores or infect any new root they come across. Hyphae can grow out 6-8cm from the root surface. The hyphae which eventually grow from the spores, also grow through the soil until they reinfect a young root. Normally seedlings become heavily infected by the indigenous mycorrhizal fungi in a soil within three to four weeks of seed germination. Mycorrhizal fungi, unlike most other fungi, can only survive and grow on living roots in soil, and cannot be cultured on artificial media.

As well as infecting pasture plants, mycorrhizal fungi also

Figure 1.



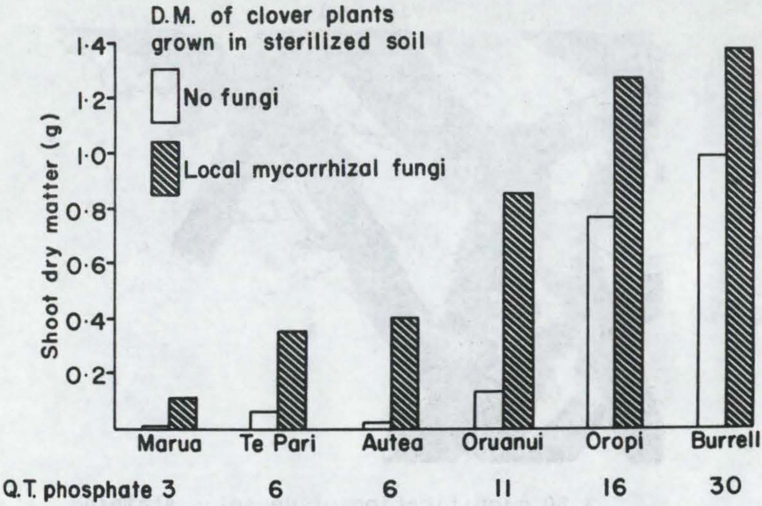
X 50 magnification of densel y staining mycorrhizal roots with fungal hyphae (arrows) growing away from root surface

infect almost all crop plants such as lucerne, soybean, barley, wheat, maize and corn, and many important horticultural plants such as citrus and grapes and many ornamentals. Crucifer crops such as turnips, swedes, mustard and kale are the only important agricultural plants not infected.

EFFECT ON PLANT GROWTH

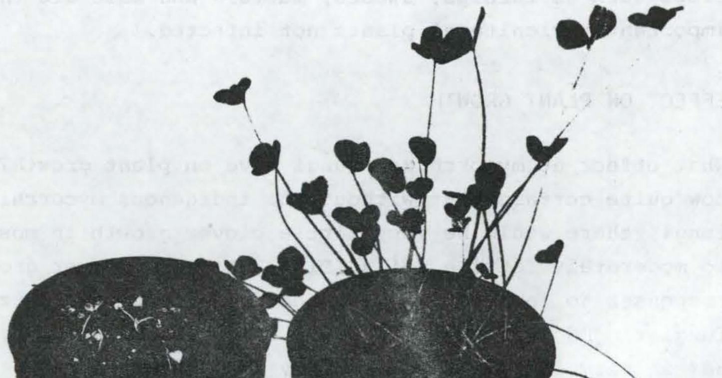
What effect do mycorrhizal fungi have on plant growth? It is now quite certain that without the indigenous mycorrhizal fungi, there would be very little clover growth in most low to moderately fertile soils (Figs 2 & 3). Clover growth responses to inoculating with the indigenous mycorrhizal fungi ranged from 23-fold in the infertile Marua clay, to 38% in very fertile Burrell sandy loam, and responses of 10-fold or more are common in most moderately fertile soils. Mycorrhizal fungi greatly increase phosphate uptake from soil, because the fungal hyphae which grow out from the root, well past the root hair and phosphate-depletion zones (fig 4) and

Figure 2



Effect of the indigenous local mycorrhizal fungi on clover growth in sterilised soils

Figure 3



Effect of the indigenous mycorrhizal fungi on clover growth in a typical hill country soil

Figure 4.

Clover root infected with mycorrhizal fungus

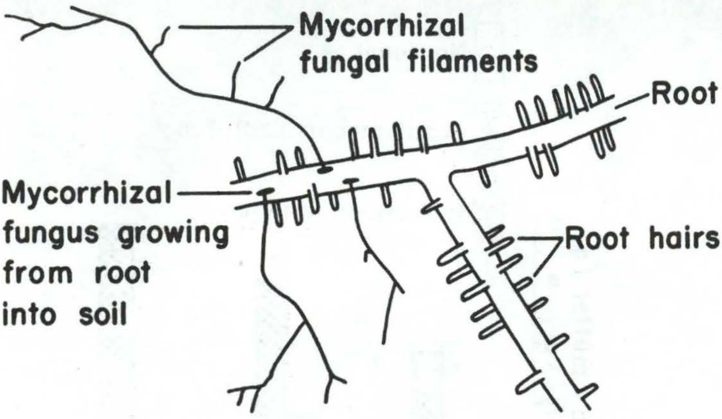
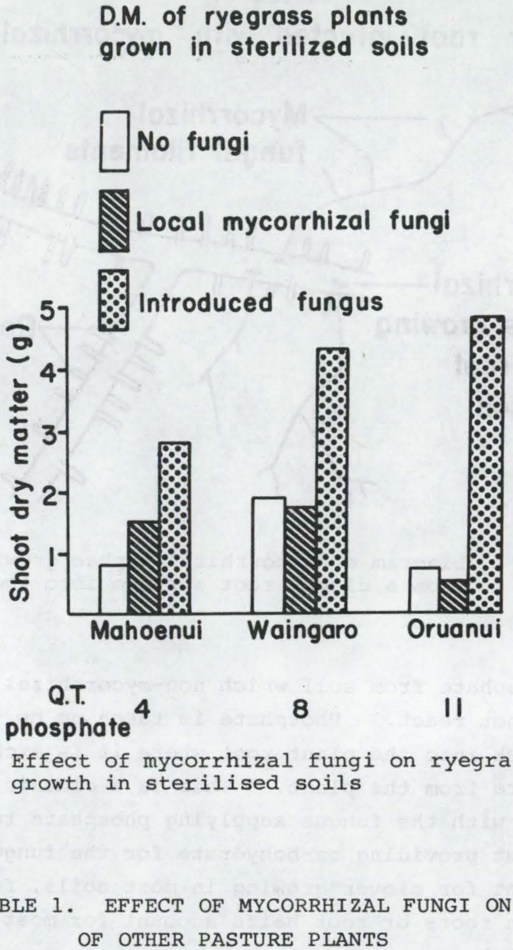


Diagram of mycorrhizal hyphae growing out from a clover root surface into the soil

absorb phosphate from soil which non-mycorrhizal roots could otherwise not reach. Phosphate is taken up by the hyphae and carried back into the plant root where it is exchanged for carbohydrate from the plant. This is a classic example of symbiosis, with the fungus supplying phosphate to the host, and the host providing carbohydrate for the fungus. I am certain that for clover growing in most soils, fungal hyphae, rather than roots or root hairs account for most of the phosphate taken up.

Mycorrhizal fungi also stimulate phosphate uptake and growth of ryegrass (Fig. 5), and also of red clover, lucerne, lotus and prairie grass (Table 1), among others. Mycorrhizal fungi, however, are no substitute for phosphate fertiliser - they merely tap what is already in the soil. Table 2 shows that non-mycorrhizal plants growing in a high phosphate-fixing yellow brown loam recovered only 4% of fertiliser

Figure 5.



Effect of mycorrhizal fungi on ryegrass growth in sterilised soils

TABLE 1. EFFECT OF MYCORRHIZAL FUNGI ON GROWTH OF OTHER PASTURE PLANTS

SPECIES	SHOOT DM (g) Non-Myc	Myc
Lucerne	0.01	0.16
Red Clover	0.05	1.10
Lotus	0.41	1.12
Prairie Grass	0.33	0.68

phosphate after four crops, whereas plants infected with *Glomus tenuis* recovered 27% of the phosphate originally applied. In addition mycorrhizal clover plants form good nitrogen-fixing root nodules, while non-mycorrhizal plants are usually too phosphate-deficient to nodulate at all.

TABLE 2. EFFECT OF MYCORRHIZAL FUNGI ON RECOVERY OF PHOSPHATE FERTILISER FROM SOIL

FUNGI	% P Recovery	
	Soluble P	Nauru rock P
None (non-myc)	4	0.3
Glomus tenuis	27	13

HIGHLY-EFFICIENT MYCORRHIZAL STRAINS

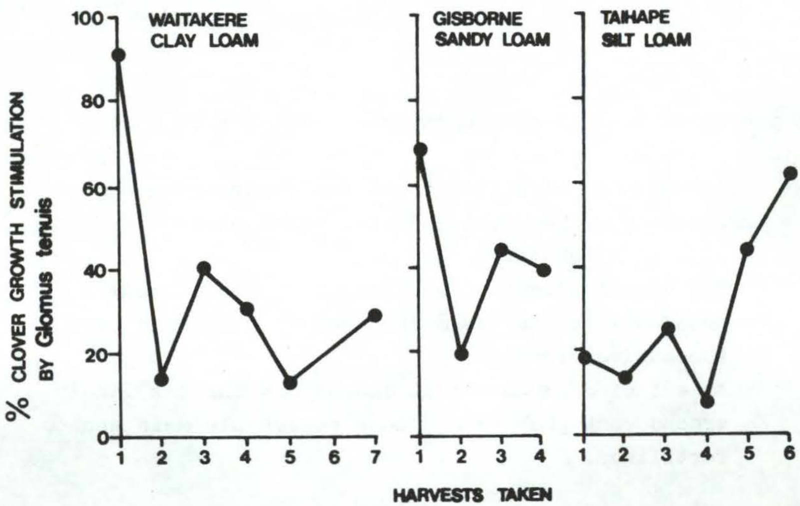
So far I have described what mycorrhizal fungi are already doing in our pasture soils. How can we improve phosphate uptake from soils if all plants are already infected? The simple answer is that mycorrhizal fungi vary greatly in the efficiency with which they recover phosphate from soil and stimulate plant growth. This is illustrated in Table 3, where ryegrass seedlings were inoculated with the indigenous mycorrhizal fungi from six pasture soils and grown in a sterilised test soil along with some non-mycorrhizal plants. Increases in ryegrass growth ranged from 220% (fungus 1) to 720% (fungus 6).

TABLE 3. SELECTED EFFICIENT MYCORRHIZAL FUNGI FROM GLASSHOUSE TRIALS

Fungus	Ryegrass shoot growth (g)	% growth response to mycorrhizal infection
None (non-myc)	0.27	-
1	0.60	222
2	0.91	337
3	1.24	459
4	1.38	511
5	1.49	552
6	1.95	722

We are doing many experiments at Ruakura at the moment on finding ways to inoculate field soils with strains of highly efficient fungi. To date, efficient fungi have been introduced into more than forty field soils under glasshouse conditions. In one trial, clover seedlings were inoculated with the indigenous or one of three efficient mycorrhizal fungi, and transplanted into undisturbed cores of soil taken from field fertiliser trials. Results for three of the eight soils are shown in Figure 6. In Gisborne and Waitakere soils, clovers inoculated with *Glomus tenuis* produced 68% and 90% more shoot DM than plants inoculated with the indigenous mycorrhizal fungi at the first herbage cut. This growth benefit then dropped to a more or less constant 20-40% growth response in subsequent cuts. In Taihape soil, the growth stimulation to *Glomus tenuis* inoculation increased with successive harvests. Other experiements have also shown - at least under glasshouse conditions - that efficient mycorrhizal fungi can be inoculated into unsterile soils and give long-lasting increases in plant growth.

Figure 6.



Long term clover growth responses to inoculation by *Glomus tenuis*, in efficient fungus

USE OF ROCK PHOSPHATE

In a recent experiment, ryegrass seedlings were inoculated with *Gigaspora margarita* or the indigenous mycorrhizal fungi and then transplanted into pots of unsterilised ash soil. As in the soil core experiment (Fig. 6), *Gigaspora margarita* had to compete against the high population of indigenous but less efficient mycorrhizal fungi in the unsterilised soil in order to infect the clover roots. In unfertilised soil, *Gigaspora margarita* successfully out-competed the indigenous mycorrhizal fungi, and after five harvests had increased ryegrass growth by 53% (Fig. 7). In addition, plants had been grown in soil in which Nauru Island, Christmas Island and Chathams Rise rock phosphates had been mixed at the rate of 80 milligrams phosphate per 600 millilitre pot, equivalent to 60 kilograms per hectare. After 12 months growth in these fertilised soils, *Gigaspora margarita* had increased plant growth by 73%, 18% and 29% respectively (Fig. 7).

The practical results from this experiment are that :

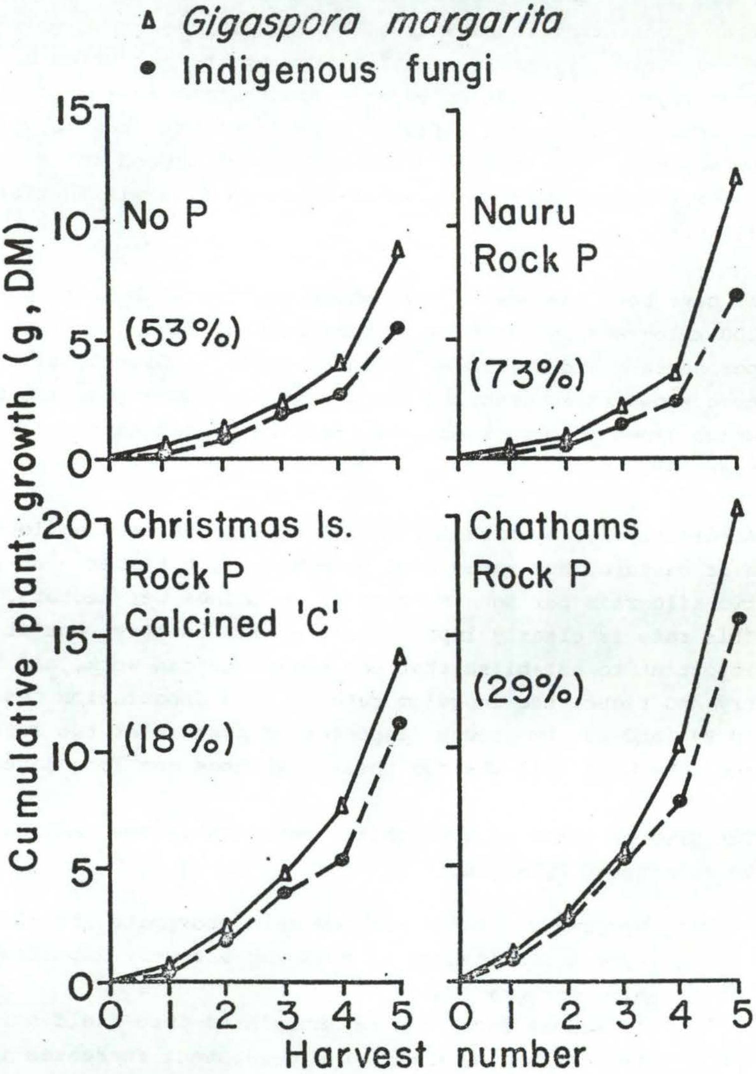
* Inoculation with the efficient fungus increased the recovery of residual and fertiliser phosphate from soil by ryegrass.
* The growth stimulus resulting from the increased phosphate uptake was maintained or increased over successive harvests.
* An efficient mycorrhizal fungus may convert finely ground rock phosphate into a reasonable maintenance fertiliser.

New Zealand will soon have to pay more for its rock phosphate ore, when present cheap sources on Nauru Island and Christmas Island begin to run out. Because of this, we are experimenting with Christmas Island 'C' grade ore, to see whether it can be used by plants infected by suitable mycorrhizal fungi. At present, this ore cannot be made into superphosphate because of technical problems, and would therefore be uneconomic to mine. If this ore can be managed it could supply all New Zealand's phosphate requirements for over thirty years.

FIELD TRIALS

Several field plot trials have been set up in spring, 1977, and this present autumn, and several more are due to go down

Figure 7.



Improved use of rock phosphates by an efficient mycorrhizal fungus, *Gigaspora margarita* this coming spring. We are trying to inoculate in the field by oversowing clover and ryegrass seed heavily coated with mycorrhizal inoculum. The inoculum is grown up on white clover, ryegrass or maize growing in large bins of sterilised soil. After several months, the soil is full of spores, hyphae and infected root fragments, and is very infective. The soil is dried and coated around individual seeds, producing granules about three to five millimetres in diameter.

We have been oversowing onto short pasture with granules at 200 kilograms per hectare (clover seed at five kilograms per hectare and soil:seed ratio of 40:1). Glasshouse trials have shown these granules can infect the young seedling root which grows through them, but field responses have yet to be measured.

Alternatively, mycorrhizal soil inoculum can be sown loose over pasture, but rates used have been much higher - up to two kilograms per square metre or 20 tonnes per hectare. This rate is clearly impractical on hill country, but it is important to establish that the technique can work, and then try and reduce the inoculum rate. Such inoculation resulted in 24% and 28% DM growth responses on pasture at two sites, and time will tell whether these responses are long lived.

The present state of mycorrhizal research in New Zealand can be summarised by saying:

* Mycorrhizal fungi are the main phosphate absorbing system for legumes in soil and are very important also for grasses.
* Efficient fungi can be inoculated into field soils in the glasshouse with large persistent increases in plant growth and phosphate uptake as a result. Field experiments have recently been laid down and few responses have come through yet.

THE FUTURE

There are many problems to be overcome, but the potential saving through better use of phosphate fertiliser is very great. Even a 10% reduction in fertiliser usage would save $20 million on present superphosphate prices, which will undoubtedly rise in future. Table 4 outlines four main areas for mycorrhizal research to concentrate on in future. Presently, *Glomus tenuis* and *Gigaspora margarita* are two efficient fungi often used experimentally but other highly efficient fungi are bound to exist. We are now running screening trials to try and isolate these highly efficient strains which are undoubtedly present, but as yet undiscovered in some soils. Inoculation methods will be examined to find the most effective way of getting a desired strain into the soil. We need to know how and why an efficient fungal strain in relatively low concentrations can oust or compete with the indigenous strains of mycorrhizal fungi. The whole question of field inoculation hinges on this. If the introduced fungus, no matter how efficient, cannot invade the host root because of competition from the indigenous but less efficient fungi, field inoculations will continue to fail. Long term field trials should show whether or not any initial growth responses are maintained.

TABLE 4. FUTURE MYCORRHIZAL RESEARCH

Selection of efficient mycorrhizal fungi
Better introduction methods
Physiology of fungus-root-fungus competition
Longevity of field responses

If present research progress continues, the use of efficient mycorrhizal fungi should allow farmers the chance to maintain present pasture production with lower fertiliser inputs, or increase production with present fertiliser levels.

INDUSTRIAL RELATIONS IN THE FREEZING INDUSTRY

Dr D.J. Turkington
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The New Zealand freezing industry generates industrial conflict and, in this country, conflict is news. A day seldom passes without a meat freezing strike or threat of strike being reported in the press, on radio or on television. Industrial relations in the freezing industry are difficult to ignore and most people probably realize that this is the most stoppage prone of New Zealand industries. Indeed it has been so for at least the last twenty years. In the seventies it has accounted for nearly one quarter of *all* stoppages in the country and for about *one half* of all workers involved and of resulting man-days lost. This from an industry employing only about 3% of the total labour force.

On the basis of this or even less information, budding authorities on the freezing industry provide explanations of its stoppage proneness. Most such explanations are worse than useless. Sound conclusions can come only from detailed analysis, something that the mass media cannot provide. As part of this analysis, stoppages should be put into some perspective. The freezing worker loses, on average, about four man-days a year from stoppages but over twice that number from industrial accidents. Absences other than accidents are also likely to account for a far greater loss of time than stoppages, although data on these absences are even sparser than those on accidents. In a high stoppage year like 1970, days lost in the industry due to stoppages were only 1.6% of total days worked. Whether stoppages and their associated loss of time are considered "good" or "bad" depends on the standard and viewpoint being brought to bear. But it is a fact that even in this industry there are several more important causes of time lost than stoppages.

An adequate analysis must also cover the complex patterns of industrial conflict within the industry. Not all meat works have high stoppage levels - some do, but many don't. From 1967 to 1973, for example, five works each averaged over four stoppages a year (and accounted for nearly 50% of all meat industry stoppages), yet 14 others had less than one per annum[1]. There are also big variations in time lost and worker involvement in stoppages among works. And variation is not confined to the plant level. Within works, slaughtermen and freezing chamber hands tend to be more stoppage prone than other groups or departments. An example concerns a works where beef slaughtermen accounted for one in three stoppages yet totalled only 2% of its labour force. Boners and boners' labourers also stand out as highly stoppage prone in some works.

Some companies and regions also have more stoppage activity than others. Over 1967-73, four multi-plant companies (owning 14 works and employing one half of the industry's labour force) accounted for about two thirds of its stoppages, man-days lost and workers involved. Auckland is the most stoppage prone region, followed (in alphabetical order) by Canterbury, Otago, Southland and Wellington. In the above

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1 These figures, like much of this paper, are from D J. Turkington, *Industrial Conflict : A Study of Three New Zealand Industries* (Methuen, Wellington, 1976). This book outlines the conflict patterns of the meat freezing, waterfront and building and construction industries and examines influences shaping those patterns.

period, the average Auckland freezing worker lost about eight man-days a year from stoppages as compared with his Nelson region counterpart who lost only 0.4.

Industrial accidents are also distributed very unevenly within the industry[2]. In 1964-69, for example, the accident frequency rate for works ranged from a low of 3.0 to a high of 23.3 and for multi-plant companies from 5.3 to 20.5[3]. A similar dispersion held for regions. Within the works, slaughtermen and freezing chamber hands again account for a disproportionate amount of accidents. Works with a high number of stoppages tend also to have a high number of accidents and a high accident frequency rate.

CONFLICT CAUSES

Industrial conflict in the freezing industry is obviously complex and no single factor can adequately explain it. Here we can present only a summary of the detailed examination of conflict explanations found in my book *"Industrial Conflict"*. Workers or employers will use a particular conflict form only if they have both the desire and ability to do so. Features producing inclination and ability to engage in conflict abound in this industry.

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2 There are strong grounds for thinking that some industrial accidents are expressions of industrial conflict. They are the most legitimated and sanctioned form of withdrawal from a (possibly conflictual) work situation. They may also entail little or no loss of income. Moreover, the anxiety and tension surrounding a conflict may cause a worker to behave in an accident producing manner. See D.J. Turkington, *The Forms of Industrial Conflict*, Occasional Paper in Industrial Relations No 18, Victoria University of Wellington, 1976, pp. 11-13.

3 For further information on industrial accidents in the industry see "Analysis of Freezing Industry Injuries and Compensatable (lost time) Injuries", Mimeo Paper, New Zealand Freezing Companies Association, Wellington, November 1976 and "Report of Sir Arnold Nordmeyer to the Accident Compensation Commission on Accidents and Occupational Diseases in the Freezing Industry", Wellington, August 1977.

Seasonal Character

The one that most people turn immediately to is its seasonal character. Seasonality influences the cost of conflict and may result in a casual relationship between employer and worker, continual changes in the labour force and an "unsettled atmosphere", economic insecurity, the attraction of workers "itinerant by nature", a high work pace at the peak and desire to "have a break", variations in bargaining power and so on. There is a definite seasonal pattern to stoppage and accident proneness. Seasonality has also undoubtedly led workers to attempt to gain more control over the work situation, with conflict often the result.

But works with low seasonal variation generally do not have low levels of stoppages and accidents. If anything, they tend to have relatively high levels. Now it may be that the influence of seasonality has been overestimated or that its influence is countered by other factors. For example, several works with low seasonal fluctuations are large and located in urban areas and these features themselves appear to produce conflict. Moreover, in such plants the nature of the work may have even greater effect in the sense that "the workers are at risk longer". Whatever its influence at particular works, it is likely that seasonality produces a climate conducive to conflict, especially by comparison with industries offering stable, permanent employment.

Nature of the Work

Meat freezing work can be monotonous, repetitive, physically demanding, unpleasant and dangerous. These features produce a situation where conflict easily emerges. Many people in the industry argue that the nature of the work leads to an "industrial game" in which workers occupy their minds by developing strategies and tactics. Some also see the stoppage as a "revolt" against monotonous and "soul destroying" jobs.

The same sequential, integrated production process which accounts for much of the nature of the work also produces departmental work groups which may be in a position to bring the whole works to a standstill. Some groups, notably at the beginning and end of the process, are in highly strategic positions, especially in view of the perishable nature of the raw material and product.

Hygiene and Inspection

The nature of the product also necessitates inspection to maintain standards of hygiene and prevent the spread of disease. New Zealand inspection standards are greatly influenced by export requirements. The hygiene regulations and their application have caused much conflict in recent years. They can produce changes in established work patterns and in earnings and/or effort for the worker. Resentment is heightened when neither the nature nor purpose of the regulations is adequately communicated to the workers and when there are apparent inconsistencies in their application among inspectors. The regulations have produced increased heat, humidity and discomfort generally. They are a major bargaining point and some managers argue that workers use them to "gain everything" and especially "more men or more money".

Industry Status

The freezing industry is not noted for its high *esprit de corps* or status. Pride is not engendered by the poor physical environment of some works where little is done to counteract the inevitably unpleasant features of some activities. Many buildings and amenities are old and downright unattractive.

Payment Systems

There is widespread agreement that the industry's payment systems and earnings relationships are in a mess and in need of overhaul. Many schemes involve piecework and other forms of payment-by-result. These frequently derive from its seasonal character and the need to rapidly process the raw material. Their operation often leads to conflict, especially where their basis has been outmoded by technological change, where special extra rates are applicable in particular situations and where throughput levels fluctuate. Nor are matters helped by the fact that many incentive agreements are oral and made "privately" between foreman and delegate. The industry's complex payment systems, together with its high division of labour, produce numerous bases for earnings comparisons within and among works. It is almost inevitable that these relativities will be frequently upset and that conflict will result.

Many people in the industry see the complexity and ambiguity of its main award or agreement as producing conflict. To an extent, the complicated and conflictual nature of the industry ensures its award will be complex. Even were it straightforward, differences in interpretation would still arise. But despite this, the award may be unnecessarily ambiguous and complex.

Plant Size

Large plants are often impersonal places where communications are difficult, tasks are highly segmented, administration is centralised and so on. For these and other reasons they may be more prone to conflict than small ones. The labour force of the average meatworks is about 20 times larger than that of the average New Zealand manufacturing unit. And within the industry, larger plants tend to have more stoppages and higher accident frequency rates than smaller ones.

Plant Location

Freezing workers at rural works may be less inclined or able to engage in conflict than their urban counterparts. Rural workers may be more sympathetic to the farmers' problems, have a closer acquaintance with management, have fewer alternative employment opportunities - although have continuing opportunities for off season work - and so on. Rural works are also often smaller than urban ones. The figures show that urban works, on average, have much higher stoppage and accident levels than rural ones.

Company Ownership

It is frequently argued that foreign-owned freezing companies have more conflict than New Zealand-owned ones. Many freezing workers dislike foreign companies, arguing that their owners are unaware of local New Zealand conditions, that their New Zealand negotiators lack normal negotiating powers and that they are monopolies which take profits out of the country and which run their local operations to suit their global interests. Ignoring whether this accurately describes reality, overseas-owned works tend, on average, to have higher stoppage and accident levels than local ones. But these levels vary considerably within each ownership group and some of the most stoppage and accident prone works are New Zealand-owned.

Communications and Personality Influences

The poor communications existing in many works can cause, but often result from, conflict. The more basic influences that we have documented tend to produce poor communications. Even the personality differences which arise and add to conflict can be influenced by these factors. An industry like this shapes personality characteristics and the way they are expressed.

Male Domination of Work Force

The freezing industry has been very much a "man's world". Even now nine out of ten workers are male. Some see this male predominance as a source of conflict. Females, it is alleged, "enhance" industrial relations, are less prone to engage in industrial conflict, are better suited to repetitive work, have a "better attitude" to hygiene, are less likely to quit and generally "put a tone on the place".

Certainly a high proportion of works managements intend to hire more women workers in the future. But many of these allegations are based on neither detailed research nor experience. It is likely that where significant numbers of women are employed, they too will be influenced by the nature of the work and by many of the other factors which cause conflict among men. There is evidence in some works with relatively large female labour forces that this is indeed the case.

Agitators

There are some who ascribe all conflict in the industry to agitators who apparently even have the ability to incite otherwise peaceful workers. Why these "agitators" exist in this industry and why they are apparently so successful is never explained. Whether someone is an agitator depends on the viewpoint adopted. Management may regard leaders of workers in a conflict situation as agitators, but the workers may regard them as anything but.

Private Ownership

Some people certainly see industrial conflict as arising from the private ownership of the industry. Where there is strong antipathy to private ownership, conflict may result. But it's easy to overestimate the extent of that antipathy in this industry. In any case, many of the basic causes of its conflict are quite unrelated to the form of property ownership.

SUMMARY

Among the more important influences on conflict are: the nature of the work and of the worker; the nature of the production process and product, and the formation of work groups; the hygiene regulations; the physical environment of works; payment systems and earnings relativities; the size and location of works; and overseas ownership of works. Seasonality also creates a climate conducive to conflict.

Personality differences and inadequate communications may be important in particular situations. Many of these influences derive from basic technical and economic conditions.

SUGGESTIONS FOR IMPROVEMENTS

Our discussion has implications for proposed "solutions" to conflict in the industry. Some see the answer as lying in revised disputes procedures. Frequently little thought has been put into the design of New Zealand disputes procedures. But however well designed and operated a disputes procedure is, it is concerned with conflict once it has arisen rather than with preventing its generation. It cannot be expected to change the fundamental conditions producing conflict. Moreover, in an industry like this, with so many causes of conflict, it is unlikely that the decisions of a disputes committee will invariably or even generally be accepted by both parties. The decisions and the procedure itself may even be sources of conflict.

Subsidisation by the State of meat workers' wages is no solution. In effect, it passes the conflict onto the taxpayer who bears the cost. Of course, stoppages generally impose a cost, but much of it is borne by the disputing parties. The supply of benefits extractable from the employer through stoppages is likely to be seen by workers as less than that available from the State. After all, the government in normal circumstances cannot go broke. State subsidisation may complicate an already complex situation by adding a third party which could come into conflict with either or both of the two existing parties. Government has always been heavily involved in this industry, but now it seems effectively to be dictating the wage rate.

There are those in the industry and elsewhere who argue that it should be nationalised, possibly together with some worker and farmer participation in its control. This may remove such sources of conflict as overseas and private ownership, and even lead to greater potential for worker involvement and participation in the industry. But its effect on conflict may be unsubstantial if it is not accompanied by significant changes in the nature of the work and production process. Unless the operation of the industry is changed, a substitution of one form of ownership for another may have little effect.

Some see penalties as the way to suppress stoppages. There are numerous penalty provisions, both general and specific, in the industrial legislation which relate to this industry. Their intention is to reduce conflict but their effect tends to be the opposite. They discriminate against one party in a situation which necessarily also involves another. Each party sees its interests and tactics as legitimate, yet one is restricted by law in the tactics it can use to pursue its interests. And that party is usually the union. Most penalty provisions relate to both strikes and lockouts, but those on lockouts are redundant. Employers do not need to lockout. If they wish to close a plant they can usually promote a strike and so avoid being seen as the aggressor. Workers are therefore opposed in principle to penalties in industrial relations.

Their application raises further issues. It is not usually practical to charge all workers involved in a strike. That leaves the union official, although a paucity of evidence for the prosecution may make it impractical to charge even him. But assuming the official is found guilty, the fine for a first offender will be laughably small. Whatever its size, the fine will not be paid. The making of a martyr is in process with the trade union movement, whatever the merits of the original dispute, backing him to the hilt. Should the official be imprisoned, massive sympathy stoppages will ensure a short stay. Penalties, intended to regulate conflict, can only exacerbate it if applied.

Simple answers are always appealing, but there are none for this industry. Indeed, it is very difficult to significantly change its conflict levels. Such a change may require alterations in the nature of the production process, work methods, the structure of work groups, the application of regulations, payment systems, standards of amenities and plant generally and so on, aside from alterations in size and location of plants and the like. Some of these changes though are easier to make than others. For example, the industry's payment systems are an important influence on conflict yet have considerable potential for modification. The same applies to some secondary influences on conflict. The provision of adequate training and preparation of foremen is but one example.

That high levels of conflict need not necessarily be a feature of meat plants is demonstrated by the numerous works which traditionally have been fairly conflict free, by the several new works with attractive facilities and equipment, thorough induction and training, steady employment and workers lacking habitual attitudes to the industry, and by those few works which have seen radical reductions in their conflict levels.

INDUSTRIAL RELATIONS IN THE FREEZING INDUSTRY - A COMMENTARY

Mr A.F. Crooks
Manager
Hellaby Shortland Ltd., Auckland

Let me say that I regard the meat industry as the greatest industry in New Zealand, as it outstrips the dairy industry and the pulp and paper industry and all others by its sheer size, capacity and complexity; and it is an intensely competitive industry.

It provides employment for about 33,000 people at peak periods and contributes almost twice as much as its nearest rival, in terms of gross national product.

It is of such complexity, that throughout the entire operation this industry needs all the skills, technology, sciences and all the faith that New Zealand can produce. There is no section of this industry in New Zealand today that is not being effected by change and with change is generated challenge and great challenges they are proving to be.

I found Dr Turkington's paper to be a very stereotyped, low key document containing little that is not already known and certainly a paper which hardly challenges ones thinking at all. I must assume then that he would wish me to generate discussion by a provocative commentary.

Statistics

My comments on the statistics quoted will be brief. They count for little because the meat industry can produce . statistics to support or dispose of any theory on industrial behaviour.

However, I would respectfully suggest that the lower South Island plants are now far more stoppage-prone than those in Auckland which is quite the opposite to the quoted figures.

I would dispute also, in New Zealand conditions, the assumption that the number of accidents occuring is indicative of the tenor of industrial relations. This degree of sensitivity might, however, apply in a lingerie factory, but certainly is hardly recognised in the meat industry. For instance, since the introduction of the accident compensation scheme, work injury rates have doubled in many of the works where industrial relations are reasonably good.

Lost Time and Accidents

The early reference to the importance we seem to place on lost time for industrial stoppages compared to accidents and absenteeism is a hardy annual which always escapes an explanation.

In my view accidents happen too often because workers and managers take unnecessary risks.

Industrial stoppages in this industry are generally the results or effects of the power game associated with conditions of employment. Displays of power and conflict always attract attention.

The magnitude of the statistics of the former, in my view, in no way excuse the statistics of the latter.

Seasonal Influence
Seasonal influences again find favour as a major reason for industrial unrest and with this the casual relationship between employee and employer, the unsettled atmosphere and the itinerant nature of the worker attracted by this particular characteristic.

In my view these influences can have some bearing on industrial stability but competent personnel administration can largely counter the effects that apply under this heading. However, I would also believe that the influence of seasonality has been overestimated or countered by other factors.

The growth of the number of departments and integrated work groups are sources of conflict, as the freezing workers language of direct bargaining usually provides for any group to extract as much as possible. Having a large number of groups to deal with, with the added support groups give to each other, does not improve the bargaining situation.

Hygiene Regulations
These have proved a wonderful scapegoat for all the parties in the industry. I am firmly of the opinion that where a genuine attempt has been made to comply with the regulations, working conditions have greatly improved and I can see no substance in the claim that increased heat, humidity and discomfort has followed. After all, the industry has had to move from a traditional position of processing raw material to that of food production and I am of the opinion that we should wash hands and sterilise equipment when we work with food.

As a result, for instance, of all the foreign meat imported to the United States of America last year, the New Zealand quota has reduced its rejection rate from 7% to 0.24% over the last five years and as a further compliment, New Zealand has climbed to the position of being the second greatest exporter of meat to this market.

The Ministry of Agriculture have been proven to be amateurs of the greatest degree in the delicate process of implementing changes of the magnitude undertaken, but was it their real responsibility? They have not been helped greatly by the general attitude of the typical company and its employees and therefore the Ministry's imcompetence is second only to that of the meat companies who led again from behind in most cases, hoping that even the requirements agreed upon as necessary, would surely disappear.

Morale and Status

This paper suggests that morale is generally low. In my experience quite the opposite applies. I find that generally there is a high *esprit de corps* in the typical New Zealand meat works. Whether the morale is productive or counter productive is largely a management prerogative. The freezing worker as such, enjoys a very poor standing in the community but I have found him to be able to respond to challenges designed to improve his status.

Pay Systems

I find grounds for agreement with Dr Turkington in the area of pay systems and the award. These are so seriously out of step with the realities of the industry that nothing short of a tribunal can hope to even start a long voyage back to common sense.

Neither union or management can be proud of the present which, in my view, is now completely unmanageable.

Here we have a national award, fixing rates and conditions for similar factories in climatic situations as diverse as Bluff and Auckland. We are not a national industry but a mixture of vigorous private enterprise, farmer co-operatives and overseas owned organisations.

The award in my view cannot possibly cover the industry without adding to the confusion by encouraging 'local deals' which in the eyes of the authors more adequately reflects a local situation. However, it is not long before the heavy-weights move in with the industrial muscle and transport the attractive portions only, to an area where in fact the new relativities just cannot survive without conflict. In my view a contractual type piece-work system of payment with the employees officially organising and supplying all the labour is worth trying.

Ownership, Siting and Size

The ownership of a particular works has little real reference in the climate of the industry over the last few years and I doubt whether it has ever been a real factor.

Urban works certainly have little if any of the understanding of their rural counterparts, so farmers can expect a relatively unsympathetic hearing on the questions of an understanding of the labour and endeavour that goes into presenting ones lambs or prime beef in top condition for the market place. The typical urban worker works to get money and the easier they can get it the better they like it. The casual urban workers are generally workers in a competitive labour market and so are less likely to accept serious employment responsibilities in our industry.

Nationalisation in my view is no real remedy for the industry although theoretically its purpose would serve to placate certain political ideals. I see nationalisation as the acceptance of the level of efficiency that is just not viable. The size of factories in human terms requires that communications be of the most efficient order possible. Agitators and disrupters find fertile ground for their activities under the protective umbrella of the trade union movement, particularly when management communications are inadequate.

Disputes and Disputes Procedures

If we are to have disputes then we must have an effective disputes procedure which both parties believe in and respect. The irony of the whole business at this point is that having designed an acceptable procedure and having tried it and tested it, in practice it is seldom used because the parties themselves will finally concede that they can resolve the issues themselves anyway. The exception to this are, of course, issues of national significance.

Ideals and Solutions

Remedial solution. In my view the nature of the production process, work methods and working groups offer the most significant improvement opportunities for both management and men.

For a long time now we at Shortland have believed that the mass production characteristics of a mutton chain which lead to boring, sole destroying, repetitive work, must be tackled. Some preliminary work already accomplished in Auckland suggests that butchers can work in smaller groups of 20 to 25 men, can carry out job rotation and enjoy being identified with the product. Strangely enough, mutton butchers can be seen to accept responsibility for quality.

The question of efficiency and economic results is always the counter that the traditionalists have for us when we suggest the mutton chains or any form of repetitively boring production work must go.

I would challenge the economic viability of the average New Zealand mutton chain now and the tremendous costs of back-up labour, absenteeism, labour turnover and the real wastage of human resources where we expect a person to repetitively do insignificant operations of about ten seconds duration at eight times a minute, day in and day out. It is failing as a production unit.

Industrial site agreements where all those employed are members of one union, having full time paid officials on site is an absolute necessity today. I would suggest that factories of 400 people or more should be the cut-off point. In fact, this issue is of critical importance for continued progress in industrial relations which will take us towards worker participation and industrial democracy programmes, these are objective and challenging symptoms of industrial progress. We must attain them.

INDUSTRIAL RELATIONS IN THE FREEZING INDUSTRY - A COMMENTARY

Mr G.J. Pullar
President, Federated Farmers,
Southland

I share with all a genuine concern for the welfare of people, the farming and freezing industries and the economic security of New Zealand.

Considerable efforts have been exerted in the field of industrial relations. Constant reminders from farmers, and my own Executive of Southland Federated Farmers, suggest there should at least be some visable sign of an improved industrial performance. However, I am well aware that the beneficial result of an Industrial Relations Programme will only be obvious in the long term.

Dr Turkington's paper highlights the major issues and problems restricting the industry. I agree with most of the points made, but believe there are other aspects and outside influences to be looked at.

The problems of the freezing industry cannot be treated in isolation but are symptomatic of the ills of society. Down through the ages, history has shown that man is constantly in conflict, in his endeavour to be supreme over fellow man. Conflict over the possession and ownership of land, water, material resources, and the amount, or relativity of financial rewards. Conflict in relationships with people, partners and families. Conflict over expressed thoughts, opinions, religious or political ideologies. Disagreement in such matters has, and always will be, an integral part of life.

We need to accept the fact that conflict is a reality; we must face this and learn how best to deal with it. Over more recent generations, social and economic changes have been rapid and violent. The stresses and tensions of a modern society leave us in an atmosphere of insecurity. Today people tend to be self-centred, selfish, greedy and less concerned as to how their actions may affect others. Many lack commitment and dedication to their work and we are psychologically conditioned to believe that the State will provide whatever our emergency or need. We "play the system", see how much we are able to get, for how little work input. We push our political ideologies of capitalism, socialism or communism to the point where the welfare of the company, business or nation is at risk - or conversely, where people are exploited.

In industrial or human relations we must remember that *people* are important. Human beings do have rights, thoughts, opinions, contributions and feelings. They may be our partners, members of our families. neighbours, friends, freezing workers, company staff or farmers.

Recognition of these rights, recognition of these thoughts and opinions are strong motivating forces both for farmers and freezing workers. Each of us has the need to develop a sense of personal worth, to know we are wanted, to know we are a valued and needed section of the community. We need to know that our productive effort and contribution is recognised by more than a monetary reward.

People most frequently feel at ease

* In a happy home situation
* When good relations exist with employers, foremen and

employees

* On those occasions when we are told our work is satisfactory and appreciated
* When we are successful and achieve objectives and standards
* Where there is security and our employers are obviously concerned about our welfare both during and following the works season.

In these circumstances we co-operate, act responsibly and respond.

On the contrary, we feel far less at ease when we have an unhappy marriage or home situation, when people ignore us or when people won't listen to our problems or seemingly worthwhile suggestions for work improvement. We have similarly uncomfortable feelings when we procrastinate in the decision making which effects us or when communications and job expectations are unclear, inadequate or unobtainable.

Finally, we may be expected to feel upset when people take us and our work effort for granted, put us down, criticise us publicly through the press and other media, and when we are always blamed for the things which go wrong.

To be human is to err. We are all prone to make mistakes or pass wrong judgements.

Because we are all different we think, act and respond to people and situations in a variety of ways. We play games in subtle ways, cease to co-operate, become militant, are inefficient in our work, more likely to damage plant or product and are more accident prone. When we in the community act out the critical, condemning, judgemental role, we behave as if what is wrong and bad with man is more important than what is right. We also display a great deal about our own attitudes.

To pay attention to what is good widens our vision - is positive and progresive. By adopting attitudes which encourage we provide an atmosphere in which others are able and willing to act as responsible adults; permits them to develop potential and skills.

Authoritarian relationships are inappropriate when a high degree of co-operation and personal endeavour are called for and team work is an essential ingredient in the establishment of healthy work attitudes. When we share in decision making then we are keen to see corporate ideas work, having already committed ourselves to their success.

There are many other essential attributes to enable us to develop right relationships in the community, or industry to which we belong. Fairmindedness, honesty, trust, care, concern, to be prepared to listen, to hear and accept a different point of view, tolerance, integrity, sincerity responsibility, sharing, commitment and a loyalty to others, are all important.

It is an interesting thought that we cannot offer the 19th century solutions to 20th century problems, yet even so, the most renowned human relations specialist practised two thousand years ago. The practical application of his code of ethics and doctrine for living, and acting within industry are still relevant and necessary to retain a balanced and just society.

We all seek solutions to the complex problems as summarized towards the end of Dr Turkington's paper. At the risk of becoming one of his "budding authorities" several issues seem abundantly clear.

Remuneration rates and relativities are the single greatest cause of conflict.

If people go on strike for increased monetary reward and continue to profit by this action, we will perpetuate the system.

Even when negotiating parties do settle down to rational and honest wage adjustment, experience has shown that a weak employer on a cost plus system or an over powerful key union may not necessarily arrive at a responsible decision. In my opinion the most logical alternative is to subject parties to arbituary decisions from a third party authority who would have much more control over relativity and the stabilisation of income levels than is evident at the present time. If this system became the only recognised means of wage and salary increase which must take place prior to the beginning of each killing season, there would be little point in going on strike.

There is a need to appoint a full time, highly skilled and trained industrial relations specialist in each meat processing plant.

Departmental foremen, board of control delegates, personnel officers and Ministry of Agriculture and Fisheries meat hygiene officers need to be trained in the art and skills of communication to enable them to be more effective and obtain greater co-operation.

There is a need for all parties within the industry to agree to work together with honest intent to build a new improved image for the industry.

There is a need to acknowledge our interdependence on each other, and collectively work together to anticipate and deal with likely problems in advance, to prevent possible disputes or loss of works through-put.

The united efforts of all involved in the meat processing industry could resolve all our existing problems.

If we do not allow ourselves to be part of the solution, then we are part of the problem. We need to unite in common purpose, to use the assets, skills and potential of each individual person to build our future - not destroy it.

FARM PRODUCTION AND ANIMAL FATS

Dr A.H. Kirton
Meat Section
Ruakura Animal Research Station

Overfatness in animals is basically not an animal health problem. Concern is expressed about overfatness in farm animals because meat is an important component of human diets. Consumers, particularly in the western world, where overeating is considered an important problem, are becoming increasingly sensitive to the presence of large amounts of fat in their diet because of health, cosmetic and also household economy reasons. In addition, some people just do not like a lot of fat. A recent survey reported in Time Magazine (January 2, 1978), indicated that almost all age and height groups of Americans were heavier in the 1971-74 period than similar groups in 1960-62, indicating their natural tendency to under-exercise and overeat.

Although a long life is considered desirable for the human population, longevity is of little economic significance in farm animals because what is usually considered to be the useful productive life is considerably shorter than the natural life span which is therefore seldom measured.

Jean Mayer, a well known Professor of Nutrition at Harvard University, has recently commented that obesity or over-fatness occurs in humans where calorie intake is high with activity at normal or near normal levels; it may occur where calorie level is in the normal range with activity abnormally low, or it may mean that calorie intake is somewhat high with energy expenditure somewhat decreased. These same combinations are likely to occur with farm animals under intensive farming conditions with the extreme situation being the feedlot. The emphasis in animal production on maximum efficiency of conversion of pasture or feed calories to animal calories, with no bonus for "waste" in the form of exercise, may in fact be encouraging the production of over-fat animals where the carcass meat is the production endpoint. In fact, intensive animal production appears to be encouraging the conditions that Mayer has described as the major prerequisites for obesity in man, hence the fact that overfatness is a problem in some farm animals, should not be too surprising.

WHAT IS OVERFATNESS?

Most attempts to define overfatness in farm animals are made in relation to the carcass of meat animals and its expected acceptability to human consumers. The definition of overfatness will differ markedly from country to country, and may even differ between markets within one country. Although the ideal carcass for Israel comes from a 450-500 kilogram Friesian bull with a carcass practically devoid of fat, such a carcass is likely to be graded as only suitable for manufacturing in New Zealand. The United States of America, United Kingdom and New Zealand comsumers find acceptable meat that is much fatter than would be acceptable in some other countries, partly influenced by trade beliefs that fat is needed to impart "quality" or tenderness and flavour. Most consumer research, particularly in the United States of America and United Kingdom, suggests that higher levels of fat in meat is becoming less acceptable.

Those marketing our meat should have factual information specifying the fatness levels, however measured, which are acceptable and levels indicating overfatness for any particular market. We should know what proportion of the national kill is required at the various fatness levels as measured by the export grades to satisfy overall market requirements. It is only with this type of information that our marketeers can decide whether the present mixture of grades being produced is satisfactory, or needs changing. It is only with this type of information that we can decide what an overfat carcass is. It must be emphasised that carcasses currently graded as overfat will be those that are clearly overfat for *all* markets, but some of the remaining carcasses in the next-fattest grades will also be overfat for *some* markets. The overfat grades are the tip of the iceberg, and meat from such carcasses may not be exported without trimming.

I know of little readily available detailed information which defines an overfat carcass for any market. The MacIntyre Meat Export Grades Investigating Committee suggested in their 1974 report that in terms of the measurement of fat thickness over the eye muscle of the chop taken at the 12th rib in lambs, that carcasses with more than eight millimetres fat were overfat for the United States of America, and with more than ten millimetres were overfat for the United Kingdom market. When fat thickness is measured at this site, the report suggested that carcasses with 6-8 millimetres fat would be acceptable in the United States of America after trimming, and with 7-10 millimetres fat, would be acceptable in the United Kingdom after trimming. The basis of arriving at these figures was not given.

Information I received from the British Meat and Livestock Commission in 1976 indicated that lamb carcasses containing more than 34% fat, including kidney fat and measured by dissection, are overfat in relation to all markets in the United Kingdom. Lamb carcasses containing 30-34% fat are overfat, except for high class rural butchers who might accept them at average prices. Similarly, it was indicated that cattle carcasses containing more than 31% fat were overfat in the United Kingdom, and those with more than 27.5% fat are overfat for most markets, but acceptable for the high class trade.

In summary, definitions of overfatness will vary from market to market. We are short on factual information describing the borderline between acceptable and overfat meat for most of our main markets.

NEW ZEALAND CARCASSES AND THE OVERFAT GRADES

Export grading in New Zealand is the responsibility of the Meat Producers Board which lays down standards and supervises company graders in order to maintain national uniformity of these standards. The main grade symbols in sheep and cattle grading relate to the fatness of the carcasses. The F grade for lamb, the MF grade for mutton the the G, T and E grades (getting progressively fatter from G to E), for cattle, indicate the officially recognised overfat grades. These carcasses must be trimmed before their meat may be exported.

Table 1

FAT COVER - N.Z. EXPORT GRADES*

Type	Deficient ←——→ Excess						
Lamb	M	A	Y	(P,O)	F		
Mutton	MM		MX	MP	MF		
Beef	M		L	P	G	T	E

* Symbols used denoting fat cover

In the case of lamb carcasses up to 1974-75, some containing 43% or more fat by weight were graded overfat, and others in this range were not. Not surprisingly, complaints about overfatness in New Zealand lamb and mutton carcasses have persisted over the years, and the figure just quoted suggests they are justified. In the case of G grade cattle, limited information suggests that approaching 20% of fat trim was removed in one Massey University trial (Barton, pers. comm.), before the meat could be packed. I have no information on the fat trim from T and E grade cattle, but it would clearly be greater from these latter grades.

ECONOMIC CONSEQUENCES OF OVERFATNESS

These must be looked at both in the short term and the long term. If in the long term we were to continue to export carcasses or cuts which are fatter than consumers are prepared to buy, either the retailers are going to have to trim the cuts before sale and make the appropriate downward adjustment to the prices they pay wholesalers for New Zealand meat, or worse still, their customers will just stop purchasing our meat. In addition, we will be sensitising the customers to the publicity of those who can see economic gain in promoting the animal fats-heart disease story. In the long term, we must aim to avoid producing too many over-fat carcasses unless a market can be found where the price of waste fat approaches that of carcass meat. The problem is more serious for sheepmeats which are exported as carcasses than for beef, which is almost all exported as cuts trimmed before export.

In the short term, decisions on the farm are going to depend on the proportion of carcasses actually graded as overfat, and the price differential between overfat and acceptable carcasses. The figures in table 2 indicate that a farmer is paid considerably more for an acceptable carcass than one that is currently graded as overfat. These differentials are

Table 2

ECONOMIC PENALTIES FOR OVERFATNESS
(1977-78)

Lamb	P grade	receives	approx.	50%	>	F
Mutton	MM	"	"	"	500-600%	>	MF
	MM	"	"	"	200%	>	MH2
Steer	P1	"	"	"	50%	>	E
	P1	"	"	"	20%	>	T
	P1	"	"	"	7%	>	G

probably sufficient to act as a disincentive to farmers who actually produce carcasses graded as overfat, and who receive the lower prices.

The situation is confused in the case of G grade beef carcasses, as they may be graded G because they are judged to be overfat with cuts requiring trimming. However, beef carcasses may also be graded G, with only P grade fat cover not requiring trimming, because they are considered to have leggy hind quarter conformation. Thus, when you look at the round 25% of all export beef carcasses graded in the G grade (table 3), it is not clear which of these have been put there because they have G fat cover, or because they have leggy conformation, but P fat cover. I consider it rather unfortunate that those with P fat cover and leggy conformation were not put into a P2 grade, as recommended by the MacIntyre Committee, instead of into the G grade as is currently the practice.

What proportion of overfat carcasses are actually produced or

Table 3

PERCENTAGE OF STEER* CARCASSES GRADED OVERFAT

IN THE NATIONAL EXPORT KILL

Season	Steer grade G	T	E	
1971-72		(0.1)**		
1972-73		(0.1)**		
1973-74		(0.1)**		
1974-75	(26.3)	(0.5)**		new
1975-76	25.3	1.2	0.0	grades
1976-77	24.7	1.6	0.2	
1977-78	?	?	?	

* Similar trends to be seen in other classes of beef

** Graded "Trimmer" under old grades

graded? Tables 3 and 4 suggest that, as judged by grading statistics, such a low proportion of all carcasses produced are placed in the overfat grades as to indicate that New Zealand has no problem. The proportion of carcasses graded overfat to date has been so small that few farmers are likely to be convinced that we have an overfatness problem. However, one indication that all may not be well can be seen in the tendency for the proportion of carcasses graded as overfat to be increasing, and the knowledge that only a proportion of overfat carcasses are graded as such. Although as mentioned earlier, the British Meat and Livestock Commission have information indicating that lamb carcasses with more than 34% fat are

Table 4

PERCENTAGE BY TYPE OF SHEEPMEAT CARCASSES GRADED AS OVERFAT IN THE NATIONAL EXPORT KILL

Season	Lamb		Mutton	
	F grade	GR (mm)*	MF grade	
1971-72	0.2		1.0	
1972-73	0.2		1.1	
1973-74	0.4	18	1.1	
1974-75	0.4	16	1.4	new grades
1975-76	0.7	16	2.1	
1976-77	0.5	16	2.2	
1977-78	?	16	?	
1978-79	?	15	?	
?	?	10(?)	?	

* GR measurement below which lambs are not graded overfat

overfat for their market, we know that until recently, we have only been eliminating some of our lamb carcasses with 43% or more fat in their carcasses. This indicates room for toughening lamb grading standards.

The conclusion can be reached that there are economic penalties for overfatness, but because of the small proportion of carcasses affected, these have been of little signifance to most farmers until recently, although a few with larger numbers of overfats have been hit.

COMING ACTION ON LAMB?

Our Meat Producers Board accepted that New Zealand is currently producing too many overfat lambs which were not being graded out in the overfat (F) grade as in operation in the 1966-67 season. They therefore announced that standards for F grade lamb were going to become progressively tougher over a number of years until only carcasses completely acceptable to our overseas markets are placed in the grades where no trimming is required. The announcement of this long term plan has given farmers time to adjust management procedures and take necessary action to produce leaner lambs before they are adversely affected economically.

Carcasses are assessed by graders for fat cover by eye appraisal but those considered borderline between the overfat (F) and next fattest grades (P or O) may be probed in the vicinity of the 12th rib at a point 11 centimetres from the midline with a knife or measuring ruler. The tissue thickness measurement between the surface of the carcass and the underlying rib bone taken at right angles to the surface, is known as the GR measurement. Lamb carcasses with a GR measurement of 18 millimetres or over were graded as overfat in the 1974-75 season; by the 1977-78 season this measurement had been reduced to 16 millimetres, and in the 1978-79 season it is to be reduced to 15 millimetres. The Meat Producers Board has indicated the belief that this measurement will have to be reduced eventually to 10 millimetres before most of our lamb carcasses are suitable for most customers. I have seen one estimate which suggests that if present day lamb carcasses were judged by a 12 millimetres GR standard, just under 20% could be graded as overfat. I think this means that farmers are going to have to take this overfatness problem very seriously for lambs if they do not wish to be penalised.

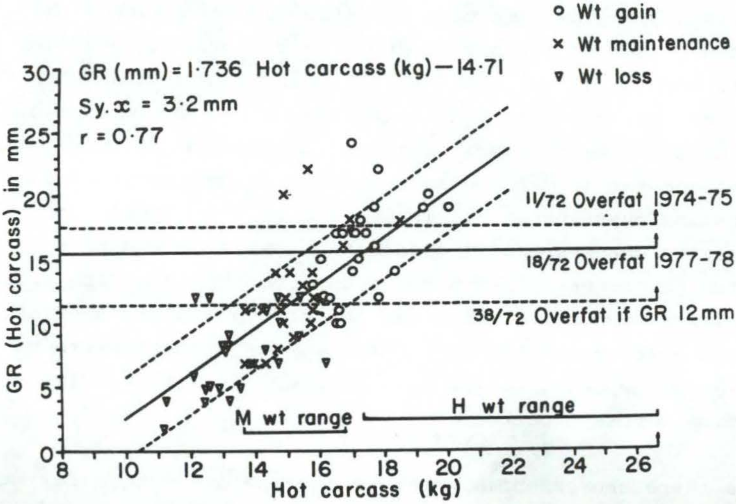
THE GR MEASUREMENT AND CARCASS WEIGHT IN LAMBS

Having one GR measurement as the cut off value between overfatness and acceptability over all carcass weights in lambs has probably been satisfactory up to the present time because this does provide an objective cut off point and not too many carcasses have been affected. However, it is known that almost any carcass measurement that may be named increases with increasing carcass weight. That is, bigger carcasses have bigger measurements. Therefore, any system using one key measurement which is reduced year by year can be expected to result in farmers reducing carcass weights to avoid economic penalties from overfatness.

Some data from a nutrition experiment illustrating this point is shown in figure 1 which shows the GR measurement taken on 72 Southdown Romney cross lamb carcasses plotted against their hot carcass weight. The line of best fit drawn shows that on average, for each kilogram increase in carcass weight the GR measurement can be expected to increase by 1.7 millimetres. Lines have also been drawn in going straight across the diagram showing the number of carcasses in this trial which could have been judged overfat in the different seasons, based on the GR measurement. With the 18 millimetres and over standard in 1974-75, 11/72 or 15% could have been judged overfat. With the 16 millimetres and over standard in operation in this present (1977-78) season, 18/72 or 25% could have been judged overfat. If a 12 millimetres and over standard was to be adopted, 38/72 or 53% of these carcasses could be judged overfat.

The average carcass weight of the 72 lambs in the trial was 15.4 kilograms. If the 18 millimetres GR standard was applied, the mean weight of the 61 carcasses with less than this figure was 14.9 kilograms; if the 16 millimetres standard was adopted, the average weight of the 54 carcasses not judged overfat was 14.7 kilograms. With the 12 milli-

FIGURE 1. RELATIONSHIP BETWEEN MEAT PRODUCERS BOARD GR MEASUREMENT (mm) AND HOT CARCASS WEIGHT (kg) FOR 72 SOUTHDOWN ROMNEY CROSS LAMBS



metres GR standard, the average weight of the 34 carcasses not judged overfat was 14.1 kilograms. These results show that if one GR measurement is to be adopted over all carcass weights, the effect will be to reduce the average carcass weights of those not judged overfat.

By this stage many people will have concluded that as the aim is to eliminate overfat carcasses, the ones we want to avoid are those that are fatter or have larger GR measurements than the average carcass of any given carcass weight. Within limits, this must be true, and to reduce the fatness of heavy lambs by breeding or management we will have to follow policies that will also lower the fatness in lighter lambs. Therefore, to achieve this it is desirable that there be different GR measurements to define overfatness in the different carcass weight ranges (L, M and H), with smaller measurements for lighter carcasses. This involves using a biological solution to solve a biological problem.

Unfortunately, the marketing situation and the marketing solution required may differ from the biological solution. As the carcass of any type of animal increases in weight it is clear that on average both the weight and proportion of fat in the carcass also increases. Therefore, if any percentage fat or carcass measurement can be specified as indicating overfatness, it is certain that a higher proportion of heavier carcasses will exceed such measurements than lighter carcasses. If measurements can be specified which consumer research indicates can be used to measure overfatness, then we must accept the fact that heavier carcasses are more likely to be penalised for this reason, and will require trimming before export.

It is therefore essential that we have an accurate description of what an overfat carcass is, for any particular market, before the best solution to the grading side of the problem can be found. Can overfatness be defined in terms of one measurement or one fat percentage? Will the consumer accept larger measurements from larger carcasses? Unless we have reliable answers to the above type of question, we cannot devise a method of defining overfatness which can be used to establish cut off points in a practical grading system.

WHAT CAN A FARMER DO ABOUT OVERFATNESS?

There are potentially several approaches the individual farmer may take to the problem of overfatness in his farm animals, and the best is probably some combination of these. There are problems associated with each solution.

Lowering Carcass Weights

While lowering carcass weights will reduce the overfatness problem, this is an undesirable policy both to the individual farmer and nationally. It would lower the weight of meat the farmer and the nation would have to sell from a given number of cattle or ewes wintered, and would spread increasing transport and slaughtering charges over a lowered weight of meat which is the wrong approach for farmers who plan to stay in business.

Do Not Castrate Males

A multitude of evidence has shown that entire males grow faster than castrates, provided adequate feed is available. Males are leaner and more efficient feed converters than castrates. Where overfatness is a problem, females which tend toward greater fatness should be slaughtered at lighter weights, and entire males can be taken to heavier weights.

Although there are no problems with grading of bull carcasses, there are management problems in running bulls on a farm where the same or neighbouring farms have female cattle. In contrast, with lambs, the management problems in running young rams are manageable, particularly on fat lamb farms, but there is still considerable trade prejudice against the carcasses of ram lambs. Experimental evidence shows that this prejudice is not justified.

Breed Changes

Breeds which in the past were considered superior because of their ability to fatten, are now the breeds not to use when overfatness is a problem. Animals with larger mature sizes tend to be those with leaner carcasses at any given carcass weight. Overseas, heavier ram breeds such as the Suffolk, Hampshire and Dorset (Horn or Poll), tend to be used as terminal sires for lamb production and European cattle breeds including the Friesian, are known to produce leaner beef.

Selection Within a Breed

The effectiveness of selection against fatness has been shown on an industry-wide basis for pigs in several countries.

Similarly for sheep and cattle, research has shown that selection against fatness should be effective. The main problem to date in setting up a programme to reduce fatness has been to develop a satisfactory method of measuring the fatness of live animals cheaply enough to be able to use the system on a farm basis. Ultrasonic methods are now becoming available which may solve this problem and enable selection against fatness on the farm.

Other

There is evidence to suggest that raising stocking rates, rotationally grazing, rather than set stocking, weaning lambs earlier rather than later, and increasing the proportion of twins through raised ewe fertility will all assist in reducing the overfatness problem.

THE MEAT INDUSTRY AND THE ANIMAL FAT CONTROVERSY

The New Zealand meat industry has an overfatness problem which appears to be most serious in lamb production. For reasons of economy of production and consumer acceptance, as much as because of possible associations between fat and heart disease, it would be sensible for the meat industry to move toward the production of leaner meat. As more lean meat can be produced from a given quantity of animal feed than fat from the same amount of feed, it is likely to be more economical to produce leaner meat. It also makes little sense to use pasture to produce unwanted carcass fat just to provide employment for meat workers who are paid to trim it off. Such additional costs will reduce the return to the farmer.

Few consumers want to purchase the excess amounts of fat currently produced on a proportion of traditional meat animals. Lean export grades are available to overseas customers who object to the levels of fat found in the so-called prime export grades. It is very unfortunate that the other carcass grading system in operation in New Zealand, that is used on carcasses intended for local consumption, has laid so much stress on the need for a good fat cover, making it difficult for New Zealand consumers to buy lean meat. In this regard, it is surprising that in the past the Health Department, Consumers' Institute and organisations such as C.A.R.P. have, if anything, supported the present local consumption grading regulations.

In conclusion, I believe the response of the farmer to the problem of over-nutrition in Western societies (which make up our main meat markets), and to associated health problems, whether or not animal fats are involved, should be to produce less fat carcasses from meat animals. Red meat is a highly nutritious food.

Biased information in the mass media suggesting that everyone is in danger of coronary heart disease if they do not restrict the amount of animal fat alone in their diet, should be countered with factually based replies. This accepts that there may be a small proportion of the population at risk who should be placed on special diets which may involve a lowered intake of animal fats. Such dieting should be based on medical, rather than mass media advice.

In addition, the meat industry should support medical trials which specifically test animal products as major components of diets. One such trial carried out by Professor P.J. Scott at the Auckland Medical School, has tended to show that a low fat, animal product diet was as effective as a polyunsaturated fat diet in reducing the level of blood cholesterol in a group of trial patients regarded as being at risk. More trials of this nature are needed.

Finally, I am sure that the meat industry can adjust to all its problems, and will have no difficulty in producing leaner meat of the type likely to be required by our customers in the future.

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NEW ZEALAND FARMERS AND MODERN NUTRITIONAL IDEAS

"THE URGENT NEED TO EDUCATE POLITICIANS & ADVISORY GROUPS"

Professor D.W. Beaven
Christchurch Clinical School

INTRODUCTION

Homo sapiens 1978 is literally what he eats. With the drying out of the land some 25 million years ago, the early apes were released from the trees and a fixed and limited diet, to widespread opportunities for change. The exciting possibilities over the next 20 million years with access to new chemicals, minerals and environs led to continuing mutation with the evolution of complex biological machinery to deal with a wide range of environmental situations. For example, it is now recognised that up to ten known gut and regulatory hormones deal with the absorption and assimilation of simple sugars and amino acids. These vary in activity according to the prior ratios of material in the diet. It is now being increasingly realised that the composition of the body and all the tissue is controlled by previous dietary intake. In view of the effects on the New Zealand farming economy and international dietary nutritional ideas, I would like to pass over the question of world food supplies, as these now appear to be keeping up globally with population increases (Lancet 1977). There is thus much more interest in the question of the economics of food production, and distribution between the wealthy and poor countries. Increasingly the national trading policies in regard to food and the health interest of the people are being discussed. (Lancet 1975.)

For New Zealand, a key factor is of course, the utilisation of energy in order to increase food production and for energy, one must concentrate on fossil foods, fuels and the imported cost, hydro-electric energy, and the overseas energy costs of making fertilisers and machinery together with food processing, technology, packaging and cooking.

In Britain and America, about 12% of energy consumed goes to food production, and in those countries, six calories of fuel are utilised in producing one calorie in food. (Lancet op cit). It is now widely agreed that the limits of increased food production are dependent on modern technology for increasing most economic yields of essential nutrients and the ability to find new sources of energy.

NEW ZEALAND FARMING

New Zealand farmers are, by general agreement, and by international statistics (Scientific American 1976), some of the most efficient in the world, and this country being a small island, has adequate supplies of rain water and solar energy for photosynthesis. One percentage of solar energy is trapped by good standard farming methods and this surely suggests that we should look at the economics of trapping solar energy by photosynthesis in order to reduce the use of grossly inefficient machines such as ruminant animals to convert green fodder into beast and useless fat. One of the great tragedies of the New Zealand economy of the last decade or more, is the fact that major New Zealand advisory groups and producer boards have been prepared to accept a narrow segment of advice on the future dietary requirements of those countries to which we export, and in some cases, actively oppose the suggestions of medical and nutritional scientists who have been closely monitoring changes of attitudes in North America and Europe. Thus, throughout the late 60's and early 70's, the Dairy Research Institute and Dairy Board, rather than accepting the need to diversify from what is essentially fat production, resisted change, despite New Zealand medical pressure. Top calibre scientific magazines such as Nature, Science, The Lancet, Journal of Clinical Investigation, Journal of Clinical Nutrition, scientists and others, have now for half a decade accepted the major change in dietary habits of North Americans and Europeans towards goals which have been increasingly spelt out by different countries.

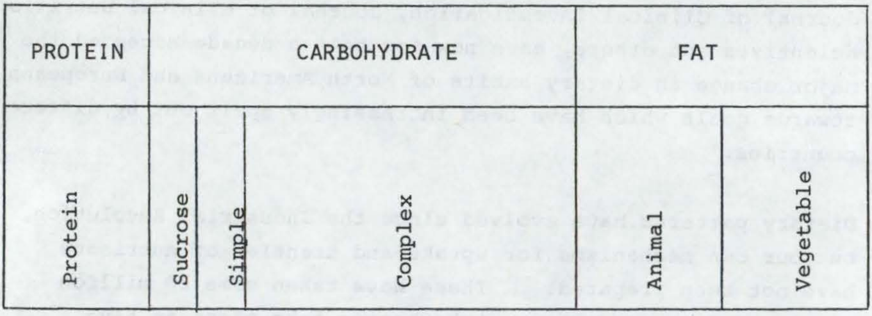
Dietary patterns have evolved since the Industrial Revolution, but our own mechanisms for uptake and transfer of nutrients have not been prepared. These have taken some 20 million years to adapt, and when quick changes take place as have happened over the last twenty generations, disease states result because adaptation to change has always taken place by mutation and survival of the fittest. Those unable to survive by change - by adapting and remaining healthy - are lost.

GOVERNMENT INVOLVEMENT IN DIETARY GOALS

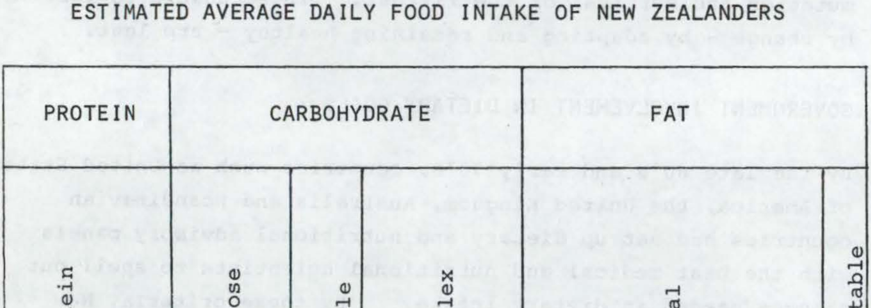
By the late 60's and early 70's, countries such as United States of America, the United Kingdom, Australia and Scandinavian countries had set up dietary and nutritional advisory panels with the best medical and nutritional scientists to spell out changes needed in dietary intake. By these criteria, New Zealand governments of the last decade have not received balanced advise from farming advisors on the one hand, and nutritional and medical scientists on the other (figure 1). Whilst the overseas countries to which it is vitally necessary that we export our food products have been strongly guided by nutritionists, our economic planning groups and farm advisory groups, together with Government agencies have been driven towards economic disaster. They have pressed for greater productivity of the same kind, rather than a major diversification away from traditional New

Figure 1.

IDEAL INTERNATIONAL DIET



ESTIMATED AVERAGE DAILY FOOD INTAKE OF NEW ZEALANDERS



ENERGY 13.4 MJ 3,200 kcals

Zealand farming practices.

For example, the United States of America dietary goals, formulated in 1976, (Nutrition Review 1977), bear on the New Zealand farming economy:-

* Reduction of fat consumption from 40 to 30% of energy intake.
* Reduce saturated, or animal fat to 10% of total energy intake. The rest to be vegetable oil.
* Increased consumption of fruits, vegetables and wholegrain.
* Decreased consumption of meat and increased consumption of poultry and fish.
* Decrease in consumption of foods high in fat.
* Substitute non-fat milk for whole-milk.
* Decrease consumption of butter-fat. (Nutrition Review 1977.)

There has been a steady shift in the United States of America dietary intake towards the goals spelt out some ten years ago. Impetus has been given towards such dietary programmes in Norway, the United Kingdom, and North America by studies which have shown for the first time the reversability of atheroma and coronary heart disease by groups of people switching from an animal fat or butter-fat intake to vegetable oils and little or no animal fat. More recently, the change in mortality from coronary heart disease in Great Britain (British Medical Journal 1977), and in the United States of America (New Zealand Journal of Medicine 1977), argues that the beginning of national dietary change is the only significant risk factor known for atheroma which has significantly altered. In my opinion, such results are likely to have an accelerating effect on changing dietary patterns in North America and Europe.

IMPLICATIONS TO NEW ZEALAND FARMERS OF REVERSAL OF DIETARY PATTERNS

These recent reports on changing mortality from coronary heart disease in North America and the United Kingdom, with the assumption that they are due to the increasing trend away from animal fats and butter, does have serious implications for the New Zealand economy. Moreover, reports over the last few years such as that by Blighs (Blighs 1978), make a passionate plea for a significant reduction in meat and fat in the diet - by which is meant, meat, butter and cheese - and an increase in unrefined cereals and starches. Blighs uses his own pressure group, Food Policy and Environmental Research Limited. Such a policy has been adopted in Norway since 1973 as a national food policy, and in that country, government nutritional advisors have "persuaded" citizens by means of food pricing and production policy.

These food policies, to encourage the use of vegetable and fish oil, fish and poultry, in place of lamb and beef, and the phasing out of butter and cheese with a total reduction in calories, has now been in operation for five years and such a "tough" nutritional policy has recently been adopted in Sweden.

Others (Schaffer and Maar 1977) viewed major official reports from many parts of the world. They indicate that virtually without exception, there is now growing government pressure in many countries to reduce total fat intake from animal origin, and in particular butterfat and animal fats, and to push for a greater swing towards the polyunsaturated vegetable oils. In this excellent review, which should be part of the essential reading by politicians and the Producers Boards, they review the various dietary recommendations from 42 countries. They come up with the clear and unequivocal statement that in every country there are major nutritional policy pressures for a reduction in saturated or animal fat intake or partial substitution by vegetable oils and pre-industrial revolution diets.

There are now several atheroma research journals published every month, and about half the scientific articles produced are fat induced research studies. They indicate quite clearly that the acceptance of high blood fats in the induction of atheroma is now complete. The only controversy left is the mechanism by which this occurs. There is also of course, increasing argument as to the relative percentage risk added by things such as overweightness, high sugar intake, high blood pressure, smoking and physical activity. It would be fair to summarise by saying that over the last decade, the argument regarding animal fat intake and coronary heart disease has gone from a stage of controversy to adoption of an anti-fat policy by most government advisory groups in the affluent countries.

So, if New Zealand farmers want to see the results of photosynthesis in the form of biological products abroad, these should certainly not be in the form of animal fat. We should be phasing the New Zealand dairy industry out of butter production and towards low fat milk protein production. Milk should be paid for on a solids, not fat or protein content, and there should be a national policy with due target deadlines, whereby butter production was significantly and steadily reduced, perhaps by 15% every five years over the next 15 years. Absolute priority should be given in the meat production industry to find methods of producing lean animals with no additional fat. This has been advocated by a number of us over the last ten or fifteen years.

IMPLICATIONS FOR NEW ZEALAND POLITICS

The shift away from butterfats and muttonfat has become, in essence, a way of life in the affluent western countries. We must either steadily move away from current farming practices, or accept the alternative of looking for markets other than Europe, North America and Japan. These do not seem very hopeful. We cannot afford to allow political leaders in New

Zealand and planning experts without nutritional awareness to continue with unmodified proposals that greater farm output of the same kind as before can be any answer to the future. If one takes inflation into account, it has been obvious for some time that "traditional" farm products have been doing less well than other products as a percentage increase of export earnings. Regrettably, the major investment input of the last ten years into appropriate butter making equipment may have to be slowly written off. This is a political decision, eventually to be made by government pressure on the Dairy Board. Increasing farm output, of the same as before, spells economic disaster for the future of New Zealand farming. The highly efficient farmers deserve better advice than many have been receiving till now on future market trends.

Greater productivity on farms has been shown in the Scientific American to be related to the fertiliser imports of any country, and fertiliser imports are related to fuel prices and essentially, oil prices. Thus, greater output of an accrued undifferentiated kind can only be achieved by greater use of imported oil and the real future lies in diversifying into a wide range of luxury type farm and processed goods and to include positive dis-incentives to goods no longer sought in our traditional market places.

New Zealand farming is the most productive and efficient in the world and farmers should be given positive incentive subsidies only if they produce material in high world demand. In no way should any subsidies be given to those products such as butter which are difficult to sell.

Financial dis-incentives must be introduced on farm products of an undifferentiated kind meeting increasing resistance in market places. Butter, unsophisticated cheeses, and overfat meat products have already been mentioned.

DIVERSIFICATION BASED ON NUTRITIONAL DEMANDS

Three years ago, in our publication on the Future of New Zealand Medicine, (Beaven & Easton 1975), Professor John Scott argued persuasively for a joint committee of top medical and nutritional people in a consortium discussion with the Meat & Dairy Boards, and with the Dairy Research Institute. In fact, such overtures have been met with the general comment that New Zealand medical and nutritional experts already predicting the future outlook for butter of the last few years, have been branded as disloyal to our trade aspirations.

Two years ago, after a talk on diversified dairy material with penetration into the luxury market of a small amount of luxury cheeses, and an enzyme fortified health type milk product, I stated, "that government should urgently explore the means of diversifying some of our dairy farms into fish farming, leaf protein and production, cereal crops, such as saffron seeds, soya beans, and nut crops of all sorts. All forms of nut production should be explored. These are one of the fastest growing profit areas in North America. Any product of photosynthesis with light, water and warmth from the sun should be explored by the Department of Agriculture and the D.S.I.R....."

Indeed, if we are to look at the world's requirements from the viewpoint of economic returns for the New Zealand farmers, we can see that the green revolution of the last decade has meant that calories are no longer in short supply; animal fats likewise are not in high demand. Lean protein meats will still be required from non-arable farmlands, but urgent feeding programmes to produce the type of lambs grown in the hill country of France would continue to be explored. It is totally uneconomic for much of the efficiency of New Zealand farming to go into the production of unwanted fat in the carcass. Luxury foods for the Pacific Basin should be far more actively encouraged by export incentives further looking at the traditional diets of the over 1,000 million people around the Basin.

Seed Oils

If we are to look at the foods eaten by South East Asian people, we can see that the traditional diet contains very little which has been part of our current New Zealand farming practice. I believe that seed oils could be grown in virtually every part of New Zealand; species varying according to the climatic conditions and the isobar levels throughout the year. The variety of oils as shown in figure 2, could be utilised in different parts of New Zealand and would have a ready sale in South East Asia where vegetable oils are in great demand and the prices rising disproportionately to cereals. Obviously people in this area have a much greater demand for fish, fish products including fresh water fish products, and various pork products, rather than beef or lamb.

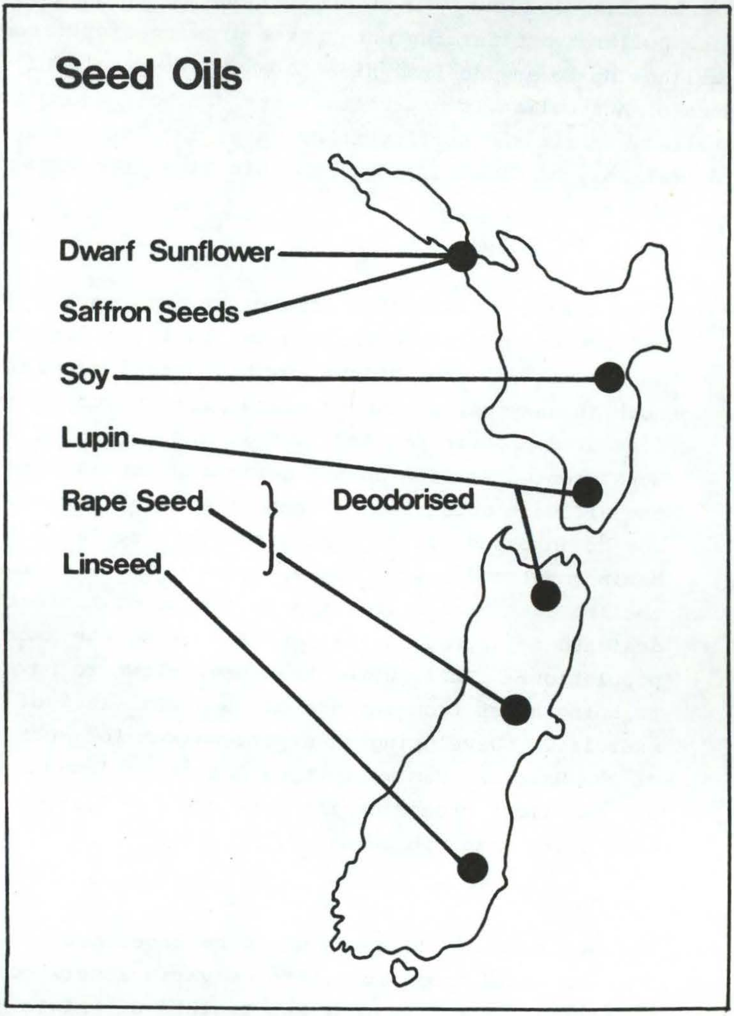
Pork

What of incentives for pork farmers in comparison to the use of land for sheep farming? Surely the small number of breeding sows could be increased over the next decade, and a worthwhile diversification of processed pig meat into South East Asia could be undertaken on a pilot basis initially.

Fish

In an excellent review on fish culture (Weatherley & Coggen 1977), we see that commercial fishing of fresh water fish could make a major contribution to world protein needs but, in most of the countries with the technology, there is a shortage of fresh water. Surely this does not apply to New Zealand, and I remain unconvinced by the arguments of the Acclimatisation Societies regarding infestations and viruses as a hazard in fish farming. Such problems have been met and dealt with in the United Kingdom and to a major degree in Canada where fish farming is now a recognised part of diversified farming without hazard to the natural trout stocks. In 12 years,

FIGURE 2


Seed Oils
Dwarf Sunflower
Saffron Seeds
Soy
Lupin
Rape Seed
Linseed
Deodorised

Norman Douglas of Albury in Australia, has built up a multi-million dollar trout farming enterprise growing trout from fingerlings up to any desired size to partially meet the demands of Australian luxury restaurants. Water supplies in Australia limit the ability to do this, but New Zealand could certainly be diversifying into this area in a major way.

DIVERSITY FOR THE FUTURE

* I am amazed to find that some dairy farmers are still encouraged to produce more on the basis of fat product in the milk. What of the new biological materials such as enzymes, expensive trace protein substances, flavoured protein powder, invalid and fortified foods, supplemental feeding in the geriatric populations of the affluent countries? What of a wider variety of ice-cream bases, instant puddings for the Pacific Basin hotel and luxury trade, and the infiltration of the American health industry by ranges of instant milk designed to appeal to the neuroticism of the American population? Their women have been shown to have thinning bones from the age of 35 due to lack of exercise. Developing an export market for soft cheeses of the Brie and Camembert type has been slow despite our excellent cheese making base and our heavy input into dairy research sciences.

* Various nuts of all sorts could be developed. Subsidies for the field crop population of various nuts could be appropriate for different New Zealand districts. On enquiring, I find that there are no major grafted walnut plantations sponsored on the basis of climatic conditions, although one or two small export pilot schemes have developed sending our trees abroad.

* Food enrichment programmes, and supplementation of cereals and cereal diets with grain legumes and amino acids, is one of the hottest developing issues in world nutrition. There is a major world shortage of these high quality amino acid powders which could be derived in New Zealand as a result of the progressive farming industry in this country. The recent lupin workshop supplied by the Chemistry Division of the DSIR in Palmerston North in 1977 showed the possible future value of lupin flower. It also made an appeal for government to underwrite financial risks taken by commercial enterprises and farmers into such ventures. Such short term subsidies must be given if we are to diversify further.

* Vegetable oils such as alfalfa or lucerne oils, and a wide variety of oils of various sorts could be sold with supplements of various amino acids extracted from our own meat industry. At a recent international meeting on nutrition (Nutrition & Metabolism 1977), there was considerable discussion and a number of papers on the enhancement of the biological value of whey and vegetable proteins, in addition to the essential amino acids. For some time in Nutritional Review, there has been considerable discussion on microbial proteins.

One could envisage a linked gain using the excellent water and sunlight in New Zealand to perhaps grow pigs for the South East Asian market, and use the material from the pig slaughtering to feed fresh water fish in ponds with the fish offal being used for microbial protein growth, which will also be stimulated from the faecal and urinary effluents from the pigs.

There has also been major interest in the obtaining of nitrogen from such substances as butanedial and urea, to improve the nitrogen content and incorporate this into body proteins of animals and even humans, (Kies et al 1973). Lucerne has been shown to yield an excellent high quality water soluble protein from the green leaves and already in California such protein is being incorporated into food stuffs.

* Luxury Vegetables and Fruit - The recent development of plasticised and aluminium containers which can be gassed with inert gasses, to remove all water vapour and oxygen from the container, allows expensive fruits and vegetables to be transported long distances and for several days without damage or oxidation. Such developments, incorporated into intensive farming practices in New Zealand could allow maximum utilisation of irrigated land and vastly improved farm output.

WHAT OF THE FUTURE

It is quite essential that New Zealand re-develop a strong nutritional base and that considerably more than the current one quarter of one percent of the total scientific research budget go into human nutritional study groups in this country. Such groups will produce the able nutritional scientists who can be utilised in a variety of ways, and who can advise government and policy makers together with the Producers Boards, on diversion of present resources to some of these newer areas which are vital to the well being of the New Zealand economy. Modern scientific research no longer allows a person say in agricultural research, to understand all recent human nutritional research, particularly related to gut hormones, absorption and transport of amino acids, and the control in the human organism.

It is as a result of such studies on human beings, that current nutritional policies are being formed in a number of countries to which we currently market our farm produce. What I am really saying is that it is essential that we build up human nutritional research groups in New Zealand so that they have a really major influence on government and agricultural policy. It is essential that such policy is determined with close collaboration and discussion between human nutritionists and policy makers.

In my opinion, our one hope as one of the most efficient farming nations in the world, but critically open to changes in fuel prices, is for a top level farm production group to be guided by an advisory council on human nutrition. This should have real teeth, and be able to influence rapidly diversifying agricultural policy in this country. Members from many different scientific disciplines, who are already aware of the steady shift away from traditional eating patterns by Europeans, North Americans and Japanese, could review the changing patterns in dietary advice and consumers of our products.

I believe that they can already advise reasonably well on the likely eating patterns of these countries and of South East Asians through the 1980's. Sadly, I believe that the Producer Boards may be too remote from the scene, too inflexibly isolated from the cutting edge of scientific research in nutrition, and even possibly too remote from the changing patterns of the trend setters and advertising leaders in these countries, to take real notice.

In my opinion, continued current farming policies advised even by top government planners will only lead to further surpluses of unwanted farm products which reduce prices and a loss in the New Zealand quality of life. Individual farmers cannot undertake some of the research and development necessary.

This of course, has been the major New Zealand economic tragedy over the last 15 years and the oil crisis merely showed up an already rather inflexible farm produce policy based on bulk butter, bulk cheese and rather overfat sheep meats.

Economic adversity may push official policy makers and politicians to accept advice from far more diversified quarters. This is available in this country, but largely gone unheard. Such changes may help the top calibre farming talent up where the action is - a better chance, a better income and a better future.

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TRACE ELEMENTS IN HUMAN NUTRITION IN NEW ZEALAND

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Lincoln College has just celebrated its centennial - a time in the life of an institution to pause and reflect. I also reflect on matters and events of a century ago, for it was then that my favourite trace element, selenium, was shown to have that special property of converting light to electrical energy, a property which is the basis of photoelectric cells, exposure meters and today of photocopying processes. We were reminded of this earlier this year when we found the blood selenium concentration of one of our control subjects rising steadily. We were perplexed, until we discovered that this subject worked right next to a much used Xerox photocopying machine. I am sure we know of more ordinary ways of raising our blood selenium, if we had to.

As farmers in this area, you are only too well aware that New Zealand is a unique natural laboratory for studying of trace elements in soils, in plants and in animals. Man holds a privileged position at the end of the food chain, and the question we ask when yet another trace element is shown to be essential for plants and animals, is does the deficiency of this trace element reach right through and affect the human New Zealand residents?

Table 1 lists the trace elements essential for animals with the deficiency states in man. The asterisks indicate the elements we are investigating in Dunedin; those in brackets, are not being investigated at the moment.

TABLE 1. ESSENTIAL TRACE ELEMENTS

	Animals		Deficiency in Man
	iron		anaemia
	iodine		goitre
	copper	*	anaemia
	manganese	*	?
1930's	zinc	*	growth
	cobalt		Vitamin B_{12}
	molybdenum	(*)	? dental caries
1950's	selenium	*	? muscular complaints
	chromium	*	? diabetes
	fluorine	(*)	dental caries
	silicon		
	tin		
1970's	vanadium		? atherosclerosis
	nickel	*	
	arsenic		

SOME NECESSARY TRACE ELEMENTS

You will note the recent additions of nickel and arsenic. Even arsenic is essential, but natural deficiencies have not yet been reported, so hopefully you won't have to worry about them.

Iron, Iodine and Fluorine

Human trace element deficiencies are already well known for iron, iodine and fluorine. Fluorine is almost synonymous with Dr Muriel Bell and it was she who introduced me to trace elements. How disappointed she would be to find that so many in Christchurch, and elsewhere in New Zealand, are still not receiving fluoridated water. I appreciate that there are problems, but where there's a will, there's usually a way.

Copper

At the 50th anniversary of this College in 1928, I wonder if it was mentioned that copper had just become essential for animals. Although copper deficiencies have been largely overcome in animals in New Zealand, we sometimes wonder about the residents. Most of the 130 different foods analysed in Dunedin contained less copper than reported overseas. Also analysis of (180) duplicate daily diets showed our intakes were mainly under 2 milligrams (mg) a day, except when liver was eaten; 2 to 3 mg a day has been suggested as an adequate intake for residents in the United States of America. Our observations, along with lower than normal serum copper concentrations, suggest that the copper status of some New Zealanders could be inadequate.

Zinc

Our dietary intake of zinc is also not generous - an average of 10 mg a day, compared with the recommended intake of 15 mg a day. Otherwise the zinc status of healthy New Zealanders appears to be adequate.

Last year at the international trace element meeting at Munich, there was much discussion about the disparity between the recommended intakes and the much lower actual intakes for the trace elements. It was pointed out that in New Zealand the trace element intakes were particularly low, and yet the population was apparently no less healthy than in other places. Perhaps too wide a safety margin had been recommended, and further work is needed.

However, the dietary pattern of many New Zealanders is changing with the growing realization that to avoid obesity, we need to eat less or we must become more active. To eat less could mean simply a reduced overall intake of all nutrients, including trace elements, but there are pressures from the Heart Foundation to eat less of the animal foods and to increase our intake of plant foods, including cereals. This could reduce the intakes of zinc and copper still further, and it might also reduce their availability; a study in our laboratory two years ago on four subjects showed reduced absorption of zinc in two of the subjects when an extra quarter cup of coarse bran was eaten each day.

Meanwhile the trend to refine and to fabricate foods continues. The replacement of meat with analogues such as textured vegetable protein, (T.V.P.) reduces the zinc and copper content still further. I feel that we shall have failed as nutritionists if we ever reach the stage in New Zealand where we have to replace the nutrients artificially or to fortify our foods.

These refined and fabricated foods are as good as modern science and food technology can make them, but are they good enough? Fortification is no substitute for nutrition education and to fortify our cereals would be contrary to the ideals of the Wheat Research Institute here in Christchurch who pioneered the higher extraction of flour.

Selenium

And lastly selenium. Has the selenium deficiency in animals reached through to man? Our daily intake is usually less than 30 micrograms (µg), which is 50-100 µg less than Western-type diets eaten elsewhere. From analysis of 140 duplicate New Zealand diets, we found that selenium intakes exceeded 30 micrograms of selenium only when diets included fish, liver or kidney.

Table 2 gives the intakes of 4 young Dunedin women for 14 days on self chosen diets. Intakes varied between 5 - 102 µg Subject R's mean intake of 34 µg was greater than the others because she had eaten 3 fish meals weekly; the others had only one weekly meal of fish, liver or kidney. Tracer studies with [^{75} Se] selenomethionine showed that most of our small selenium intake was absorbed. The tracer also gave us the

TABLE 2. MEAN SELENIUM INTAKE AND EXCRETION OF SELENIUM FOR 14 DAYS BY 4 WOMEN ON SELF-CHOSEN DIETS

Subject	Intake	Urine $\mu g\ Se\ d^{-1}$	Faeces	Absorption* % Intake	Whole Body* content mg Se	Blood $\mu g\ Se\ ml^{-1}$
G	20	14	9	80	5	0.070
R	34	19	13	79	9	0.087
C	23	8	11	80	5	0.055
T	20	12	10	76	6	0.062
Mean	24	13	11	79	6	0.068

* derived from use of [^{75} Se] selenomethionine

estimated whole body content as 6 mg of selenium, which is less than one third the only other estimate of 13 to 20 mg of selenium for persons living in the United States of America. You will note that Subject R's higher intake and body content were reflected in her higher blood selenium concentration. This supports the use of blood selenium concentration as a measure of selenium status, just as you do for your animals.

Fig. 1 shows mean blood selenium with standard deviation, given as a vertical bar. Blood selenium is lower than for most other countries, of over 0.2 µg per ml or 0.2 ppm for the United States of America, then Canada, Sweden and some areas of Finland. Some Finnish residents have bloods similar to ours from Dunedin (the hatched area) and Tapanui. Auckland bloods were higher and last year at the first New Zealand trace element meeting held at Hamilton, Dr John Watkinson reported similar differences between North and South Island residents. You will recall that in the North Island not much of the arable land is low in selenium, and selenium-responsive diseases in animals are common only in the central volcanic plateau, whereas in the South

FIGURE 1

Blood Selenium of Healthy Adults

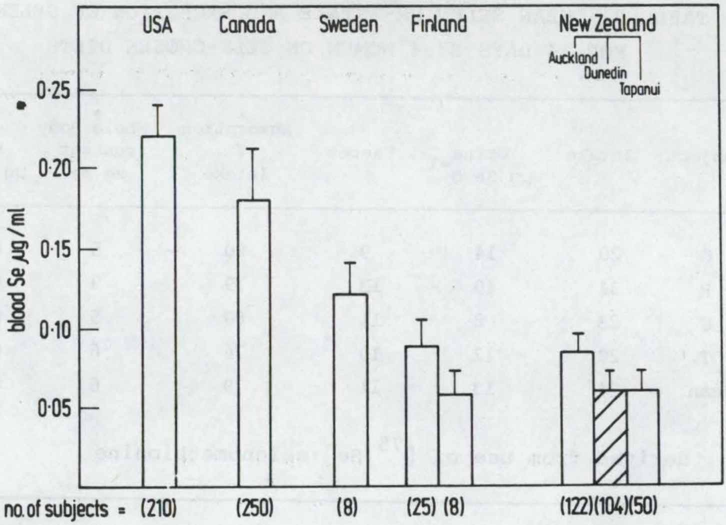
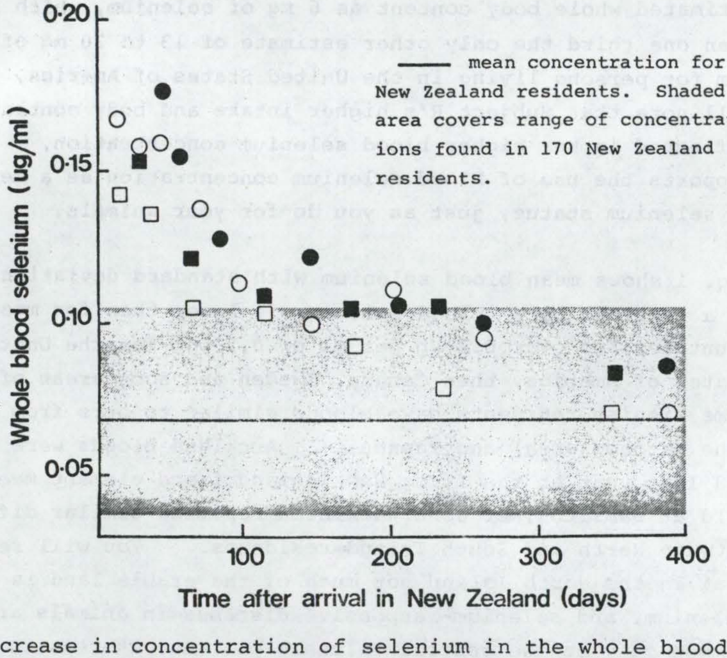


FIGURE 2



Decrease in concentration of selenium in the whole blood of four adults arrived in New Zealand from the United States of America (day 0 = day of arrival in New Zealand.

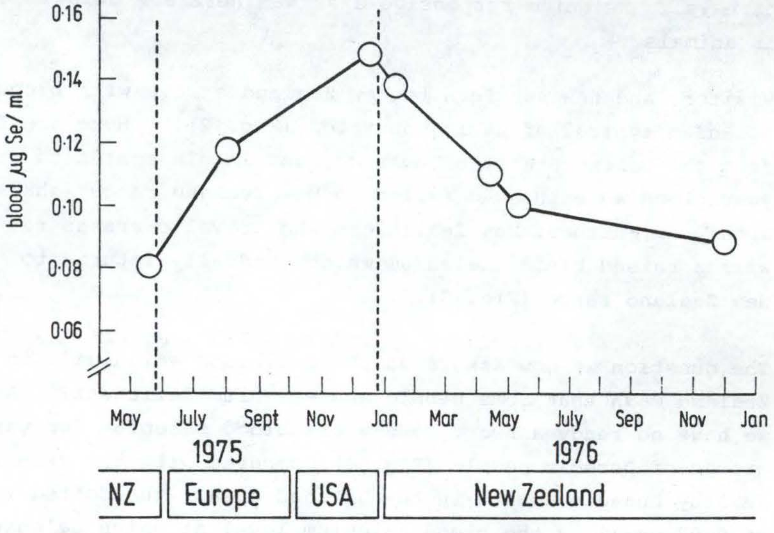


Fig 3. Blood selenium of a New Zealand subject before travelling overseas and after return to New Zealand.

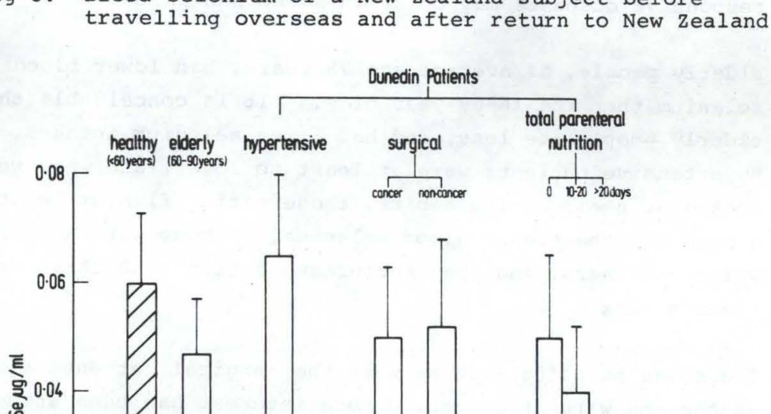


Fig 4. Blood selenium for various groups of Dunedin people.

Island most arable lands are low in selenium, and so are the cereals. Selenium responsive diseases here are ubiquitous in animals.

Visitors and new settlers to New Zealand arrive with blood selenium typical of their countries (Fig. 2). Here are four from the United States of America, and in six months to one year blood selenium had fallen to New Zealand range (shaded area). Further, New Zealanders who travel overseas return with a raised blood selenium which gradually returns to New Zealand range (Fig. 3).

The question we now ask is do the low blood selenium's in New Zealand mean that some people are selenium deficient? As yet we have no ready answer. Here are blood selenium for various groups of Dunedin people (Fig. 4) compared with our mean for healthy Dunedin adults in the hatched area; the dotted line at 0.02 μg/ml is the blood selenium level at which selenium-responsive diseases may occur in sheep and lambs.

Elderly people, of average age 78 years, had lower blood selenium than the 16-60 year olds. It is conceivable that elderly people ate less, and had lower selenium intakes. Next, hypertensive patients were at least no lower, and when we looked at their eating habits, those eating fish at least once a week had the higher blood selenium. Many were members of weight watchers, and they encourage eating fish three or four times a week.

There was no difference between the surgical patients with cancer and without cancer. Much interest has been aroused in the United States of America about a possible relationship between low selenium status and cancer. If there were a causal relationship, New Zealand might be expected to show an unusually high incidence of cancer. We do seem to have a few more cancers of colon and rectum than, for example England and Denmark, but no more than the United States of America, where bloods and selenium intakes are two to three times greater than ours.

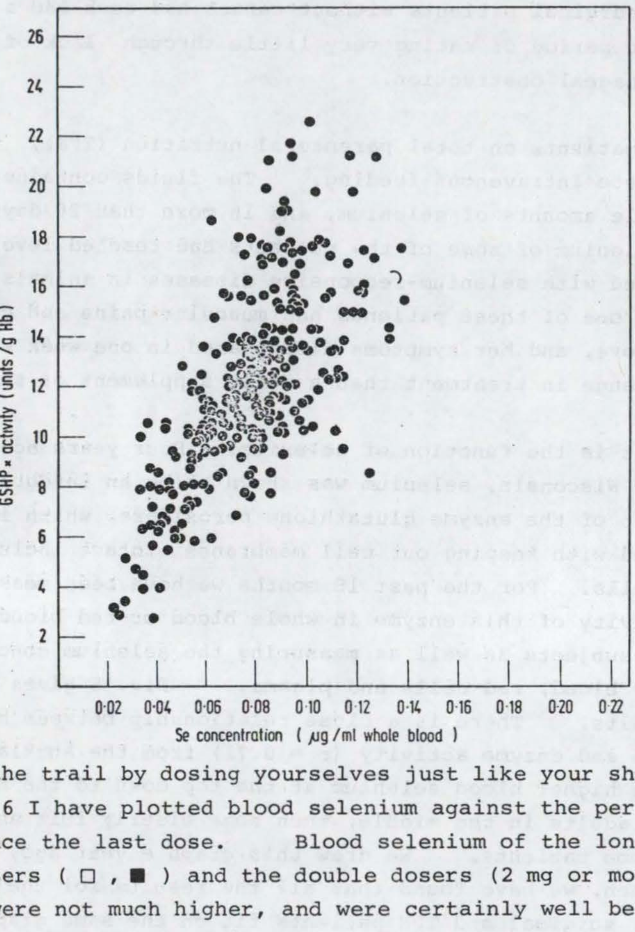
The dots (Fig. 4) indicate the lowest individual blood values; the two surgical patients without cancer had each had a prolonged period of eating very little through lack of appetite or oesophageal obstruction.

And now patients on total parenteral nutrition (TPN), that is on complete intravenous feeding. The fluids contained negligible amounts of selenium, and in more than 20 days, blood selenium of some of the patients had reached levels associated with selenium-responsive diseases in animals. Actually one of these patients had muscular pains and could hardly move, and her symptoms disappeared in one week with no other change in treatment than a daily supplement of selenium!

Now, what is the function of selenium? Four years ago in Madison, Wisconsin, selenium was shown to be an integral component of the enzyme glutathione peroxidase, which is concerned with keeping our cell membranes intact including red blood cells. For the past 18 months we have been measuring the activity of this enzyme in whole blood or red blood cells in all our subjects as well as measuring the selenium concentration in whole blood, red cells and plasma. Fig. 5 gives some of our results. There is a close relationship between blood selenium and enzyme activity ($r = 0.71$) from the Aucklanders with the higher blood selenium at the top down to the healthy Dunedin adults in the middle, then some elderly folk and lower still some patients. We drew this graph a year ago, and since then, we have found that all the results for the hypertensive, surgical and TPN patients fit on the same graph. Thus differences in blood selenium, whether due to geographic location, to age, or to illness, were all reflected in enzyme activities are influenced primarily by the dietary intake. We are now looking to see whether patients on TPN with negligible selenium intakes are actually deficient in selenium.

Meanwhile how may we raise the selenium status of New Zealanders if this should become necessary? You realise that many of you

Fig 5. Se concentrations vs. Glutathione Peroxidase activities in whole blood



blazed the trail by dosing yourselves just like your sheep. In Fig. 6 I have plotted blood selenium against the period of time since the last dose. Blood selenium of the long term dosers (□ , ■) and the double dosers (2 mg or more, ■ , ●) were not much higher, and were certainly well below the United States of America values of 0.2 µg/ml.

Last year we measured both enzyme activity and blood selenium in another group of Lincoln dosers, including some from the 1974 group. Blood selenium was a little higher, perhaps reflecting some more frequent dosing. These points were added to our graph of healthy Dunedin adults as well as other points for our own bloods at the end of eight months on daily

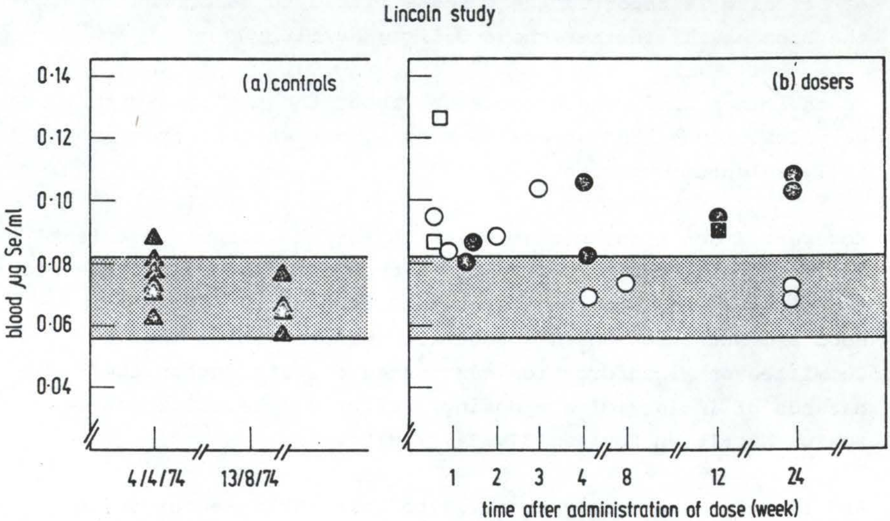


Fig 6. Blood selenium concentrations of subjects associated with Lincoln College (a) who had never ingested selenium supplements (▲) and (b) who had been ingesting spasmodically an oral dose since before 1965 of 1 mg Se (□) or 2 mg Se (■), or more recently 1 mg Se (○) or 2 mg Se (●). (⊡), range for mean ± SE for blood Se for New Zealand residents.

supplements of 100 μg Se as selenite, This raised our intakes up to the United States of America selenium intake, but even so, many of our bloods were still below bloods from overseas visitors from the United States of America, the United Kingdom, Australia and were well below the bloods for two Tahitian visitors of over 0.4 μg/ml. We found that enzyme activities were not correspondingly increased. It seems that above 0.12 μg/ml the enzyme activity has reached a plateau, possibly because the selenium requirement for making the enzyme has been met.

Now, *if* the sole function of selenium were in this enzyme, then many of us may have reached the optimal blood selenium concentration and perhaps optimal selenium status with our dosing.

I'm afraid I don't know the answer but until some other function of selenium is reported there seems little to recommend raising the blood still further above 0.12 μg Se/ml.

On the other hand we are concerned about the patients with those very low values, and we are looking to see whether they are truly selenium deficient.

However, I don't think that selenium is "the miracle nutrient" as it is being advertised to be in the United States of America at present. So concerned are the United States of America Food and Nutrition Board about all this publicity that the Committee on Misinformation has issued a statement on the hazards of indiscriminate dosing; after all selenium can be toxic (Nutrition Reviews 34, 347 (1976).

And finally I am deeply honoured to be speaking about trace elements at this College where so much of the early work on selenium was carried out over 20 years ago, long before it was possible to estimate selenium, and when the effects of selenium supplements could only be assessed by an increase in the live-weight of the animals. Early dosing of lambs must have occurred on some of your farms as well as on the College and Ashley Dene farms. It is now ten years since I first came to Lincoln College to talk to Professor Jack McLean about selenium; he offered me my first real selenium cocktail, a seletoc capsule, a blend of selenite and vitamin E. Many more have I swallowed since then. May I thank you all for your encouragement and support of our work, not just on selenium, but on all the trace elements.

This work was supported by the Medical Research Council of New Zealand and the New Zealand Medical Research Distribution Committee.

WHEAT RESEARCH INSTITUTE
1928 - 1978

To record the fiftieth jubilee of the establishment of the Wheat Research Institute, the Farmers' Conference and Institute staff arranged a special session on the agronomy, utilisation and economics of wheat. This was followed by a 50 year review of the Institute's work by Dr H.C. Smith (Director, Crop Research Division, DSIR, Lincoln), and Mr R.W. Cawley (Director, Wheat Research Institute). It is intended that this review paper, together with the three recorded here, be published next year in the 14th issue of *New Zealand Wheat Review*.

THE DYNAMICS OF WHEAT YIELD

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An important event like the 50th Anniversary of the Wheat Research Institute should encourage us not only to glance backwards on the history of the past, but also to look forward to what appears attainable in the future and plan how this might be achieved. Wheat has been a recurring topic at this

Conference, going back to 1952 when the formidable trio of Danks, Dunshea and Mulholland reviewed trends in production, and again almost 12 years ago to the day when I had the responsibility of looking at changes in yield. These and other reviews, including one by Calder in 1953 and another by Walker in 1962, set themselves the task of examining wheat yield over the years and of commenting on reasons for apparent increases that had occurred. It seems to me, on further reflection, that any such trends are highly influenced by differences in growing season, incidence of disease and other factors, and that in consequence it is not easy to discern a clear picture over relatively short periods of time. What is probably far more significant is the range of yields within the same year. For example, in 1975, the national average of 3.4 tonnes per hectare was made up of crops ranging from as little as 2 tonnes per hectare to almost 10 tonnes per hectare. If we accept that the upper end of this range was attainable by more and more farmers, we would of course see a considerable lift in production. However, at the same time we would also be faced with greater agronomic inputs to sustain these yields, assuming continued progress in plant breeding and in pest and disease control. Under the shadow of continuing economic crises, it must be our obvious policy to use expensive resources as sparingly and efficiently as possible so as to obtain maximum effects. I believe that recent intensive work on the wheat crop at Lincoln College, conducted by Department of Plant Science staff and research students, has helped to identify the optimum use of inputs by providing answers to such important questions as "Which part of total yield is most responsive to treatment?", "Which developmental processes are shaping the components of yield and when do they occur?", "How can these processes be controlled and directed?".

COMPONENTS OF YIELD

There are many different ways in which to look at yield. Perhaps the simplest is to say that we are aiming to produce as many grains of wheat as possible from a given area of land, and that each grain should be of good size. Of these two components we find that the former, the number of grains produced, is closely related to yield but that average grain size does not change very much within the same cultivar. In other words, the greater the number of grains we can harvest from each hectare, the greater the yield. How can this be achieved? One approach would be to increase the number of ears per unit area, and in moderate crops, yielding up to about 4 tonnes per hectare, differences in yield can often be related to differences in ear numbers (Dougherty *et al.* 1974, 1975). In higher yielding crops, the emphasis is more on the number of grains produced by each ear, either by having ears with more spikelets or by improving the grain set, that is the number of grains formed within each spikelet (Fig 1).

Fig. 1. COMPONENTS OF WHEAT YIELD

GRAIN YIELD/ha = EARS/ha x SPIKELETS/EAR x GRAINS/SPIKELET x WT./GRAIN

The number of spikelets per ear does vary with treatment but equally, or even more important, is the second component, the grain set in each spikelet. This is highlighted by the observation that each spikelet contains eight or nine individual florets, and yet the number of grains formed seldom exceeds four, and if all spikelets in a crop are taken into account, may only be two or three. What is required for high yield is to produce crops with a large population of ears, each bearing as many grains as possible.

DEVELOPMENTAL PATTERN

Now that the most influential yield components have been identified, the next question to arise is at what time during the development of the crop are they being determined. It will also be useful to know what physiological processes are taking place and, more particularly, when these events are occurring. Figure 2, adapted from a scheme proposed by Scott (1977), is based on the average performance of several cultivars sown in Canterbury in about June, and indeed the chart would be made more precise by confining it to a single cultivar.

You will note that the final number of ears present is determined over a prolonged period of time and at a relatively early stage as the plant produces tillers and as these either develop ears or die and disappear from the system. We will see later by what means ear numbers can be increased, but at least the timing of any treatment to be applied is clearly indicated. Spikelet numbers are determined over a much shorter time span, as the growing point stops producing any more

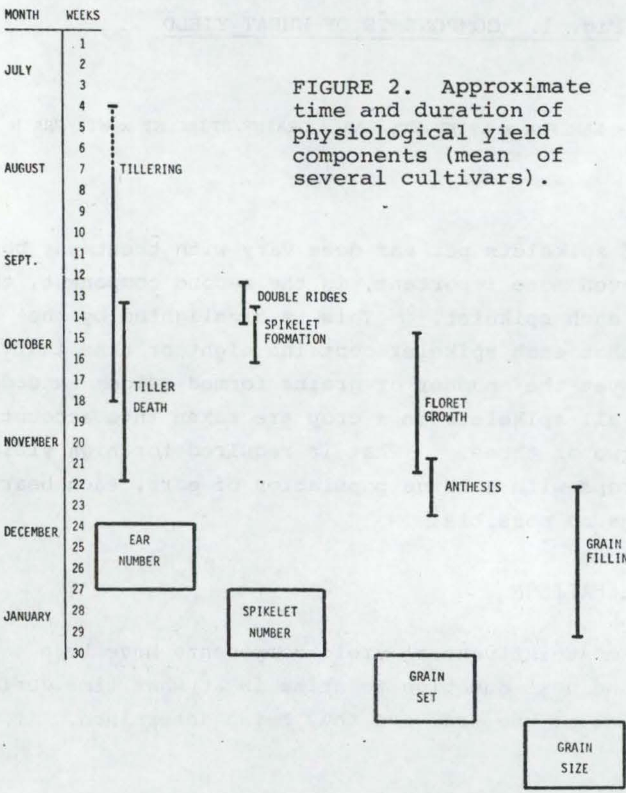


FIGURE 2. Approximate time and duration of physiological yield components (mean of several cultivars).

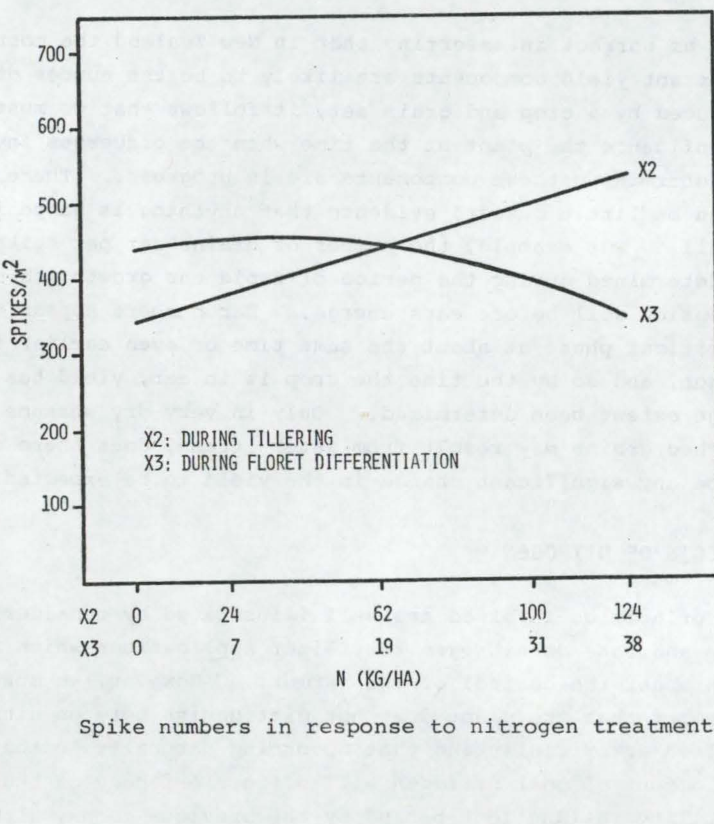
leaves at the so-called double-ridge stage and when spikelets appear instead and develop further. After this stage has begun florets are formed, the stem elongates and the ear emerges, following which the anthers extrude (anthesis), fertilisation occurs and grain setting occurs. Each grain then fills over the next few weeks, eventually reaching its mature size. It will be obvious from the scheme presented in Figure 2 that the various yield components are determined not only at different times but also over periods varying in length. The greatest contrast exists between determination of ear numbers which occurs early in development but over a prolonged time span, and the very short duration of the processes which fix spikelet numbers.

If I am correct in asserting that in New Zealand the most important yield components are likely to be the number of ears produced by a crop and grain set, it follows that we must try to influence the plant at the time when the processes involved in determining these components are in progress. There may often be little outward evidence that anything is happening at all. For example, the number of grains set per spikelet is determined during the period of rapid ear growth and stem extension well before ears emerge. Ear numbers appear to have a critical phase at about the same time or even earlier in the season, and so by the time the crop is in ear, yield has to a large extent been determined. Only in very dry seasons when pinched grains may result from water stress, does there appear to be any significant change in the yield to be expected.

EFFECTS OF NITROGEN

The principles involved are well illustrated by considering the time and rate of nitrogen fertiliser applications which are both under the control of the farmer. However, we must also remember that the plant does not distinguish between nitrogen applied artificially and that occurring naturally in the soil. The amount of soil nitrogen will of course depend on the fertility residue left behind by the previous crops, although weather conditions influence its availability to the plant. Mineralisation occurs actively when soil temperatures are favourable, but excessive rainfall may remove much nitrogen below the root zone. Fertiliser responses will in consequence vary from season to season, but nevertheless certain general trends are discernible. In our experiments we adjust fertiliser levels according to soil analysis, and this is the reason why, for the purpose of comparison, we have in the following figures plotted responses at two different times of application on the same axis, each at the mid-value of the other.

FIGURE 3



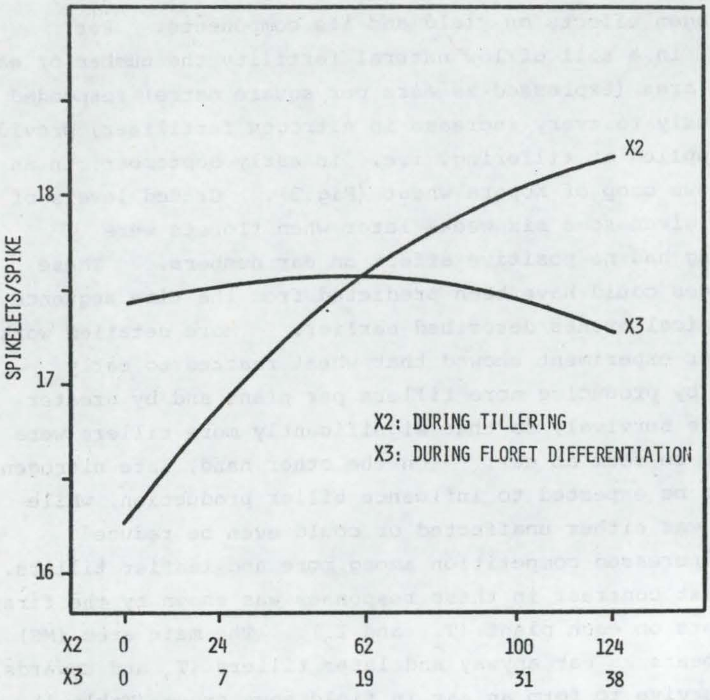
Spike numbers in response to nitrogen treatments.

A clear difference, depending on growth stage is shown by the nitrogen effects on yield and its components. For instance, in a soil of low natural fertility the number of ears per unit area (expressed as ears per square metre) responded continuously to every increase in nitrogen fertiliser, provided it was applied at tillering, i.e. in early September, in an autumn-sown crop of Kopara wheat (Fig.3). Graded levels of nitrogen given some six weeks later when florets were developing had no positive effect on ear numbers. These differences could have been predicted from the time sequence of physiological events described earlier. More detailed work in another experiment showed that wheat reacted to early nitrogen by producing more tillers per plant and by greater percentage survival, so that significantly more tillers were available to form an ear. On the other hand, late nitrogen could not be expected to influence tiller production, while survival was either unaffected or could even be reduced through increased competition among more and leafier tillers. The biggest contrast in these responses was shown by the first two tillers on each plant (T_1 and T_2). The main stem (MS) usually bears an ear anyway and later tillers (T_3 and upwards) rarely survive to form an ear in field sown crops (Table 1). An improvement of some 10% in tiller survival may appear to be a trivial matter, and yet it would mean an addition of 300,000 ears per hectare and another two - three tonnes of grain in the bag. In fact we have reason to believe that most of our crops are too thin and could support many more ears

TABLE 1. % TILLER SURVIVAL TO HARVEST

		MS	T_1	T_2	TOTAL
Early N (early Sept.)	)Control	100	23	9	33
	)N 90kg/ha	100	29	12	44
Late N (late Oct.)	)Control	100	25	10	38
	)N 45kg/ha	100	27	11	38

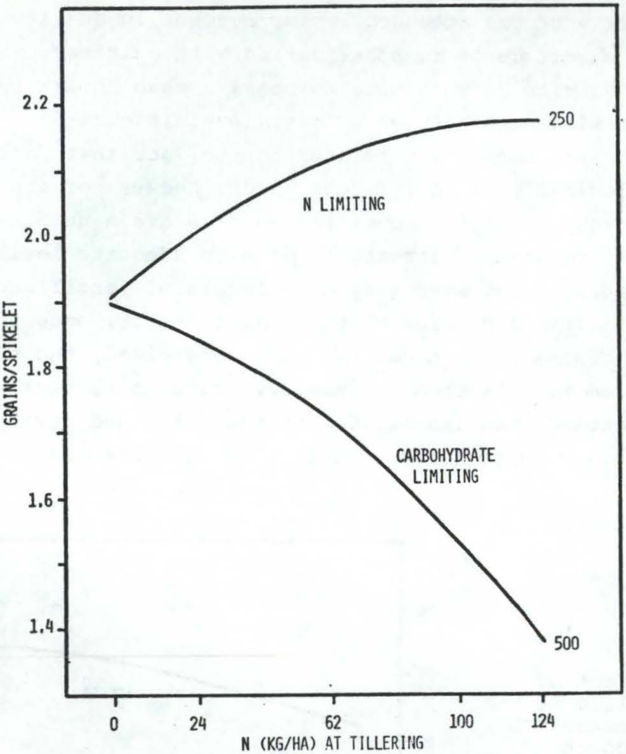
FIGURE 4



Effect of N on spikelets/spike.

The two components determining the number of grains per ear showed even greater contrast in the way they reacted to time of nitrogen application. Spikelet number per ear rose sharply in response to increasing amounts of N supplied during tillering, but changed very little when applications occurred late (Fig 4). This difference was entirely expected from our knowledge of physiological events. Similarly we found that early nitrogen also increased grain set, probably by enabling the plant to develop more florets to a stage at which they could be pollinated, provided that sowing rates were at conventional levels (250 plants per square metre). At higher plant population there appeared to be too much internal completition to allow full development of grain numbers (Fig. 5).

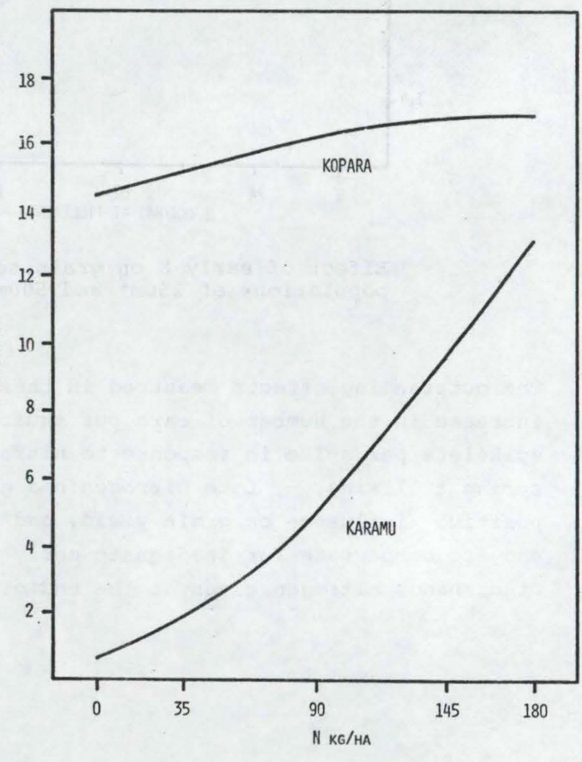
FIGURE 5



Effect of early N on grain set at plant populations of $250m^2$ and $500m^2$

The outstanding effects measured in these experiments were the increase in the number of ears per square metre and in spikelets per spike in response to nitrogen given during early spring tillering. Late nitrogen had generally little positive influence on grain yield, and had only a slight tendency to compensate for inadequate early nitrogen. On the other hand, nitrogen given at the end of October can be very effective in raising percentage grain nitrogen, and this in much of our work was attended by improvement in quality. However, the magnitude of response varied with cultivar, with Karamu proving to be much more responsive than Kopara but also performing generally at a lower level (Figure 6). Part of the cultivar difference relates to the fact that Karamu is physiologically an early wheat which, because of its genetic makeup, is often committed to high grain numbers without having enough nitrogen to develop adequate levels of grain protein. But even very high levels of fertiliser do not turn it into a premium wheat. As I see it, once the number of grains in each ear has been determined, the plant is committed to fill them. Usually, there is no real shortage in the carbohydrates assimilated by the plant and diverted into the grain, but whether there is enough nitrogen present

FIGURE 6. Effect of nitrogen applied at the end of October on MDD (mechanical dough development) scores in Kopara and Karamu wheats.



to provide the protein components will depend on the availability of nitrogen in the soil and the ability of the plant to take it up. It seems that Karamu develops more grains than it is able to supply with enough nitrogen, an aspect which probably requires further investigation.

EFFECTS OF WATER

Stage of growth also plays an important part in determining responses to irrigation or rainfall. Of course, just as in the case of nitrogen, it will be the soil water status at different times which will decide whether or not additional amounts of water are effective. Consequently, when it comes to irrigation responses, we again have to consider soil type and seasonal conditions, and how these interact with the developmental processes of the plant. Let us look at the number of ears in a crop to illustrate the point. During the period of tiller production in early spring there should be no shortage of water and hence irrigation is not needed there. However, during the stage of stem elongation, as spikelets develop and ears grow rapidly inside the sheath, many tillers tend to die and are thus lost as a potential source of ears. It is then that irrigation has its major effect because it can improve tiller survival. To what extent this can be achieved, will of course depend on soil type and climate, but the results obtained by Wilson (1974) on a Templeton soil indicate what may be expected.

TABLE 2. IRRIGATION RESPONSES OF FIVE NEW ZEALAND WHEAT CULTIVARS (AFTER WILSON, 1974)

Irrigation Treatment	Yield (kg/ha)	Number of ears/m^2
Nil	3185 c	360 c
Field capacity during spikelet differentiation	3350 c	384 bc
Field capacity up till grain filling	3625 b	408 ab
Six irrigations to maintain - 0.8 bars	4160 a	456 a

You will note how closely the improvements in grain yield through irrigation was matched by increases in the number of ears which were present at harvest, and this will have been the result of better tiller survival. The individual grain weight was not greatly changed in this experiment, but in certain very dry seasons there is the danger of getting a high proportion of poorly filled, pinched grains, and it is here that irrigation during grain filling should pay dividends.

Yield responses to irrigation within the same season are greatly dependent on soil type. Wilson (1974) obtained an average yield increase of 17% through irrigation on a Templeton soil, but on the shallow Lismore soils at Winchmore responses of up to 150% have been recorded. Winter wheat, growing on Wakanui silt loam at Lincoln College, has given varying results ranging from a 12% yield increase to a yield depression. Irrigation at an early stage tends to promote tiller survival and this may bring about increased competition within dense crops to such an extent that grain set is reduced. A similar situation arises if heavy dressings of nitrogen are given early in the season to a dense crop sown at supra-optimal seeding rate. If responses to water are expected at all, the most profitable time of application is likely to be the period from spikelet differentiation till just after ear emergence.

FUTURE PROSPECTS

Research of the kind I have described shows how much more we now know about grain yield and its components, and about the timing of critical phases of development. We will need all this information, and probably more, if we are aiming to raise wheat yields without incurring additional costs in fertiliser and water applications. It is not only a question of what to do but when to do it. There is, however, a further advantage in our ability to improve the precision of these operations, because this provides the plant breeder with a clearer set of instructions of what is wanted than hitherto has been possible. This will require close co-operation between the breeder, the agronomist and the farmer, but arising from it there is the prospect of greatly improved wheat yields. New wheats will no doubt come onto the market more rapidly in the future, not only because of collaboration of breeders in the Northern and Southern Hemispheres, but also through the activities of commercial organisations in plant breeding. These prospects are exciting, even though some may regret that change may bring rewards as well as problems in its wake. What is certain, however, is that services of the Wheat Research Institute in monitoring the quality of the crop will be required more than ever in the future.

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UTILISATION OF WHEAT IN NEW ZEALAND

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I suppose with a family and company background of more than 100 years of milling, and considerable, though more recent involvement in most other areas of utilising wheat, it could be said I am experienced, or would "ground down" be a better phrase? But it is the experience of applying the theories that proves or disproves the worthiness of research and development and establishes decisively whether or not we are in touch with consumer requirements. If my comments do throw some light on the subject, it will be only a small instalment in repayment of the debt which I owe, especially to the Wheat Research Institute and its past and present personnel.

I want to talk on several matters: the background of the wheat utilisation industries, how they developed to the present stage, how the system is supposed to work in New Zealand, some thoughts on why it does not work that way at all, and some personal views on what the future has in store.

EARLY DEVELOPMENTS

It is probable that wheat was the first cereal crop to be grown by man and there is some evidence that this happened 6,000 to 7,000 years ago. There is little doubt that wheat growing contributed to the growth of early communities, and that the establishment of them tended to be in those areas where wheat could be grown.

From the beginning and until about 200 years ago, users of wheat were almost exclusively interested in converting it to an edible food. As a first step it had to be ground and this was the origin of the flour milling industry. The early milling equipment was crude. At first, and until about 300 A.D., only hand operated pounding and grinding implements were used. Then, evidently first in Rome, the quern and grindstone were devised and were used in much the original form until about 1860.

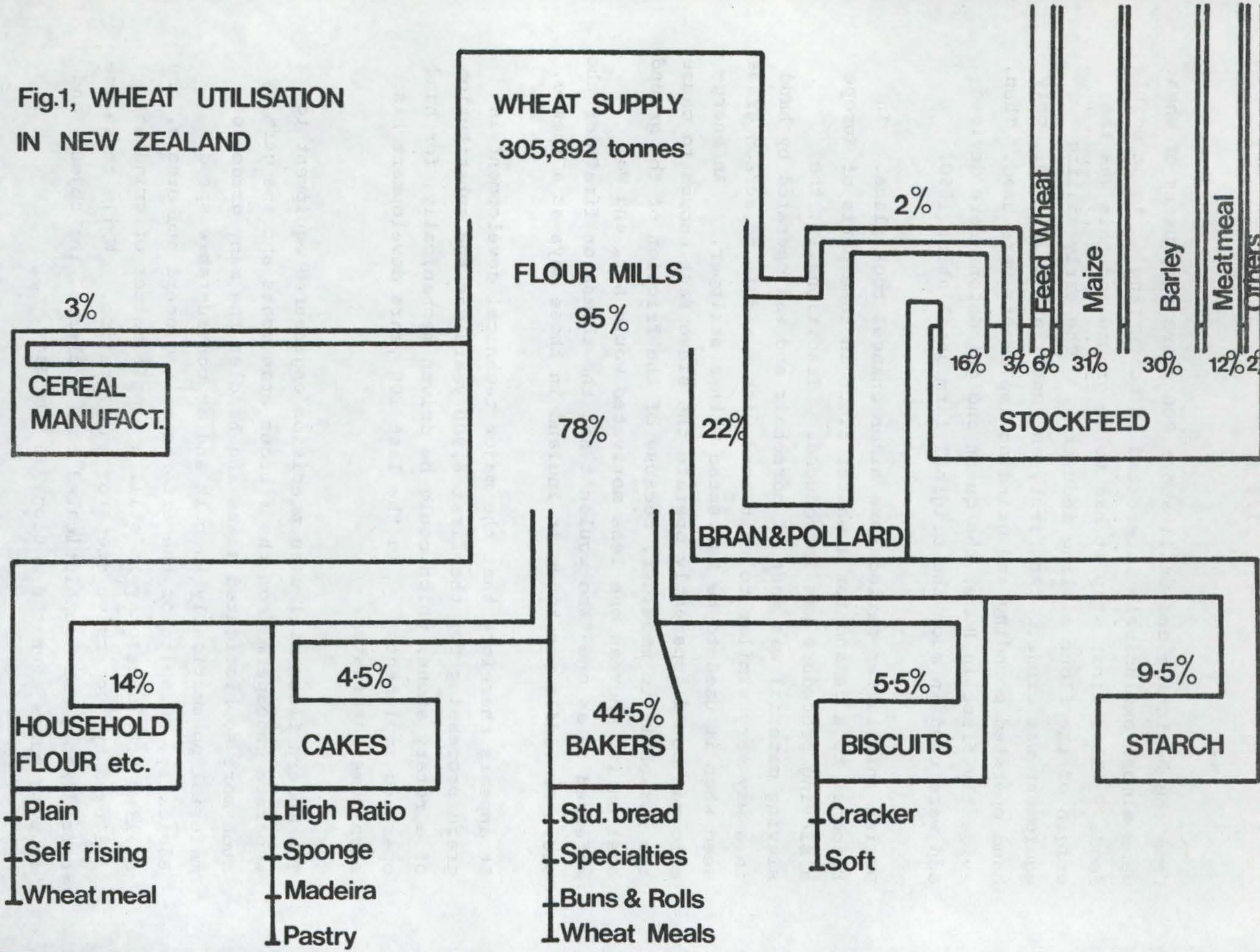
During this latter period some minor changes took place. In response to a demand for a whiter flour in some parts of Europe a sieving procedure was introduced. Traditionally, the sieving material was made of horsehair and was operated by hand in a way very similar to that used with a riddle to screen grass seed when it used to be harvested with a stripper. An energetic man could apparently operate the sieve fast enough to cause the horsehair to smoulder, because of the friction of the ground meal on it, whereas one less motivated would not, and was referred to as one "Who wouldn't set the themse on fire" for the sieve or riddle was known in England in those days as a themse.

It appears therefore that the major technical development in grain processing for the first 6,900 years was the substitution of a rotary stone, which could be driven mechanically, for hand operated implements. In the last 100 years development has been somewhat faster.

The modern flour mill uses precision engineered equipment to separate endosperm from the fibrous bran coats and the germ by much more sophisticated means and handles the many grades of material pneumatically in bulk and at considerable speed. Basically, in spite of the efforts of engineers and others, the milling of flour today is still a simple matter of grinding, followed by successive steps or purification. While these are considerably more sophisticated than a themse, the object, and in some cases even the action, is the same.

It is of some interest that the first miller and probably the

Fig.1, WHEAT UTILISATION IN NEW ZEALAND



first wheat grower in New Zealand was the Maori Chief Ruatara, who imported seed wheat from Australia, and by 1814 had established a flourishing wheat industry. He then imported a pair of mill stones, and from the resultant flour the first wholly New Zealand bread was baked, but Ruatara's plans to export flour to Australia were interrupted by his death. His enterprise and business acumen are a humbling example of what can be achieved without knowledge of any of the techniques which today we regard as essential.

STOCK FEED

The conversion of wheat directly into wheaten products without the preliminary process of flour milling is limited in New Zealand mainly to the manufacture of stockfeed and breakfast food. Of these two main categories, stockfeed manufacturing is the greater consumer.

About 20 years ago the feed manufacturers used much more wheat and poultry farmers purchased considerable quantities directly from the farmer. The specialised hybrid birds now dominating the poultry industry require much more sophisticated rations than the older breeds and the increased investment in intensive production facilities demands the most efficient rations available. Despite this, the feed manufacturer still uses quantities of mill offals such as bran and pollard. He also uses varying amounts of wheat which is not suitable for milling and thus provides a valuable service to the wheat industry.

The importance of whole wheat, therefore in livestock rations has greatly diminished in recent years because it now has to compete with a variety of other grains and raw materials in the never-ending search for amino acid, mineral and vitamin balance which wheat itself does not supply. The tonnage of wheat used however, has not necessarily reduced and although the demand for feed wheat fluctuates, depending on the quantity and price of competing raw materials, there is no evidence yet of a progressive decline.

The whole-wheat cereal manufacturers produce mainly cold cereals of the puffed, flaked or compressed type and there is one whole-wheat hot cereal.

All other wheat for human consumption is first milled into flour by one of the 20 flour mill units situated between, and including Auckland and Invercargill. The millers produce the flour which is generally suitable for the end products of the industrial users and for the householders' requirements. This is not to say that a different flour type is produced for each type of user, or that the flour is as good for the user's purpose as he would like it to be.

Each type of product shown (figure 1) does need a particular type of flour, particular in terms of strength, colour, granularity, starch damage, or protein content. Because of problems in wheat and flour distribution however, it is not often possible for the miller to arrange this.

However, for the reasons given earlier, the needs are real and are becoming increasingly necessary in the operation of the modern bakery facilities.

UTILISATION

Baking Industry

In most ways the development of the baking industry has followed a similar pattern to that of milling. Bread, cakes and scones were baked and burnt in much the same way for centuries until the rising cost of wages obliged the baker to mechanise his operations.

Mainly because of the perishable nature of bread and because the other ingredients used are more easily transported, bread baking has tended, especially in Europe, to be a very localised operation. This was true also in New Zealand last century for similar reasons and several hundred bakeries were at one time in operation. At present there are about 80, which contrasts sharply with about 50,000 in Germany, 30,000 in France and about 15,000 in the United Kingdom.

This mechanisation of bakeries took place later even than in flour mills and it was not until 1925 that the first travelling oven was installed in New Zealand, and this was at Stacey & Hawker Limited, Christchurch. Since then, the new technologies have developed rapidly and the modern high capacity bread plant is now a fully mechanised factory. The very high cost of modern bakery equipment however can only be justified by very high throughput, either potential or real, and because of this the many small bakeries have decided to leave the field to larger units.

While the first move to mechanise bakeries was inspired by the need to reduce costs, the main need now is to meet the consumer demand for bread which consistently has good colour, fine texture and good keeping qualities. This need has resulted in replacing in a decade or so with a mechanical dough development technique the traditional process which has been used for thousands of years.

While from a technical viewpoint the bread so produced is excellent, of necessity, the number of varieties produced on a high capacity plant is limited and obviously the hand produced loaf is all but eliminated. A recent development, perhaps in response to a need for something different, or a knowledge in recent immigrants of hand-styled specialty bread, is that a number of small specialty bakeries have made their appearance. These have not much in common with those of earlier days, but although because of the cost of labour, their bread is expensive, they meet a specialist demand which the plant bakeries could not, and thus earn their place in the scene.

Biscuits

The biscuit manufacturing industry has developed in much the same way and with the same objectives. In this field there is an increasing number of types and varieties, some requiring highly specialised equipment which has only recently been developed.

Cakes

The cake manufacturer too has obliged the consumer by producing cakes and related products of great variety and consistently high quality through mechanisation, although not to the same extent yet as bread and biscuit manufacturers.

Starch

The starch industry is comparatively new, in that the techniques mostly in use now were first conceived in the middle of the eighteenth century. The modern starch plant is now almost totally mechanised and automatically controlled.

DEVELOPMENTS

These main wheat using industries, while having their roots deep in history have each in the last few decades refined their techniques and mechanised their operations to a major degree. This has had a number of interesting effects:

* Because of the high cost of mechanisation only large units and large companies could take advantage of it. Inflation in the countries where the latest technologies and equipment are produced has magnified this. For instance, in 1880 a flour mill could be built and equipped for less than $2,000 and a bakers oven cost about $200. Today each would cost 1,000 times that figure. For many years therefore the number of flour mills, bakeries and biscuit and cake manufacturers has been steadily reducing, and as the present plants need to be renewed further rationalising will occur.

* Because the machines can control their own operations

to only a limited degree, they depend on a consistency of specified quality never demanded before. I am referring in particular to the bread baking plants, but the same is true for cake, biscuit and starch producers.

When the quality of wheat or flour deteriorates below a certain point the modern processes are sometimes incapable of producing a saleable product, giving rise to requests for Committees of Inquiry, minimum quality standards, etc.

* There has developed a need for higher protein quality and quantity because of the greater tolerance required by the mechanised processes in baking, and because of the high value of protein in the starch industry.

THE WHEAT BOARD

No outline of the utilisation of wheat in New Zealand would be complete, or could even be contemplated, without a view of the dominant position of the Wheat Board. The Board and its officers are bound by, and charged with, the responsibility of administering the regulations associated with the Wheat Board Act; and because of this, are essentially an extension of government and reflect government policies. That this is achieved, as it is these days, with considerable depth of understanding, is a tribute to the ability and integrity of the people involved. To say that the area, over which the Board exercises its control, is complex, would be to understate the reality, but the imagination shown by the Board in recent years has done much to enlighten the industries with which it is involved.

In case you have begun to think that I approve of everything the Board does, I emphasise that I am praising the improvement in attitude and not necessarily the results. I am sure the Board will be relieved to learn that at least the flourmilling industry, of which I am Chairman, proposes to convince them that some of its policies are not right.

Despite the Board's ability and integrity however, or perhaps even because of them, there is a real risk that it may come to be regarded as the wheat industry's government, and that signals which government proper should receive clearly may become muted unintentionally by the Board.

I am deeply concerned that the flour milling industry, which is the key wheat utiliser, is about to suffer from attitudes which fail to recognise that rewards and penalties are much more effective when gained or suffered as a result of performance than when applied by regulation. It is to be hoped that within the administrative framework that has been created by act and regulation, some means can be found to allow confidence and initiative to be restored to the milling industry.

Of necessity, this will involve the co-operation of the pricing authority, who, however, has been largely responsible over the last 25 years for restraining the rewards for milling to a level which is too low to allow the industry to continue to exist, let alone re-equip to perform the functions which are now required of it.

To a certain extent, wheat growers and bakers are in a similar position and should this state of affairs continue, the wheat and wheat utilisation industries will do little better than stagger from crisis to crisis, giving little satisfaction to shareholder, employee or consumer.

THE WHEAT RESEARCH INSTITUTE

The Institute performs the advisory and the quality definition function for the benefit of the wheat industries. The work of its personnel, both past and present, is increasingly known internationally, and some of their achievements have won world-wide acclaim. It is not always understood however, that the function of the Committee is largely distinct from that of the Institute.

The Committee, being composed of representatives from all the parties involved in the distribution and utilisation of wheat, is able to give balanced consideration to matters affecting quality and breeding of wheat for consumption within New Zealand. It is informed regularly by the Crop Research Division of the progress of new varieties and is responsible for recommending their release or otherwise.

In these matters alone, the Committee performs a special and valuable function in viewing new varieties, in terms of user and consumer requirements, assisted of course by the staff of the Institute.

It is greatly to be hoped that the Committee will continue to function in this way so that its conclusions will be free from the effects of promotional pressure.

THE FUTURE

There is no doubt whatever that future demands, by the consumer of wheat-based products and by the producer of those products, will bring the need for change in processing technology, be it in milling, baking, starch production, or the introduction of new processes not yet being considered as part of the picture. It is also certain that the speed of change will increase.

This will put heavy financial pressure on the wheat utilisers; pressure on the breeders to improve and modify varieties which may already be successful beyond the dreams of a few decades ago, pressure on the grower to modify preconceived ideas on what is right and best for him and the nation; and pressure on those responsible for the administration of the industry to provide the flexibility and incentive for these changes to be met.

In an already over-controlled environment there is always hope by people of enterprise that the controls will some day be removed, thus permitting the re-development of the courage and initiative so strong in our forefathers. Regrettably, it appears that, as a nation, we have come to accept "additive" legislation so that controls are not removed but modified, or more frequently added to.

While obviously some controls are even desirable, the proliferation of them can only lead to the repression of the very traits which have built our country well, and which we again now need so desperately if we are to continue to build.

There is a need for the elimination of unnecessarily restrictive regulations and the development of a greater sense of nationhood than some of us appear to have at present. There is a need also for a greater degree of understanding, particularly between partners in an industry such as ours, with an acceptance of common purpose.

In moving towards these objectives, the Wheat Research Institute and its Committee have a vital role to play, and it is essential that an environment, somewhat removed from the pressures of day to day needs, be fostered actively so that its contribution can be maximised.

ECONOMICS OF THE NEW ZEALAND WHEAT INDUSTRY

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Attitudes held by individuals or groups to the economic and policy situation in an industry are generally influenced by their position and role within that industry. This situation can often result in difficult decision making. To aid decision making, all groups should be aware of the impacts that the current situation and possible changes will have on all other groups.

For this reason I would like to discuss the economics of wheat production in New Zealand from three view-points; the farm, the national and international level. I will concentrate on what I consider to be the major economic factor in our wheat industry; the wheat pricing mechanism, since, unlike many other agricultural industries in New Zealand, prices in this industry are determined by the government. I hope that the following discussion will provide insights into the current state of the industry and also show the difficulties involved in attempting to determine an appropriate wheat policy.

THE FARMERS' VIEWPOINT

Wheat production has always been an important part of agricultural production in Canterbury and has been increasing in importance in other parts of New Zealand. Under the current pricing policy wheat has been a valuable crop in these areas. Relative to other agricultural products the farm price has been stable and has increased over time. It is debatable, however, whether or not the price has increased sufficiently to keep up with estimated costs of production or the general level of inflation.

Estimated costs of production can be a very unsatisfactory measure of the profitability of producing a crop such as wheat. The problem is that the cost of production only indicates the cost to the average wheat producer. The most relevant cost of producing wheat is of course the cost of producing another tonne of wheat in the most efficient manner possible. The average cost of production is not a satisfactory basis for determining price changes. If prices are set too high, then too many resources would be devoted to wheat production and a later estimate of cost of production would include the cost of resources which should not be in wheat production. Unfortunately this can lead to the escalation of both prices and average costs.

Wheat prices have probably not kept up with the general level of inflation in our economy, but this is a problem that relates to the prices of most of our agricultural exports. The problem of rising input costs cannot be solved by adjusting the price of wheat, but must be approached as a far more fundamental problem of our agricultural economy. The most clear evidence that wheat prices have been set at reasonable levels is seen in the fact that there has been no decline in wheat production over the last 10 years.

Even though wheat prices have been stable and at reasonable levels the production of wheat in New Zealand varies dramatically between seasons. While it would be tempting to suggest that most of this variation is due to weather, a recent study has shown that this is not the case. (Chudleigh 1978).

An analysis of production, area and yield data for the previous 22 years has shown that for New Zealand as a whole, 86% of the variation in wheat production was caused by changes in area. Table 1 shows how this proportion has changed over time and also shows similar statistics for the individual wheat growing areas within New Zealand. It can be seen that fluctuations in the area sown are much less important in Canterbury than in other regions and appear to be decreasing in importance over time. In the North Island and Southland, however, 90% of the production variation is due to changing areas and this percentage appears to be increasing over time.

Further research into the specific causes of these fluctuations in wheat area has shown that the major causes are the wide swings in the prices of other farm products such as lamb and wool. The results show that although the actual cash price for wheat has increased over time, the value of wheat relative to meat and wool products has fluctuated drastically. Thus, in periods of low meat or wool prices wheat has been an attractive farming proposition and the area of wheat sown has responded. Conversely, when other prices are high relative to wheat, there has been a contraction in the wheat area. Reactions of this type have been documented before, (Guise 1968) and they make good economic sense from the farmers point of view in that they allow total incomes to be maintained when meat and wool prices are low.

Although the changes in national area have been large at times - for instance, the area of wheat almost doubled between 1975 and the 1976 harvest - the impact of these changes on individual farm incomes has probably not been that drastic because of the relatively low proportion of farm resources which are devoted to wheat production.

The survey of wheat producers conducted by the Agricultural Economics Research Unit (Moffitt 1977) showed that in 1978 the average wheat farm in New Zealand had only 9.5% of the

TABLE 1. RELATIVE IMPORTANCE OF SOURCES OF VARIATION IN WHEAT PRODUCTION

Region	*Source of Variance*	*Data Period* 11 Year Period 1953-63	11 Year Period 1964-74	22 Year Period 1953-74
New Zealand	Area	0.88	0.86	0.86
	Yield	0.12	0.14	0.14
		1.00	1.00	1.00
North Island	Area	0.79	0.95	0.91
	Yield	0.21	0.05	0.09
		1.00	1.00	1.00
Canterbury	Area	0.82	0.69	0.74
	Yield	0.18	0.31	0.26
		1.00	1.00	1.00
Otago	Area	0.91	0.84	0.90
	Yield	0.09	0.16	0.10
		1.00	1.00	1.00
Southland	Area	0.81	0.96	0.91
	Yield	0.19	0.04	0.09
		1.00	1.00	1.00

total farm area planted in wheat; North Island wheat farmers had the lowest percentage (6%) and not surprisingly Canterbury had the highest, although it was still only 13%.

These low percentages suggest that the major part of many wheat growers incomes still comes from other agricultural products. The fact that Canterbury producers have a greater dependence on wheat is reflected in more stable wheat areas in that region. Some farmers are now almost entirely dependent on cropping and use wheat as the cornerstone of their farm programmes. In this situation a major factor affecting the area of wheat grown is probably a rotational restriction.

In summary, it can be seen that from the farmers point of view, wheat can be a valuable crop. The price is announced well before planting and has been stable over time. This has meant that wheat production can be used to stabilise incomes in periods when prices for alternative products are low. Wheat prices may not have kept up with the estimated costs of producing wheat, but the same situation exists for other products and wheat production has not declined over time.

THE NATIONAL VIEWPOINT

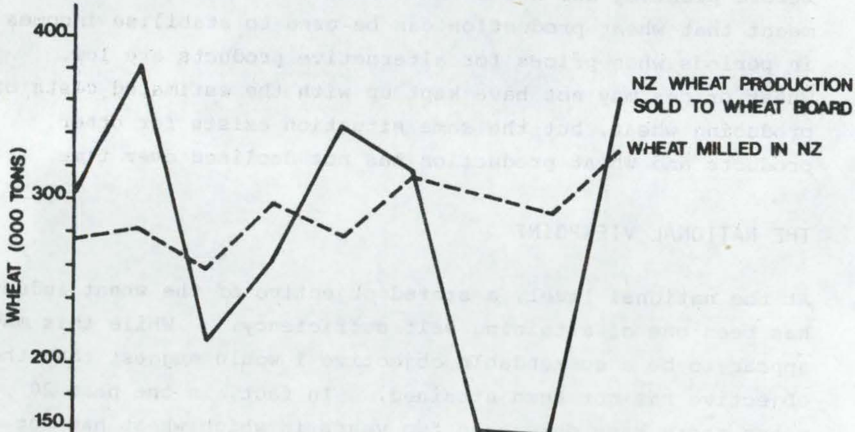
At the national level, a stated objective of the wheat industry has been one of attaining self sufficiency. While this may appear to be a commendable objective I would suggest that the objective has not been attained. In fact, in the past 20 years there have only been two years in which wheat has not been imported.

Self sufficiency would normally imply that domestic production of wheat should be stable and equal to the domestic demand for wheat. As I have already stated, however, the fluctuations in the area planted have caused New Zealand wheat production to be quite variable even though prices have been stable.

What are the implications of this policy for the nation as a whole?

Consumption of wheat in New Zealand has been relatively stable, but the wide fluctuations in domestic production have made it necessary to import variable quantities of wheat (figure 1). The cost of this imported wheat has obviously fluctuated with the world price. Throughout most of the 1960's low international prices made it possible to import wheat cheaply, but the sharp price rise in the early 1970's increased the cost of imports substantially. Because farm prices for wheat are set in advance and have not responded to changes in world prices, the fluctuations in import costs have caused substantial changes in the cost of providing wheat for New Zealand consumers.

Fig 1: WHEAT PRODUCTION AND CONSUMPTION IN NEW ZEALAND



Flour prices in New Zealand are administered by the Wheat Board. Historically they have been stable, but they have increased in recent years to cover rising import costs and higher producer prices. The increases in flour prices, however, have still been insufficient to cover the complete cost of providing flour for the consumers and it has been necessary for the government to provide Treasury grants to cover losses made by the Wheat Board. The Wheat Board accounts show that these grants have totalled $35 million over the past few years. Thus, the consumers pay the full cost of their flour, usually in a direct manner through the flour price or at times through Treasury grants to the wheat industry.

This particular situation is not necessarily bad except that the subsidisation does not allow flour consumers to respond to the true price of flour. If they were to pay the true price directly they would probably reduce consumption when wheat is expensive. This would reduce the demand for imports.

The element of subsidisation in New Zealand wheat pricing has changed over the years. Throughout most of 1960's consumers were subsidising producers because domestic prices were higher than world prices, but the fact that New Zealand prices remained relatively stable when world prices increased in the last five years meant that producers were subsidising consumers. At the moment we have returned to the pre-1972 situation where our producer price was above the world price. This situation would seem to be satisfactory provided there is a long-run balance. The danger is that any long degree of subsidisation would lead to an inefficient allocation of resources within New Zealand agriculture.

Are There Alternative Policies?

The suggestion has been made in recent years that the farm price of wheat should be increased to ensure a surplus over domestic consumption. It has been argued that such a move would ensure self sufficiency every year and at the same time provide valuable foreign exchange from exports. Unfortunately, such a policy at the present time would mean that domestic prices should be higher than world prices. This would impose a cost on the nation as a whole since consumers or taxpayers would be paying more for their wheat than they would need to. There may not even be a gain in foreign exchange. For instance, if we were to raise the domestic price to $150 per tonne there would undoubtedly be an increase in wheat production. Farmers would look carefully at the returns they are getting and increase the area of wheat at the expense of other export products.

This would increase farm incomes, but if the export price were lower than the domestic price there may be a loss in foreign exchange. This is because the foreign exchange component of the farmers wheat income can be lower than foreign exchange component of the unsubsidised product which the producer has sacrificed to increase wheat production.

Thus, the net outcome of such a policy change would be to increase consumer costs with little change or even a reduction of foreign exchange earnings. There is also another policy alternative to this, in which the New Zealand price would be set below the world price. In this situation consumers of wheat would benefit because they would not have to pay the world price for all their wheat. However, at the same time producer incomes would be lowered and the nation as a whole would be losing foreign exchange which could be saved from reduced imports of wheat.

Unfortunately, we do not have the information available at this stage to be able to put dollar values on these public costs and benefits, but I have recently completed a theoretical analysis of the general problem using a computer simulation model (Zwart). The major result from this brief study was that national costs of wheat policy were minimised when wheat prices were set at world price levels. With such a policy the nation as a whole would gain. In periods of high world prices such as 1973-74 we could benefit from exporting wheat. In periods of low world prices such as we could be entering at the moment, the nation would be better off by importing cheap wheat and using our farm resources to produce other products which have a relatively higher value.

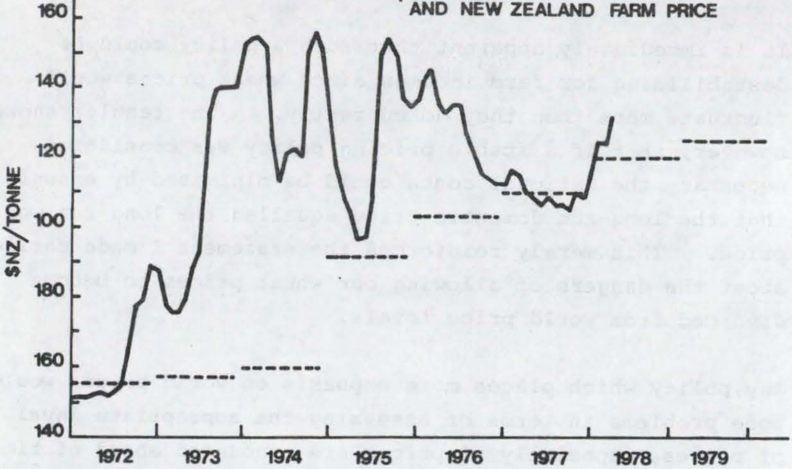
It is immediately apparent that such a policy could be destabilising for farm incomes since wheat prices would fluctuate more than they do currently. The results showed, however, that if a stable pricing policy was considered necessary the national costs could be minimised by ensuring that the long-run domestic price equalled the long-run world price. This merely reinforces the statement I made earlier about the dangers of allowing our wheat prices to become divorced from world price levels.

Any policy which places more emphasis on world prices would pose problems in terms of assessing the appropriate level of prices, especially if prices are announced ahead of time as they are currently in New Zealand.

The graph in figure 2 shows that at present the New Zealand farm price is very close to the Australian export price. Because the cost of shipping Australian wheat is almost the same as moving New Zealand wheat from farms to the demand centres (mainly in the North Island), these prices would be very competitive. Unfortunately, I feel that this outcome was more by luck than good management as when the local price was announced, international predictions were that the world price would continue to fall.

This very brief discussion of our wheat industry has shown that there can be costs to the nation of maintaining a wheat price different from the world price. I am not suggesting that there should be a policy change towards a free market for wheat, but I merely wish to establish that there are costs involved in our current policy of price stability. Discussion of the international market for wheat will reveal that there are also international costs associated with such a policy.

Fig 2: AUSTRALIAN F.O.B. PRICE (ASW/FAQ) AND NEW ZEALAND FARM PRICE



THE INTERNATIONAL MARKET FOR WHEAT

New Zealand plays a very small role in the world wheat market. In 1972 we imported 148,000 tonnes which was the highest level in the last ten years. In that particular year our imports represented 0.2% of total imports in the world market. While this is a very small amount it should be noted that there are many other countries around the world which import similar amounts. The international wheat market is in fact characterised by a very large number of small importers and a few large exporting countries. The largest importing countries are probably the USSR, China and Japan who each account for approximately 10% of the trade. The remaining imports are in much smaller quantities and go to a very wide range of destinations. 50% of the exports originate from the United States of America and the major share of the remaining exports came from Australia, Canada and the Argentine.

An international comparison shows that the percentage of variability in wheat production caused by changes in the area grown is higher in New Zealand than in eight other selected countries. These results can be seen in table 2.

Although the stated objective of the policy makers may have been one of self sufficiency, the outcome of their attempts to attain that objective has the appearance of a price stabilising policy. They have attempted to attain self sufficiency by increasing prices in a stable manner, but the unstable nature of production has meant that we have rarely been able to attain self sufficiency.

TABLE 2. RELATIVE IMPORTANCE OF SOURCES OF WHEAT PRODUCTION VARIANCE BY COUNTRY/ECONOMIC GROUPING

Source of Variance	New Zealand	United States	Argentine	Australia	Japan	Canada	EEC	India	Europe
Area	0.87	0.71	0.59	0.54	0.53	0.46	0.33	0.32	0.10
Tield	0.14	0.29	0.41	0.46	0.47	0.54	0.67	0.68	0.90
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Only about 12% of the total wheat production in the world is traded, but this trade is still vitally important for many countries. This is because wheat is a basic constituent in diets of a large proportion of the worlds population and the ability of wheat to be stored and shipped without spoilage makes it invaluable as an emergency source of food in regions which suffer from natural disasters or food shortages.

Almost every country involved in the wheat trade has some form of domestic policy which affects the production, consumption or domestic price of wheat. The most commonly stated objective of policies in these countries is that of domestic self sufficiency. In developing countries the motive for self sufficiency is to ensure that the basic food requirements of the country are met. In developed countries the objective is similar, but the motive is more close linked to ensuring adequate levels of income for domestic wheat producers. While a policy of domestic self-sufficiency may satisfy domestic objectives it can have dramatic impacts on the stability of the prices in the world market.

Instability is caused by the fact that most countries attempt to retain stable domestic prices, thus any shortfall in local production is made up from imports usually with no regard to the prices that are paid. Similarly, any surplus domestic production, as occurs in the EEC, is released onto world markets and sold at any price.

Policies such as these have little impact when world wheat stocks are high, as was the situation throughout the 1960's. The five major exporting countries held over one year's trade (60 million tonnes) in stock. In those years any small shortages caused changes in stocks, and world prices remained very stable and low.

Problems resulted when the exporting countries had made concerted efforts to reduce the cost of their stock-holding by reducing the level of stocks. Thus, when the USSR made a large purchase on the world market, the prices began to rise. This price rise was exacerbated by the fact that none of the importing countries attempted to reduce domestic consumption when the price rose. In their attempts to retain domestic price stability these countries purchased wheat at very high prices on the world market and often sold it at much lower prices domestically. This could be seen in New Zealand's behaviour during this period. In 1975 and 1976 we purchased large quantities of wheat on the market without making any serious attempt to reduce consumption and increase production which could have helped alleviate the world shortage. The exporting countries reacted in a similar manner. The United States of America imposed an export embargo and Canada fixed the domestic price of wheat to retain domestic stability. The ironic factor in this situation is that if every country, including the USSR had made small reductions in wheat consumption, there would have been little reaction in world prices.

This situation will continue to cause instability in the world market especially when stocks are low. The basic problem is that countries are not prepared to adjust domestic prices to changes in world markets. They are in fact exporting their domestic production instability.

The current stability of the international wheat price is due to the re-emergence of substantial wheat stocks in the major exporting countries. The recent price rises are most probably due to domestic policy changes in the United States which have resulted in substantial cut-backs in production. The speed with which exporting countries have accumulated stocks would suggest that prices will be relatively low for some time. The key to price changes in times of high stock levels are the domestic wheat policies in the United States and the other major exporting countries. The support prices in these countries determine minimum prices for the world market. If prices fall too far below these levels these countries will be forced into holding even further stocks. If stocks were to become depleted again however, we could expect further periods of high and unstable prices.

SUMMARY

I have attempted to review pricing policy in the New Zealand wheat industry from three vantage points. From the farmers point of view, I have shown that they can benefit from stable prices which allow them to stabilise their total farm incomes. At the national level, however, there are costs to both producers and consumers of allowing our prices to diverge too far from international levels. These costs must be carefully weighed against the benefits of the stable prices. The very brief discussion of the world wheat market has shown that there are also international costs associated with our present policy in the form of unstable world prices. Obviously the adoption of a flexible pricing policy in New Zealand would not solve the world wheat price problem, but it must be remembered that we are on the receiving end of similar domestic policies in other markets such as dairy products and beef. I leave you with the thought that perhaps the European's view their dairy industry, and the Americans their beef industry, in much the same manner as we view our wheat industry.

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ROTATIONAL GRAZING AND PASTURE UTILISATION WITH THE BREEDING EWE FLOCK

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INTRODUCTION

After considerable growth during the 1960's livestock numbers and production levels in the sheep industry appear to have stagnated (table 1), falling well short of projected targets.

Table 2 compares the levels of production obtained on intensive farms and from farmlet studies at Ruakura. The most noteworthy thing is the contrast in production achieved at Ruakura and that achieved on North Island intensive farms. This is mainly a reflection of carrying capacity or stocking rate, but other factors such as fertility levels and top dressing rates, and their effects on pasture production levels, and management techniques used will have some effect. In regard to the latter, this paper is going to emphasise the grazing management procedure adopted on these Ruakura farmlets.

In the late 1960's 'stocking rate' almost became a dirty word, and progress in reaching livestock numbers and production goals halted. This was due mainly to a series of droughts and as shown in table 3, a drop in prices received for farm

TABLE 1. SHEEP NUMBERS, PERFORMANCE AND PRODUCTION[1].

Season	*Sheep (Millions)*	*Breeding Ewes (Millions)*	*Lambing %*	*Mutton & Lamb 2*	*Wool 3*
1960-61	47.1	32.6	98.0	136	151
61-62	48.5	33.6	100.0	140	150
62-63	49.0	33.9	99.3	137	159
63-64	50.2	35.0	99.3	145	158
64-65	51.3	35.7	97.4	141	160
65-66	53.7	37.2	99.5	139	178
66-67	57.3	39.6	99.2	155	182
67-68	60.0	41.4	98.8	168	186
68-69	60.5	42.7	94.8	167	188
69-70	59.9	43.4	97.0	167	185
70-71	60.3	42.9	93.1	167	189
71-72	58.9	43.0	94.4	171	182
72-73	60.9	44.2	92.0	165	175
73-74	56.7	41.0	91.0	147	161
74-75	55.9	40.4	92.7	146	166
75-76	55.3	41.1	94.0	152	175
76-77	56.4	41.2	96.4	149	171

1 From N.Z. Meat & Wool Boards Economic Service (1977a)

2 Relative to 1949-50 = 100 (337,000 tonnes)

3 Relative to 1949-50 = 100 (177,000 tonnes)

TABLE 2. LEVELS OF PRODUCTION

Farm Type	*South Is. Intensive* [1]	*North Is. Intensive* [1]	*Ruakura Farmlets* [2]	
Stock Units/ha	11.8	12.9	19.8	27.7
Lambing %	107	95	125	117
Meat (kg/ha)	162	179	325	421
Wool (kg/ha)	67	49	97	138

1 From N.Z. Meat & Wool Board Economic Survey (1977b)

2 Rattray unpublished

TABLE 3. PRICES, COSTS AND PURCHASING POWER
(Base 1965-66 = 1,000)

Year	*Prices Received Index*	*Prices Paid Index*	*Terms of Exchange Index*
1965-66	1000	1000	1000
66-67	947	1032	918
67-68	938	1068	878
68-69	1035	1102	939
69-70	1191	1136	1048
70-71	1105	1192	927
71-72	1074	1268	847
72-73	1810	1333	1358
73-74	1857	1520	1222
74-75	1308	1724	759
75-76	1962	1932	1016
76-77	2580	2291	1126

From N.Z. Meat & Wool Boards Economic Service (1977a) produce. The table shows the relative prices received and costs over the years and the 'term of exchange index' which is an estimate of the 'real relative purchasing power of the farmer at the farm gate'. It can be seen that this fall off in the late 1960's was due mainly to low prices for produce, but also to increasing costs. In other years where it fell below 1000 this was due to either a fall in prices received or to costs increasing more than prices for meat and wool.

Per Animal - Per Hectare Production

Probably another important feature to note is that, apart from some exceptions, contrary to many present day claims to government the 'real relative purchasing power of the farmer' is not declining. This is borne out by the trends in fertiliser usage which is very strongly related to farm incomes (N.Z. Meat & Wool Boards Economic Service, 1977a) and tends to indicate that in spite of continued expenditure on the farm, little progress has been seen in terms of meat and wool production (table 1).

It is the opinion of the authors and of many others in the industry (J.D.J. Scott, pers. comm.), that this has been mainly due to undue emphasis on per head production rather than on per hectare production which can be achieved mainly by increased carrying capacity. As stocking rate increases, however per head production does decline, but production per hectare increases. Only at extreme levels does production per hectare decrease due to very low levels of feeding causing a dramatic drop in per animal performance. It is our contention that if some of the investment had gone towards increasing stocking rates, farmers would have capitalised on the recent few good years. In support of this statement (J.D.J. Scott, pers. comm.), the I.C.I. Farmer of the Year Award farms have carried more stock units per hectare than comparable farms resulting in a greater cash surplus per hectare. On intensive farms the stocking rate over the last 10 years has remained around 13 stock units per hectare while in the years where comparison is possible, award farms carried on average 19.5 stock units per hectare and had a 47% greater cash surplus ($92 as against $63 per hectare). Hill country farms have averaged around 10 stock units per hectare while similar award farms have carried 12 stock units per hectare and have had a 27% greater cash surplus ($70 as against $55 per hectare).

Optimising the Animal and the Pasture

In the 1960's when there was an emphasis on increasing stocking rates, a major factor often ignored was the importance of rationing and allocating feed at critical periods. A lack of knowledge of optimum and minimum pasture allowances aggravated the situation. This allocation of feed can only be done under rotational grazing. Over stocking and poor management led to the decline in emphasis of stocking rate. Stocking rates should not be lifted in one dramatic step, but rather gradually as pastures, management skills and confidence improve.

Efficient conversion of pasture into meat and wool requires the integration of several factors : pasture growth, effective pasture utilization, feed allocation, and animal requirements.

It is not always possible to optimise both the treatment of the animal and that of the pasture, and we have to reach a compromise that will allow us to feed animals as close to optimal quantities throughout the year and grow as much high quality feed as is possible. On one hand we have a considerable knowledge of the many factors that can influence plant growth, and on the other hand a good knowledge of animals' feed requirements. Because of the complex and difficult nature of the research relatively few studies have considered the grazing animal-growing plant interface or have measured the effects of one on the other and the inter-relationships that can occur on a year round basis.

This paper will now discuss the advantages of rotational grazing and then describe the system used at Ruakura to enable 25 ewes per hectare to be farmed successfully.

ADVANTAGES OF ROTATIONAL GRAZING

Rationing and Allocation of Feed

The seasonal nature of pasture growth is well established. To obtain maximum animal production per hectare, we must match as closely as possible the feed requirements of the grazing animal with the pasture available. It is possible to go a considerable way towards achieving this through the adoption of rotational grazing which can assist in the rationing and allocation of feed. Through restriction during non-critical periods, such as in mid-pregnancy, saving feed for more critical periods such as late-pregnancy is made easier. Under set stocking there is only limited scope as the amount of feed available per animal is dictated mainly by pasture growth. Only through some sort of agistment, such as the buying or selling stock, can feed allocation be changed. In contrast, under rotational grazing feed allocation can be controlled by merely opening and shutting gates; that is by speeding up the rotation or by allowing access to more than one paddock.

Level of feeding is probably still the major factor influencing per animal performance and is responsible for much of the difference between high and low producing farms on a similar class of land, or between good and bad years. Other things being equal, the better allocator of feed or the farmer with a better appreciation of feed requirements should obtain higher levels of production.

Although the feed requirements for different types of stock and levels of production are quite well known, there is little information on how much pasture should be offered to grazing animals to meet these requirements. Pasture allowance describes the amount of pasture *offered* per animal per day, measured to ground level. The grazing animal can only harvest a proportion of the pasture, hence allowance is always greater than intake. Pasture allowance is what the farmer uses to control animal performance. Current research at Ruakura is defining the optimum pasture allowances for various classes of stock at critical times of the year. Such knowledge will help to provide a much sounder basis to feed budgeting and grazing management, when used in conjunction with rotational grazing and a method of measuring or estimating pasture yield in kilograms DM per hectare. Table 4 contains some recommended pasture allowances for sheep, which give intakes quite close to recommended requirements. By simple arithmetic it is not difficult to calculate how long a grazing period in a paddock of known yield should be for a given allowance. If allowances are insufficient, some drop in performance could be expected or supplementary feeding adopted.

TABLE 4. RECOMMENDED PASTURE ALLOWANCES FOR SHEEP

Status	*Pre-grazing Pasture Yield (kg DM/ha)*	*Pasture Allowance (kg DM/head/day)*	*Pasture Intake (kg DM/head/day)*
Ewe:			
Mid-Pregnancy	1000-2000	2.1	0.9
	2000-2500	1.2	0.8
Late Pregnancy	2000-3000	2.0[a]	1.4
		3.5[b]	2.2
Early Lactation	3000-4000	4.5[a]	2.1
		6.5[b]	3.2
Flushing -	2000-3000	6.0[c]	1.7
Mating		4.0[d]	1.4
Weaned Lamb	3000-4000	5.0	1.5

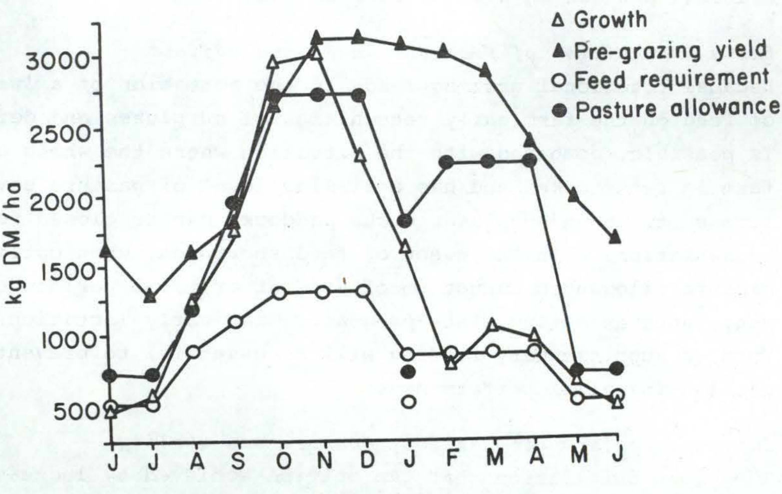
a,b Ewes with singles or twins, respectively

c,d High proportion or low proportion of dead matter in pasture, respectively

Reduction of Fluctuations in Feed Supply

Under rotational grazing, pasture grown in periods of peak growth can be conserved *in situ* for grazing during periods of low growth, or can be accumulated *in situ* during periods of low feed requirements for grazing during periods of high feed requirements. Figure 1 shows this for one of the Ruakura trials and also how theoretical feed requirements and recommended allowances for the breeding ewe flock relate to pasture growth and the pasture available throughout the year. When growth exceeds intake and decay, pasture builds up leading to an increase in pregrazing yield, and when intake and decay exceed growth pasture yields decrease, such as in the autumn and winter. Spring and summer grown pasture is 'transferred' to the autumn and the winter. The isolated points for feed requirement and allowance in January, represent those of the ewes only. The curves include those of the weaned lambs also.

Figure 1.



Pasture growth, pre-grazing pasture yield, feed requirements and recommended pasture allowances.

Under rotational grazing there has been a reduced need for drought and winter supplementary feeding, with a movement away from fodder-cropping and conservation towards all grass farming in many areas.

However, in certain districts where winter and summer troughs in pasture growth are extremely low, some form of conservation and/or cropping may be essential if there is tractor country available, although some farmers are forced by topography into all grass farming. Silagemaking is the preferred method of conservation as it is cheaper and less weather dependent than hay. Because silage is also made earlier in the season than hay the pastures have time to recover before the summer dry period. In comparison hay-making reduces subsequent summer and autumn pasture growth by 500-1500 kilograms DM per hectare. The increased use of mechanised loading and feeding equipment also make silage feeding somewhat more attractive than it has been in the past. Recent experiments at Ruakura have shown that very satisfactory intakes and gains can be achieved by ewes at critical periods on wilted, fine-chopped silage.

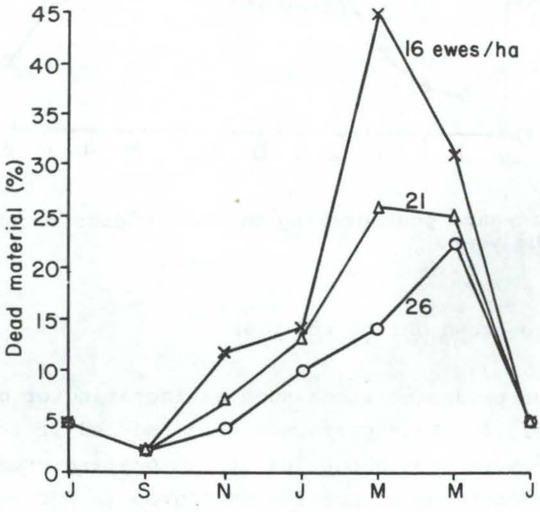
Early Recognition of Feed Surpluses and Deficits

Because rotational grazing leads to the formation of a 'wedge' of feed on the farm early recognition of surpluses and deficits is possible, compared with the situation where the whole of the farm is set stocked and has a similar level of pasture cover across it. When surpluses occur paddocks can be closed for conservation. In the event of feed shortages, when optimum pasture allowances cannot be offered at critical periods of the year, such as mating, late-pregnancy, and early lactation, some form of supplementary feeding will be essential to prevent a decline in animal performance.

Improved Pasture Utilization, Control and Quality

The close defoliation that can only be achieved by increased grazinq pressures leads to high levels of pasture utilization and removed the older senescent leaves, thereby preventing the build up of dead material and reducing losses due to decay. Compared with set stocking, there is a lower amount of dead material in rotationally grazed pasture (Campbell, 1966) and this means higher quality pastures. Pastures with a high content of dead material can be up to 25% less digestible than pasture with a low proportion of dead herbage. The effect of grazing pressure on the proportion of dead material is shown in figure 2. The increases in grazing intensity that can be achieved with rotational grazing can also be used to control weeds and secondary growth in addition to removing rank pasture.

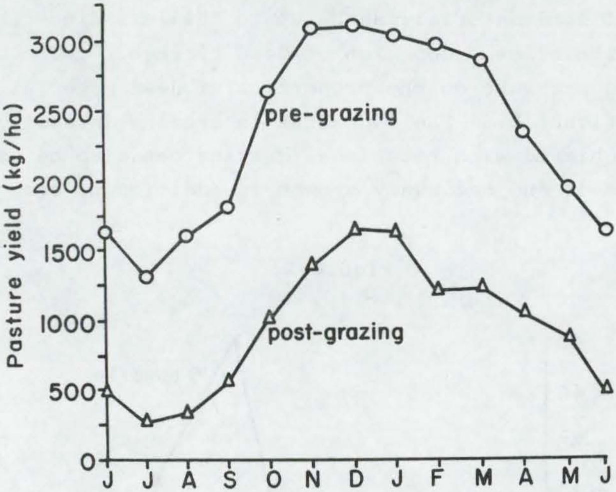
Figure 2.



The effect of grazing pressure on the proportion of dead material throughout the year.

The pre-grazing and post-grazing pasture yields that were achieved under 25 ewes per hectare in a Ruakura trial are shown in figure 3. Pasture DM utilization per grazing varied from 70 to 80% during June-September and 50 to 60% during the rest of the year. Lowest levels of utilization were during late lactation. This resulted in over 95% utilization of the

Figure 3.



Pre- and post-grazing pasture yields throughout the year.

annual pasture grown during the year.

In the case of producing stock such as lactating or growing animals, (table 4) their performance is reduced if they are forced to eat more than about 30% of the pasture present. At acceptable carrying capacities some drop in per head production must be tolerated to obtain satisfactory levels of pasture utilization and per hectare production. Where very high levels of pasture utilization are desirable as part of pasture control measures dry stock should be used.

Changes in Botanical Composition

By increasing grazing pressures at certain periods of the year such as autumn, changes in pasture species can be induced. Marked changes in pasture species, with a reduction in weeds and low fertility species such as Brown Top and Yorkshire Fog has occurred, leading to ryegrass, white clover and Poa dominance.

This change from low fertility species to improved pasture species has been very noticeable on hill country pasture.

Improved Pasture Production

Under rotational grazing high levels of pasture production have been recorded. Part of this would be due to the encouragement of improved pasture species with their longer growing periods. The spell between grazings allows the build-up of root reserves. The uniform and close defoliation obtained under rotational grazing, coupled with the well distributed return of dung and urine over the paddock leads to an acceleration of the nitrogen cycle and an increase in fertility. In addition the close defoliation removes old photosynthetically inactive leaves and dead material, and allows light into the base of the sward to promote tillering and maintain clover growth. Such improvements are usually most conspicuous under initially low fertility situations, but they can also be quite substantial in higher fertility situations.

Levels of pasture production obtained under rotational grazing with sheep at Ruakura are shown in table 5. Rainfall and temperature trends cannot explain all of this tremendous surge in production. The increased production was also associated with an increase in animal production, as illustrated by the lambing percentages.

TABLE 5. PASTURE AND ANIMAL PRODUCTION UNDER ROTATIONAL GRAZING

Year	*Pasture Production (kg DM/ha/year)*	*Lambs Born/ Ewes Mated (%)*
1973-74	11 800	126
1974-75	14 500	125
1975-76	19 200	147
1976-77	19 000	155

TABLE 6. EFFECT OF STOCKING RATE ON PASTURE PRODUCTION AND TILLER NUMBERS

Stocking Rate (ewes/ha)	*Pasture Production (kg DM/ha/yr)*	*Perennial Rye grass Tillers (n/10 cm^2)*	*White Clover Plants (n/10 cm^2)*	*Weeds (n/10 cm^2)*
26	17800	28.5	4.8	0.2
21	16300	24.6	3.6	0.5
16	15000	17.6	3.8	0.5

Pasture production was also greatest at the highest stocking rates (table 6). These pastures were best utilized and had lowest proportions of dead material (figure 2) and a highest densities of tillers, due probably both to the increased return of dung and urine and defoliation at the higher stocking rates.

Increase in Animal Production
Improved ewe live weights, lambing performance, hogget growth rates and increases in stocking rate have been achieved by many farmers. Research has shown that the advantages of rotational grazing are greatest at high stocking rates.

RISKS

No system can completely eliminate all the risks and effects of feed shortage which are accentuated at high stocking and during droughts, however, rotational grazing will help to minimize such effects through early recognition of feed shortages and rationing of pasture. In mild deficits the animals can be used to 'buffer' the feed shortage using body tissue reserves, however, a lower level of performance in lambing percentage or fleece weight will have to be tolerated. In regions where seasonal or year to year variation is very marked some form of insurance such as stored hay or purchased feed may be needed. Other means of minimising the risk include grazing some animals off the farm, selling lambs as stores rather than as fats, early slaughter of dry and cull ewes, selling of ewes either in-lamb or even with lambs at foot. In exceptional circumstances, such as this last season, with wide-spread drought, these methods may not be possible and have to be covered by other less routine policies.

DESCRIPTION OF THE SYSTEM

The system used successfully with 25 ewes per hectare in the Ruakura farmlet studies is summarised briefly in table 7.

TABLE 7. GRAZING SYSTEM USED WITH 25 EWES PER HECTARE AND 20 PADDOCKS

(No. ewe-days/ha per grazing)	*Season* 1	*Rotation Length (Days)*	*Grazing Pressure (No.ewe-days/ha per grazing)*	*Grazing Period (No days/paddock)*
Weaning-flushing	S	Variable	Variable	Variable
Flushing-Mating	S-A	20-40	500-1000	1-2
Mating-Late Pregnancy	W	60-70	1500-1750	3-3.5
Late Pregnancy-Lambing	W-S	30-40	750-1000	1.5-.2
Lambing-Early Lactation	S	Set Stocked	25	In all paddocks
Late Lactation	Sp-S	15-40	375- 1000	0.75- 2

1 S - Summer
A - Autumn
W - Winter
Sp - Spring

Lambs are weaned at 10 to 12 weeks of age. After weaning lambs receive preferential treatment, grazing ahead of the ewes, on clean pasture, such as hay or silage after-math, whenever possible. During this period the rotation adopted with the ewes varied somewhat, reaching a compromise between the need to maintain or improve ewe body weight and condition for the following mating and the need for pasture control. It is important to clean up rank, and dead herbage from pastures during this period, but this will not always be compatible with achieving high ewe body weights.

The rotation is speeded up some three to six weeks prior to mating in order to reach a ewe liveweight of at least 55 kilograms and have the ewes on a rising plane of nutrition when the rams go out - in order to capitalise on the advantages of the *static* liveweight effect and the *dynamic* flushing effect. On no account should ewes be used for pasture control during this period as subsequent lambing percentage will suffer. All market lambs are killed or sold as stores prior to this to minimize competition with the ewe mob for precious flushing feed.

Towards the end of mating the rotation can be slowed up again to 60 to 70 days in early and mid-pregnancy. Over this period some liveweight loss can be tolerated and the grazing pressures adopted will clean up the pastures. This long late-autumn and winter rotation allows for autumn growth after the rains start to be accumulated along with winter growth for rationing later on in pregnancy. In areas where very cold winters are encountered this transfer of autumn growth *in situ* is of major importance. However, even in Southland it is quite surprising how much pasture continues to grow during winter.

Approximately four weeks before lambing is due to start the rotation is quickened again to meet the increasing feed requirements of late pregnancy and so avoid any pregnancy toxaemia. Initially the bank of feed that has built up during the long winter rotation is used but later the onset of spring pasture growth meets feed requirements.

As lambing commences the ewes are set-stocked over most of the farm. This should not be done too early or feed reserves will be quickly consumed. The set stocking is mainly for ease of management. It allows near maximum intake during the time when feed requirements are the highest and avoids problems which occur with rotational grazing due to lack of mobility of newly born lambs. Stock shifts at this stage are very difficult and time consuming, and the disturbances lead to mis-mothering and increased lamb mortality.

The lambs are docked at about a month of age and are mobile enough by this time to re-commence rotational grazing. The mobs of older lambs and ewes are gradually picked up and a fast rotation of about 15-20 days is adopted. Surplus pasture is conserved mainly as silage in the spring, but some hay is made from surplus growth in the summer. After conservation all the paddocks are available and the rotation is lengthened to 30-40 days.

APPLICATION TO HILL COUNTRY

To have the greatest impact on sheep production in New Zealand, this system, although developed for flat land, must be shown to apply and prove acceptable to hill country farmers who farm 60% of the nation's breeding ewes. The first prerequisite is adequate subdivision. With this, all of the advantages and principles expounded become as accessible as they do on flat or rolling country.

It may be argued that such a grazing system may be quite feasible at Ruakura with its small mobs of 50 to 100 ewes on flat land, and all sorts of excuses are offered as to why it cannot be put into practice on hill country farms. The fact remains, however, that many hill country farmers in both the North and South Islands are using similar systems and some have been doing so for many years. On some properties because of the terrain or lack of subdivision it may be more difficult to put into practice than on others.

Many farmers and advisers have been amazed at the ease with which the system can be put into practice, and also the resulting improvements in pasture and stock. Pasture production on one hill country soil has varied almost five fold from 3,400 to 17,000 kilograms DM per hectare depending on fertility status and top-dressing treatment (Brougham, 1973), so there is tremendous potential to increase both pasture and animal production in much of the hill country. Initially, in its simplest form, a rigid rotation can be easily put into practice and lead to marked improvements, but with a knowledge of optimum pasture allowance some flexibility can be introduced into the system to help improve production.

FINALE

With kinder treatment from our government, through say new systems of land tenure and revised financial or incentive policies, and kinder treatment from our unions, overseas markets and climate, the scientists, advisers and farmers could produce a concerted effort to get our industry out of the doldrums, to the benefit of individual farmers and the country as a whole.

It is our opinion that the technology and knowledge exists for markedly improving animal production from much of our hill country. Initial steps in this direction could be taken simply by the adoption of rotational grazing, without incurring any extra work or costs. The benefits would be immediate and quite convincing.

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HILL COUNTRY GRAZING MANAGEMENT

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Hamilton

INTRODUCTION

In New Zealand there are approximately 4.5 million hectares of hill country supporting 31 million stock units. This hill country will, in the foreseeable future, remain a major resource in the national economy. Much of this land will remain in pastoral farming. Because hill country is likely to remain as grassland longer into the future than other land areas, it is desirable that major emphasis is placed on the factors influencing optimum pasture production from it.

Hill country pasture will continue to be utilised by the grazing animal. Therefore, the art or science of grazing management, the combining of good pasture husbandry with allocation of feed to animals at the desirable level, needs constant reassessment in the light of new technology, changing economic factors, the present state of hill farms, and not the least, the knowledge level of the hill farmer.

DEVELOPMENT OF HILL COUNTRY GRAZING MANAGEMENT SYSTEM

In 1973 it was noted by farm advisory officers of the Hamilton region that hill country stocking rates had declined. Despite this decrease, individual animal performance, particularly that of the breeding ewe, had remained static. It was thought that ewe liveweights were too low to achieve satisfactory performance. In 1974, the Te Kuiti sub region advisers carried out a survey which confirmed this view (Parker et al. 1974).

Further investigation showed that the manner in which pasture should be grazed to encourage the growth of improved pasture legumes (Trifolium spp.) and ryegrass (Lolium spp.) was not clearly understood. It was recognised that hill country farmers usually have between 15 and 25 major grazing paddocks and five to six mobs of stock.

The effect of management on total pasture yield and species composition is illustrated by a description of three basic grazing systems.

Set Stocking System
Here animals graze the pasture almost continuously. As would be expected from agronomic principles (Smetham, 1973), pasture plants are not given the chance to express their potential for regrowth. The more erect growing grasses such as ryegrass and cocksfoot are affected more than prostrate species such as browntop. The more palatable clovers tend to be overgrazed, existing only as stunted plants, and do not develop the vigour which will bring about effective nitrogen fixation. This can result in a loss in nitrogen input and a reduction in efficient use of applied fertiliser. It is recognised that set stocking does allow spelling since animals do not defoliate each plant daily. However, the process is uncontrolled and often highly selective and at meaningful stocking rates leads to lower production and utilization.

'Shuffle' Stocking System
This is an attempt to introduce the rotational effect, but, with a limited number of paddocks and five or six mobs. The effect must be to lengthen the grazing period or shorten the spelling period of the pasture. The result offers little

improvement on set stocking - that is, the more erect growing or palatable species will be affected most and total pasture production reduced.

Rotational Grazing

Under this system the pasture is grazed for a short time and spelled for a long time. The time pasture is spelled is dependent upon season and climate. By treating pastures in this way, the more erect, improved species of grass and the more palatable legumes are encouraged (Jones, 1933, Brougham, 1970). Plants seem to be more productive when grazed in this manner. In winter a greater leaf area allows them to intercept more light. In summer a more substantial root system is capable of drawing moisture from a deeper, moister layer of soil. Improved pasture cover in summer can also ensure a better soil moisture regime (Brougham, 1970).

Grazing Management Guidelines

Stemming from this definition of rotational grazing we have applied the following guidelines to hill country grazing management:

* Do not graze a pasture for more than three days with the major grazing mob. This minimises the setback to pasture regrowth and maintains a more vigorous pasture.
* Keep the spell between major grazings long enough to maximise pasture response.

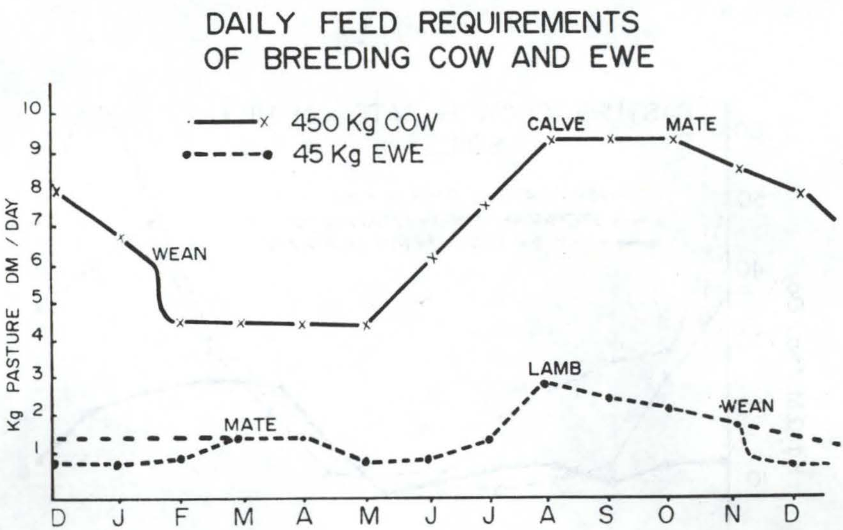
An example of the minimum length of spell at present adopted for the Hamilton region is: spring 12 days; summer 35 days; autumn 35 days; winter 35 days.

The minimum length of rotation may be reduced to 25 days in summer but only if substantial rain falls. In colder regions the minimum length of the winter rotation recommended is 40 days plus. A rotation longer than the minimum in winter allows stock to be moved early after periods of heavy rain.

Stock Feed Requirements and Pasture Production

Simply growing more pasture does not alone ensure more lamb, wool or beef. Both the stock feed requirements over the year and their relationship to pasture growth must be understood to achieve success.

Figure 1



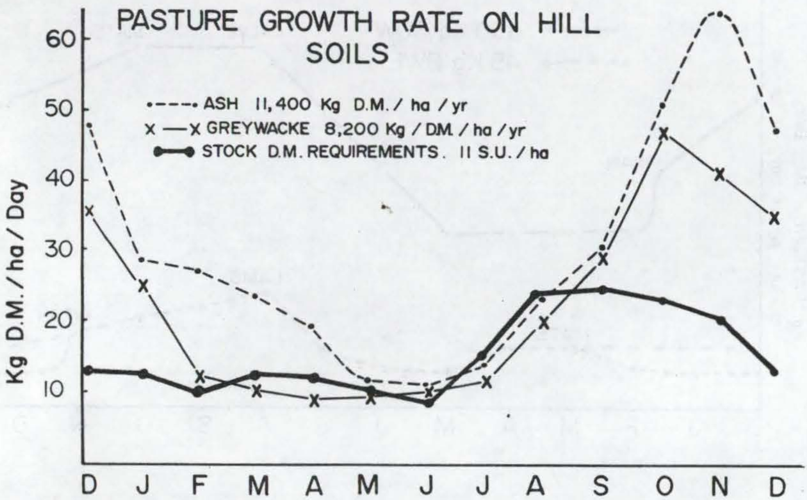
The essential points to note are the feed requirements of the breeding cow and ewe in figure 1 are:

* The need to increase feed, to three times maintenance for the ewe and to a little over twice maintenance for the cow once their offspring are born. This is a considerable increase over May feed requirements.
* Ewes should be fed to gain liveweight immediately after weaning, not fed at maintenance as suggested by the "classic" feed requirement graph. Realise, the time from weaning to tupping is relatively short and it has been shown that for every five kilogram increase in ewe liveweight between 40 and 60 kilograms a 10% increase

in lambing can be expected (Hight and Jury, 1973).

In figure 2 an endeavour has been made to relate the feed requirements of the total stock on the farm to average hill country pasture production, in this case for two soil types (Gillingham, 1973).

Figure 2



Two points can be made:

* Flushing ewes for increased fertility may not be practical on hill country. This creates the need to place greater emphasis on the liveweight effect on lambing percentage.
* The time in spring when pasture growth exceeds stock requirements can be predicted and effective early pasture control measures taken.

Effective early control means:

* Allowing ewe hoggets or cows and calves access to more feed as soon as this is available.

* Maintaining ewe milk production at a higher level by retaining pasture quality (Rattray, 1975).
* Allowing surplus pasture to be conserved as silage and/ or hay at a time when it is a true surplus and of high feed quality.
* Increasing pasture production in the summer and autumn periods.

The Grazing Management Calendar

All of the above ideas for improved animal and pasture production must be combined into a grazing management plan or action calendar for the whole year. A key point is that the hill country farmer is limited in the number of paddocks on his property. Therefore, to obtain an adequate length of rotation, the various classes of stock with similar feed requirements have to be combined. The major grazing group may contain all the breeding ewes and cows during some periods of the year. This could represent as much as 85% of all the stock units on a breeding property.

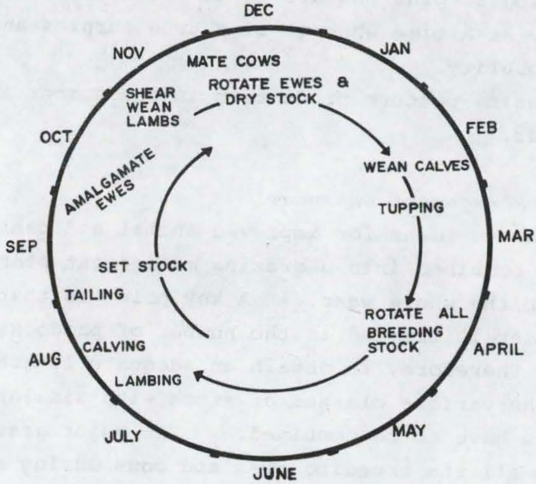
By drawing up an action calendar, recognition is given to the fact that the grazing practice in one period can affect both the quantity and quality of pasture available to the stock in a subsequent period (Smetham, 1973).

The calendar (figure 3) can be considered in more detail, starting with lambing.

* The stock are set stocked as close to lambing as is practical. Cows should be break-grazed with a mains electric fence and late lambing ewes and ewe hoggets can be stocked separately at a relatively higher stocking rate. Because of the high feed requirements of the breeding stock at this time, the whole of the farm area should be used for grazing.
* In anticipation of excess feed in September and October, the stocking rate of the lambed ewes will be increased to allow more feed for late lambing ewes, cows, ewe

Figure 3

ACTION CALENDAR



hoggets and finally conservation of silage or hay.

* Lambs should be weaned by an average of 10 weeks. This allows ewes to be shorn and begin on the rotation of the whole farm as early as possible. Also included in this major grazing mob are rising two-tooth ewes, rams and dry cows. As the drier summer approaches, the length of rotation is increased from an initial 21 days to 35 days. This spelling of pastures before the end of November is most beneficial in increasing clover content.
* Ewe hoggets and cows with calves may be run together depending on the actual size of these mobs and individual farm conditions. These priority stock graze paddocks with good feed following an adequate spell from grazing. Priority stock are not expected to eat a high proportion of the feed in any one paddock and are not therefore limited by the maximum of three days' grazing rule. No paddock should be grazed in consecutive rotations by only priority stock. Doing so could lead to

poor utilization and loss of pasture control.

* At weaning the breeding cows join the major grazing mob. The retention of steer calves on the property means that the timing of weaning can be related to the feed available and not to a fixed time such as sale date. It is recommended the retained weaners be run on a separate intensive beef unit; they may, however, be grazed with the ewe hoggets.
* If feed is available, the length of rotation may be reduced over the flushing/tupping period.
* The length of rotation is increased from tupping to three weeks before the start of lambing. Paddocks required for break feeding to breeding cows should be last grazed by the main mob one rotation length before break grazing commences.
* Three weeks before lambing the length of rotation is gradually reduced to even out the feed available on the lambing paddocks, and to increase the feed intake of the ewes. The ewe hoggets may be set stocked at this time.

This approach outlines the principles of grazing that should be followed and offers guidelines which allow the hill country farmer to plan his grazing management. This hill country grazing system has been applied within two major resource limitations:

* A lack of cash for capital inputs.
* A limited number of paddocks.

RESULTS

More than 300 farmers have adopted this hill country grazing management system over the past two years. They have found advantages in both physical management and performance. Many beneficial effects of this grazing system can be seen in the short term. However, it could take up to three years before improved pasture species are dominant. Also it will be five to seven years before all ewes in the flock have the benefit of being born and reared on the system.

Benefits

* Farmers feel they are better able to plan feeding of stock and to allocate feed more in line with animal requirements than was possible under previous systems. This is due possibly to the simplification brought about by reducing the number of mobs.
* It is felt that feed is utilised more efficiently and/ or that more feed is grown. This is judged by the fact that pasture is grazed more evenly. Also savings are made by a reduction or elimination of hay feeding while maintaining or improving stock condition. In many cases farmers have gained confidence to increase stocking rates. It is recommended, however, that farmers begin the system with present stock numbers.
* Clovers and ryegrasses emerge as dominant species under the grazing system. Many farmers say they have never had as much clover present in pastures. This is most evident in early December.
* The performance of young stock, particularly lambs, is very good. A comparison of the advantages of a rotational system over set stocking are shown in figures recorded on John Linton's Tauranga property. These show in table 1, an advantage to rotational grazing of 7 kilograms in hogget liveweight in November after being run at equivalent stocking rates since March.

This advantage was only reduced to 5.9 kilograms by February after both groups had been rotational grazed from October. Based on these weight differences at mating, a 12% advantage in lambing percentage in favour of the rotational grazed hoggets was predicted and achieved.

The increase in hogget fleece wool over the March to October period was 0.55 kilograms or 32%, in favour of rotational

TABLE 1. TAURANGA PROPERTY HOGGET PERFORMANCE

Grazing Group	*No.*	*SU HA*	*Liveweight (KG) End Treatment (Nov)*	*Premating (Feb)*	*Fleece Weight (KG) Fleece Wool (Mar-Oct)*
Rotational	550	15.6	45.5	50.5	2.28
Set stocking	1250	15.6	38.5	44.6	1.73
Difference			7.0	5.9	0.55

grazed hoggets.

* Stockmen on farms where labour is employed enjoy working in the knowledge that stock are to be shifted on certain days and on others a full day can be organised on other jobs. Planning is also easier for owners. As one farmer put it, "every two or three days, one of us shifts stock and the other does something else - like go fishing."

* Ease of stock movement is uppermost in the minds of farmers thinking of adopting the rotational grazing system and running large mobs of stock. The following shift procedure is recommended.

1. Open the gate.
2. Shift any cattle through and away from the gateway.
3. Stay by gate or more congested area to guide stock.
4. Complete any straggle muster required.

CONCLUSION

Overall, farmers have applied the principles to many different farming situations. The hill country grazing management system has given the results predicted and farmers are satisfied with the change.

In conclusion, we would say the hill country grazing management system outlined forms the base on which farmers can plan grazing management. It is a framework on which can be built sound grazing management. It does not restrict or eliminate management. Experience with the grazing system suggests that adopting this approach does offer a means to increased production without increased costs.

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HILL COUNTRY GRAZING - THE FARMERS' VIEW

Messrs J.W. Linton and A.G. Snodgrass
Farmers, Te Puke

INTRODUCTION

The properties lie 16 kilometres south of Te Puke and 20 kilometres northwest of Rotorua. The home farm with 344 hectares in grass has been owned since 1960 and the next door farm with 186 hectares in grass was purchased in 1972. While the owner John Linton has the final say in policy, the day to day management responsibility of the home farm is John Linton's and that of the new farm Alistair Snodgrass. A policy which could be recommended to farmers in similar circumstances interested in employing and retaining a skilled work force.

The farms are of rolling contour bisected by steep gullies. Steep sidlings account for about 30% of the farm area and 23% of the area can be mown. Being 300-340 metres above sea level the climate is reasonably wet with 2,000 plus millimetres of rain annually. This is well spread with the exception of the February-March period. Frosts are common; up to 25 days of frost being recorded in both June and July. Cold southerly winds from the central plateau area are prevalent from May to September.

Soils are described as Oropi sand, a volcanic soil from the Kaharoa ash shower. It has a low natural fertility requiring high phosphate applications during development together with cobalt. Once developed, phosphate requirement is quite low and some potash is required.

Subdivision is now good with 36 paddocks on the home farm and 37 on the new farm. When the grazing system commenced there were only 26 paddocks on the home farm and this caused limitations to the length of rotation. Two separate rotations are required as there is a higher proportion of growing stock on the properties than on an all "breeding stock" farm.

The stock run are Coopworth ewes with replacements and dry cattle. Weaners and 18 month cattle were grazed for finishing but this winter only weaners will be grazed. The overall stocking rate of 15.5 stock units per hectare has remained static over the past four years. Stock units in sheep have increased from 63% of total in 1974 to 69% in 1977. This winter 81% of the total stock units will be sheep and the new farm will graze only sheep, at least until late spring.

Although semi-mob stocking had been practised for some years, a need was felt for a way to improve animal performance particularly lambing percentage and wool weights. A change had already been made to Border-Romney Cross ewes and Coopworth rams used on all first cross ewes and their progeny.

Following a visit to a Waikato farm to study the hill country rotational grazing system it was decided that it offered something positive and would suit the management requirements of our property.

In May 1975, with the help of Ministry advisers, a rotational grazing system was set up on the block managed by Mr Snodgrass. The hoggets along with the weaner cattle formed one mob and the ewes another. This gave one growing and one breeding mob rotating on their own areas. The ewes were set stocked at lambing and stayed that way until weaning and shearing on November 1. Compared with the stock farmed under the old system on the home farm, all the rotationally grazed stock did particularly well.

The advantages were obvious and were proved, beyond doubt, when the comparative hogget body and fleece weights given by Smith (1978) became known. The potential production lost on the 1,250 traditionally reared hoggets, was 690 kilograms of wool and 150 lambs or about $2,250.

The system was adopted on both farms from November 1 1975. The lambs replaced the hoggets in the growing mob and the hoggets went in with the rams and ewes to form the breeding mob. These two mobs on each farm were rotationally grazed with the aim of lifting ewe bodyweight, thereby increasing lambing percentage, and improving growth rate of hoggets and fattening cattle.

RESULTS

The results in terms of body weight can be seen in Figure 1. In both 1977 and 1978 replacement and mixed age ewe liveweights were greater, with the weaning and pre-tupping weights being increased 5-7 kilograms. Autumn 1978 weights do reflect a poorer season but the major cause of the slightly reduced liveweights was the lower culling level due to the decision to retain 1,000 extra ewes. The ewe liveweight increase was reflected in improved performance. Figure 2 is a comparison of on farmlambing performance over the last eight years and that of the Tauranga county survey flocks.

It can be seen that from 1971 to 1974 the lambing performance was between 4 and 11% below the county average. However, in 1973 and 1974 a higher overall stocking rate of 16.6 stock units per hectare was carried on the farms. In 1975 and 1976, with a stocking rate of 15.5 stock units per hectare, lambing percentage was similar to the county average. In 1977 a 15% better lambing percentage was recorded and, based on ewe body weight, will be predicted 10% better in 1978. The improved hogget and mixed age ewe body weight which has resulted under the system is now giving more lambs and stock for sale.

Figure 1.
MIXED AGE EWE AND REPLACEMENT LIVEWEIGHTS

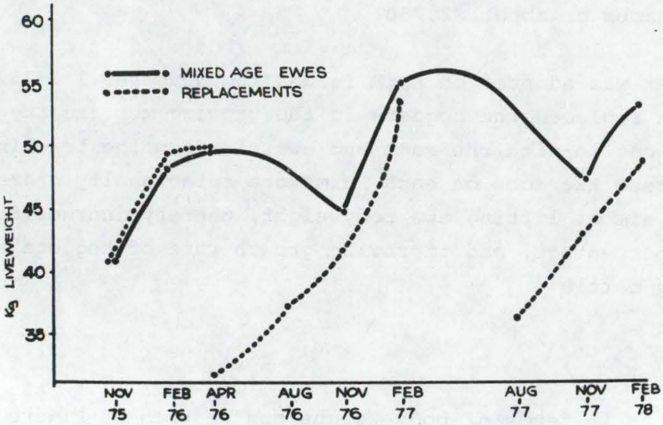
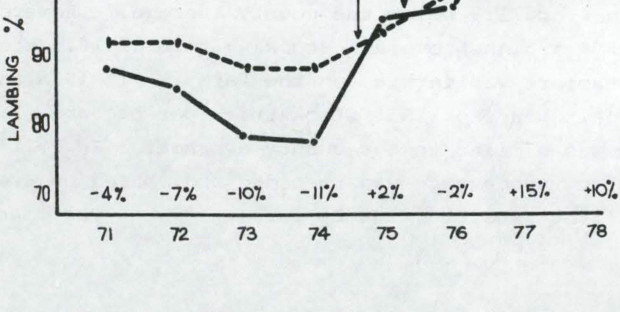


Figure 2.
COMPARISON LAMBING PERCENTAGE
FARM vs TAURANGA COUNTY



Wool production has also increased (table 1). Up until June 1975 an average of 4.0 kilograms per year per stock unit in sheep wintered was produced.

TABLE 1.

WOOL PRODUCTION

YEAR ENDING JUNE	KG WOOL/STOCK UNIT IN SHEEP WINTERED		
1972	3.9		
1973	3.7	AVE 4.0	
1974	4.3		
1975	4.0		DIFF 0.8
1976	4.5		
1977	5.0	AVE 4.8	
1978	4.9		

This rose to 4.5 kilograms in 1975/76, 5.0 kilograms in 1966/77 and 4.9 in 1977/78. An average of 4.8 kilograms over the last three years. County statistics were not available for the last period so the seasonal effect cannot be demonstrated. This increase is, however, in line with that measured in the hogget trial (Smith 1978). Also based on national statistics the between years difference was estimated to have been only 0.2 - 0.3 kilograms. (Annual Review of the Sheep and Beef Industry 1976/77).

How much can be credited to the grazing system? The estimated increase in physical and monetary terms for sheep production is shown in table 2.

A 12% increase in lambing performance gives 440 extra lambs for sale at $8. An additional return of $3,520.

TABLE 2.

MONETARY GAINS SHEEP ONLY

LAMBING % +12%			
	440 LAMBS @ $8	=	$3520
WOOL +.6 KG/SHEEP STOCK UNIT			
	3400 KG @ $1.75	=	$5920
	TOTAL	=	$9470

OR $1.67/SHEEP STOCK UNIT WINTERED

A 0.6 kilogram increase in wool per sheep stock unit wintered gives 3,400 kilograms extra wool at $1.75 per kilogram. An additional return of $5,950.

A grand total increase of $9,470 or $1.67 extra stock unit in sheep wintered.

Cattle performance has also improved but estimates in physical or monetary terms are difficult to establish due to changing policies and lack of data.

Naturally, benefits are seen with this physical and financial information. The major benefits in operating the system are:

* The shortening of the pinch periods such as droughts and winter due to better feed budgeting and control.
* An improvement in soil fertility and pasture species due to a more even spread of dung and urine instead of the old fertility shift to stock camps.
* With short grazing periods and long spells, ryegrass and clover have provided better competition for native grasses. Brown Top, a problem in our area, has become less of a problem.
* Stock move easily, often without the aid of a dog, with shifts taking only a short time.
* All animals can be seen at every move and changes in

conditions such as pasture growth and animal health noted with ease.

* Weeds such as ragwort are controlled inexpensively by large sheep mobs. Tighter pasture swards and more vigorous competition also reduces the number of weed seedlings which establish.

CONCLUSION

The system of management has proven to be a non-cost tool in our farming, providing control over both animals and pasture. It is very interesting from a management point of view, allowing seasons to be planned and stock fed with confidence. The monetary gains are useful, some may say essential.

ACKNOWLEDGEMENTS

The authors would like to thank Mr Malcolm Smith and Derek Hopkins, Farm Advisers, M.A.F. for the guidance in setting up the grazing system. Also for assistance in preparation of this paper. The authors are also grateful for photographic assistance of Mr Don McQueen, Ruakura.

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GRAZING MANAGEMENT WITH THE EWE FLOCK IN THE SOUTH ISLAND

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True rotational grazing definitely has a place in the South. A great number of farmers are using it already, - it could well be adopted by many more. However, the system outlined in the previous papers must be adjusted for South Island conditions.

The South Island is big and has a range of climatic conditions the extremes of which would probably be South Westland on the one hand and Central Otago or Marlborough on the other. The range of soils is also wide. They vary from the pakihi wetlands to the paving stones of the lightest lismores.

It would become too involved to comment on all areas of the South Island; I will talk about Canterbury, the area with which I am most familiar.

However, before concentrating on Canterbury, I would like to mention two other South Island areas. In 1976 this Conference heard a very good paper from Mr J.T.B. Guise of Southland (Guise, 1976). He described a successful 70 day, 45 paddock rotation with ewes. This incorporated many of the principles outlined by Mr Smith and Dr Rattray.

It is clear, therefore, that the principles of this system apply in the south of the South Island.

A Kaikoura farmer, Mr Peter Mowat, has successfully used a rotation system from weaning until lambing for the past two seasons. He shifts the mob every one to four days. The rotation is forty days long in mid winter. This is almost identical to the North Island system. The pasture growth pattern in Kaikoura is very similar to that in much North Island hill country. Mr Mowat and I feel the advantages of the system listed by previous speakers all apply. Pasture growth is maximised, ewe body weights are easily controlled, pastures improve, and the labour input is minimal.

ROTATIONAL GRAZING IN CANTERBURY

No fixed recipe will work over the whole area. There are too many wide variations of pasture composition and soil fertility. Rotational grazing systems *must* be designed to fit each individual farm.

Summer Management -(Weaning to Tupping)

Major adjustments to the North Island system are necessary to cope with the summer droughts. These droughts cause Canterbury farmers to seriously over-graze pastures from January to April in most years. A satisfactory summer grazing system in Canterbury must minimise damage caused by over-grazing, and at the same time must provide maintenance or better than maintenance feed levels for ewes.

In most years, weaning should take place at eight to ten weeks. Ewes will then be run as one mob and lambs will run ahead of ewes. Ewes in this immediate post weaning period will be used to clean up roughage. If conditions become dry, regrowth from grasses and clovers will be very poor - a common situation. In 'growthy' summers the ewe mob can continue on a second rotation. There should be at least a month spell for each paddock through this summer period and perhaps not more than ten days grazing per paddock.

In the very dry years - the drought years - the summer rotation with one large mob breaks down. This year was a case in point. By January, many farms were very bare and lambs had to have the best feed - what little existed. A continuation of the ewe rotation meant all pastures on the rotation were seriously over-grazed. The rotation inevitably quickened. The spell period became too short - say two to three weeks. Grass and clover plants had little time to recover while sheep were under severe stress due to under-feeding. This stress was aggravated by high temperatures and water problems when single troughs could not serve large mobs.

Under these conditions the best approach is often to concentrate the grazing on scrubby back faces or the poorest paddocks-paddocks growing poor species or paddocks damaged by grass grub. These can be set stocked by, say 300-500 ewes at 30-50 per hectare. Ewes can be sorted into liveweight groups and fed supplements at different rates in an effort to bring all sheep to tupping in reasonable order. The choice of the supplement to feed over these drought periods will differ between farms. However, grain has a clear advantage because it is easy to feed. In many years it will also have a cost advantage over hay. In drought prone areas I would recommend farmers to feed some grain most summers, if it means good ryegrass paddocks will not be over-grazed.

Canterbury does not have a drought every summer. Last year farms carried a substantial surplus of feed right through the summer. A slow rotation from weaning would have been very correct from the pasture point of view, but this was not possible. Ewes had to be set stocked. Rotational grazing was impossible because the majority of flocks were seriously affected by grass staggers. This disease dictated the management system over the summer.

To summarise summer grazing. In some seasons, in some areas, a regular planned rotation with the ewe flock from weaning until tupping will work. More often droughts will force a change of management. To minimise stress to sheep, and damage to pastures, ewes will probably not be run in one mob after the bulk of top growth has been removed.

The one thing certain about droughts is that eventually they break. When this happens in Canterbury, grass growth is usually very good. Soil temperatures are high and there is a high level of soil nitrogen due to the mineralisation of organic nitrogen. This April, after four months of drought, large areas of North Canterbury had between 375 millimetres and 575 millimetres of rain in one week. The grass in these areas has recovered well.

Winter Management

After a drought breaks, the correct management in preparation for a winter rotation is to hold stock on a restricted area for about two weeks. This allows much of the farm to recover before frosts, falling temperatures and lower light energy levels reduce growth.

This year, from early May, a slow rotation of one to three days per paddock could begin with all the ewes in one mob. Tupping which began during the drought in less than ideal circumstances will still be taking place.

The main difference between a Canterbury winter rotation and a North Island rotation, is the length of time between grazings required to allow adequate pasture recovery. In Canterbury 35 days is not sufficient. The correct rotation length is more likely to be between 60 and 100 days. Strong ryegrass pastures would require about 60 days; lower fertility species will require a longer spell.

On high fertility pastures, ewes on a rotation which began in early May will have completed one circuit by late June. The second rotation will last until late August or early September. As in the North Island, the late part of this rotation should be speeded up both to feed ewes on an increasing plane towards lambing, and also to even up pastures before set stocking.

Because of this need to feed sheep well in the last three weeks of pregnancy it is very clearly dangerous to lamb too early. I would strongly recommend farmers trying rotational grazing for the first time to lamb later than they have been doing. Lambing should be put back two to four weeks to guard against a lack of high quality feed just when the ewes need it most. Over much of North Canterbury a lambing date of mid September might not be far wrong.

In most cases, but particularly where a tight feed situation is feared, or where some paddocks are not suitable for lambing, I would recommend the use of the tupping harness. By introducing the harness two weeks after the rams are put out, you should be able to accurately identify those ewes holding to the first service. At lambing these sheep can be set stocked on the best feed saved on the best lambing blocks, while the marked ewes can continue on a restricted diet.

I have stressed a 60-100 day rotation for Canterbury. The three day maximum per paddock should be adhered to. This is the clue to minimising pasture damage and maximising growth. Therefore, the smallest number of paddocks in the winter rotation must be 20. A safer number to aim for would be 25 or 30. This is about double the number necessary in the North. This difference is probably the main reason why true rotational grazing is not yet widely practised in Canterbury. Many farmers, however, are using cheap electric fencing to double their paddock numbers. This is clearly a sound move. Once sub-division is adequate, 60-100 day winter rotations will become much more common in this part of the country.

If the build up of feed after autumn rains is good the first rotation can often be on grass alone. If autumn recovery is slow, sheep should be fed supplements to keep the rotation slow through May. In most cases, ewes will require supplementary feeding on the second rotation. Often it will only be needed on the second day on 'two day' paddocks and the second and third days on 'three day' paddocks. Wet soil conditions may make it difficult to get hay out to some of the farm and this can prove a major problem on a small number of hill farms. However, our experience is that long rotation wintering results in lower hay usage.

Summarising winter rotations. In Canterbury, the ewe flock will often not be grazing in a rotation as one mob until after autumn rains. The rotation must be longer than in the North Island and this means more paddocks. The three day maximum per paddock must be adhered to. Lambing in most cases should be put back two to four weeks.

Ewe Hoggets

Hoggets demand special attention. Their place in the scheme is often difficult to plan and execute.

On well sub-divided farms, hoggets can have their own mini rotation around six or eight paddocks at the rate of one paddock every seven to ten days. The stocking rate would normally be lower than with the ewes. Excess roughage can be dealt with by cattle coming behind the hoggets.

On many farms and particularly those with low fertility pastures and minimal sub-division, farmers will be well advised to grow a crop of turnips and grass or choumoellier. This would be saved for mid July-end August feeding for hoggets.

Invermay work has clarified the feeding levels necessary to grow good two tooths (Drew, 1976). The moderately well wintered hogget will catch up with the very well wintered sheep and will match it for life time productivity. But there is a limit to how poorly you can look after hoggets. Rotations for ewes demand the bulk of the winter grass and it is too easy to under-cater for hoggets.

An area of brassicas and grass for late winter-early spring will usually pay an excellent dividend; it is reasonably cheap. It will not reduce the summer feed significantly as the crop will be grown on one of the poorer paddocks. A crop for hoggets is the obvious answer on most farms. This will apply on the higher and more exposed properties and on those farms where soil fertility levels are low and browntop, sweet vernal and crested dogstail are dominant pasture species.

Dr E. Vartha of Grasslands Division, DSIR, Lincoln is of the opinion that Canterbury plains farmers on light land should consider a paddock of Tama grown after summer fallow. This could form part of the ewe ration on grass rotational wintering. It is his experience that the extra dry matter produced can be of critical importance in getting sheep through. An area of Tama would be of special value on farms where pastures are dominant in low fertility grass species or where winters are severe.

Certainly, cropping, whether for hoggets or for both hoggets and ewes is likely to be very important in Canterbury and is certainly not stressed by our North Island colleagues.

SUMMARY

This refinement of rotational grazing is a good one. It is cheap to use and the principles are easy to follow.

Farmers in Canterbury are already using variations of the system and their experience is indicating the adjustments we must make.

The principles apply more to the winter situation than the summer. Once there has been a build up of feed from autumn rains we can begin a long rotation. Sub-division is important. Sufficient paddocks to give at least a 60 day, and more often a 70-100 day, rotation are needed. A postponement of lambing date must be considered. Some special provision must be made for hoggets.

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THE NEEDS OF THE RURAL DOCTOR

Dr J.R. Fountain
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These needs can best be dealt with under two headings :

* Medical Needs
* Personal Needs

The two are inevitably intertwined but I will try and separate them at least artificially for clarity.

MEDICAL NEEDS

Professional Contacts

The predominant problem under this heading relates to the relative isolation of the practising doctor. We all need peers within the same profession to keep us up-to-date and to protect us from becoming complacent. This is seen today with the increase in the number of groups of doctors working together from the same centres. This not only helps to avoid this medical isolation but also makes the availability for time off duty much more easy to organise.

In the rural community, particularly in some of the more isolated areas, to gain an adequate practice population, the practitioner needs to cover a wide area. If you are going to group your doctors together, then obviously the area covered becomes wider still. This produces problems for both patient and the doctor. For the patient, travelling time to reach the doctor is increased, and for the doctor, the desire to visit his patients is reduced by virtue of the amount of travel and therefore time involved. It can also lead to a sense of insecurity on the part of some members of the community, particularly mothers with young children in that, in the case of an emergency, the time before a doctor can attend to the problem is likely to be increased. There is no easy answer to this particular problem and fortunately, I'm only meant to be talking about the needs and not coming up with the answers. But I do feel that a great deal more could be done.

If isolated communities were to organise their own lay emergency services some of these problems could be solved. We find many ex-nurses scattered through the community and I'm sure these could be used more effectively.

I might also say that certainly in the cases of the wives here today, you have chosen to get away from the hurly-burly of city life. You have chosen the fresh air and the individual freedom that the isolated life provides and you cannot therefore expect to have the same services available as your town cousins. I'm afraid you can't have it both ways.

In-Service Training

The practitioner in an isolated community may require to be more highly trained than his town counterpart. I don't say that his town colleague is not equally well trained, but the rural doctor has to live with the fact that a specialist service is not readily available to deal with problems that he feels are beyond his training. This is particularly true in the field of minor surgery and obstetric procedures, where problems can arise quickly and need rapid solutions.

This means that he must be able to get away from the practice to attend post-graduate refresher courses. He must keep up-to-date with the changing patterns in obstetric practice; he must keep up-to-date with advances in medical practice. He also needs to have knowledge of medical conditions peculiar to the farming community - animal transmitted diseases and farm accidents to name two. It is important for the rural community to appreciate this need for further training and study and it is obviously in their interest to encourage and perhaps find a replacement for their local doctor so that he can more easily get away on a regular basis.

Self Reliance in Professional Matters

He also sometimes needs to practise less than satisfactory medicine. We have increasingly and perhaps to the detriment of medicine become reliant on laboratory results. Because of his distance from diagnostic services, the rural doctor may have difficulty in using x-ray and blood testing facilities. This means that often he must treat and prescribe from clinical judgement without the backup that the diagnostic services provide. For a young doctor recently emerged from the public hospital system with its plethora of diagnostic services, this can be a frightening and frustrating form of practice. I am not suggesting necessarily that the patients are treated any worse. In fact, too many laboratory investigations tend to create problems rather than solve them, but it does mean that the diagnosis of some more serious complaints may be delayed.

Coping With Inadequate Support Services

The para-medical services which have advanced so rapidly in the urban environment are few and far between when we look at the rural community. In the Lincoln area which could hardly be regarded as more than a dormitory suburb of Christchurch, there are no nursing services available except those provided by the practice. Until recently, no meals on wheels were delivered and there are none of the psychiatric and counselling services which are present in the urban community. The country areas have always been well recognised as being far more aware of of the sense of community than the town. It is always possible to find relatives or neighbours who are willing to lend a hand to mow lawns, to provide meals and to wash bed linen. However, nursing needs are met only in isolated cases and it is sad to have to send people into the expensive base hospitals for treatment which could be handled easily and in many cases better, and certainly more cheaply, in the patient's own home.

The recent appointment of a co-ordinator for social services in the Christchurch area will mean that the town doctor in many cases will be able to ring and get him to organise all the necessary domiciliary services. In the country, we have to ring around a number of people and try and persuade them for the sake of good heighbourliness, to undertake these services for a particular patient. While we have many good neighbours, we do not have the specialized para-medicals modern medicine and modern family practice expects - the social workers, the counsellors and physiotherapists. All these people are at a premium in town, almost non-existent in the country.

As a consequence, the doctor must try and be all of these to his patient. In the realm of counselling for instance, while many may have acquired very real expertise in this field, they have gained it not through any formal training in most cases, but rather by experience of life themselves. For those of you who feel that the neurotic housewife is a speciality of the urban community, let me assure you that the rural doctor has to deal with these problems as well. The town born and bred wife transplanted into an isolated farm, has many problems for which she is ill-equipped to cope. In a small community, there are few secrets and the pressures brought to bear on people in the country by their neighbours can be equal to, if not greater than those brought to bear on their town counterparts. It is also true that too many farmers, either by choice or necessity rarely leave their farms for more than a day or two at a time. The wives are expected to spend all of the year in their farm houses, sometimes ill equipped with the luxuries and necessities to ease household chores, with no prospect of a holiday or at the most a short weekend in mid-winter, or a brief trip to Lincoln for the Farmers' Conference. Yes, we have counselling problems in the country, and we don't have trained counsellors to deal with them.

PERSONAL NEEDS

One's Family Needs

The most important need is to have time with one's family. In order to do this, one must have time off duty. As you can imagine, the isolated doctor in the isolated community has very real problems. It is for this reason that even in the country, we are now finding more and more doctors banning together in a group so that they can be protected in this important area. The standard of service that a doctor provides depends to a large extent on his enthusiasm and interest in his work. If he never has time to get away from it, then his enthusiasm and interest wanes and the medical service falls off. It is in your interest for your doctor to get away at regular intervals.

Mind you, not everyone wants to get away when they are off duty. It is nice to be able to stay at home and potter in the garden and not feel obliged to leave the house in order to get away from the telephone and patient demands. Many doctors in the country have of necessity bought cottages somewhere else so that they do have somewhere to go when they have time off. Even here in Lincoln, with four doctors available, there are pressures to see your particular patients if they happen to need treatment at weekends, and there are many times when I have been approached in the garden by my patients or more particularly by battered Lincoln College students who wander up the path with broken bones and bleeding cuts, wanting me to deal with them! It's nice to be able to tell them that all they need do is wander back down the path and ring the doctor at the Medical Centre but it does produce a moral pressure.

Material Needs

The material needs of the rural doctor in some respects are greater than his city counterparts. If as a house surgeon in the hospital he has been married, he has possibly owned a house in town and he can perhaps continue to practise in the town from that same house. When he moves to the country, he has to buy a house, equip a surgery and probably buy two cars in order that his wife and children have a measure of freedom to live their own lives. There is a lot to be said for smaller communities providing houses and surgeries at reasonable rentals to encourage young doctors to set up in practice. A doctor who is not sure whether he is going to like a particular area or is going to like rural life, may think twice about going up to his ears in debt. Buying a house and surgery in the country, with the very real prospect that in two or three years time, if he wants to leave, he may be unable to because of the capital outlaid in the country, takes a lot of courage.

Education

The education of a doctor's children has always created problems. His children may be able to gain a very satisfactory education at local primary schools and area schools but if the parents want their children to have a broader education and get a broader view of life than is possible at many area schools, they may want to send them away to a town school which inevitably means greater expense, probably a single sex school, and loss of contact during the formative years. I realize these problems are equally yours but as I have already said, you knew this possibility when you went to live in the country away from the main centres - the doctor knows this before he moves into the country and may decide against it for this reason. It is easier for the doctor to make his living in town and avoid this problem, or else, after a few years he leaves the rural life and moves into town. Many do.

Many doctors who have started out in a rural community have ended up after five to ten years moving back into town. They may not want to do this but for the sake of their children, they feel obliged to.

As a consequence, many doctors in rural areas are young with young families. This has both good and bad features. Good in that they tend to be full of the latest knowledge, both from medical school and the hospital. Bad in that they lack experience and lack knowledge of human nature. They learn the art of family medicine on their rural patients and when they move to town, their new practices gain the advantage of the experience they have already learnt on their long-suffering country patients. It also tends to create problems in the doctor-patient relationship as the doctor does not stay long enough in the area to really get to know patients as families and to have real insight into what makes some of his patients tick.

IN SUMMARY

The doctor deciding to settle into a rural community has many needs and disadvantages. Like the farmer's wife, he knows what he is letting himself in for. Speaking as a rural doctor, albeit barely rural, I think the credits well outweigh the debits. As a 'towny' by birth and upbringing, I find the atmosphere both climatic and social very much more rewarding in the country. As a doctor, you get to know the patients so much better. This does have a debit side in that you feel a greater obligation to deal with their problems at your inconvenience. You see your patients at other activities outside the consulting room. You get to know how they live. You get to know their interests. You see them in their social setting rather than purely in the artificial setting of the doctor's consulting room.

HEALTH SERVICES IN THE RURAL COMMUNITY - THE COMMUNITY NEEDS

Rev. Hugh Paterson
Sheffield

Mark Anthony in his famous speech talked of coming to bury Caesar. In somewhat similar vein I want to do a bit of burying as well - but of myths rather than Caesars! There are in fact three myths about rural communities that I want to concentrate on.

MYTH ONE

The majority of people who live in rural communities are farmers. For contemporary New Zealand this is just not true. The majority of rural workers are to be found in jobs like truck driving, railways, sawmills or post-office. Others grub tussock or fix power lines or live in rural retirement.

The clear implication of this is that health services in the country should be geared to a wide range of occupations. Yet so persistent is the myth "that rural people are also farmers" that we tend to plan rural health services on the assumption that we are catering for farmers.

MYTH TWO

Those who live in the country must be happy because it's such a pleasant, relaxed, peaceful, tranquil, environment.

This myth comes in an almost infinite variety. It's perpetuated by the Sunday drivers looking with some nostalgia at things rural. The "environmentalists" movements don't do much to dispel the myth. Nor does the plains land farmer who said to me as we looked up towards the mountains "up there they are giants who run those stations". I fear also that my good friend Nor'wester adds to the myth making.

This myth does a great disservice to rural communities. And those who perpetuate it are wrong.

I can think of no more forceful way to illustrate how wrong the myth is than to quote the words of a dying man: "Hugh, I've not seen a sane woman come from the back country in thirty years".

We who live in the rural communities are human. Our greatest need is that we be seen as human with the full range of human joys, fears, triumphs, disappointments, anxieties, frustrations that any range of human beings have. To sentimentalise, to romanticise, to mythologise rural living, is to do it an immense disservice.

So too is to concentrate solely on economics, plant breeding, farm and rural politics, wool growing, the unions - as Mid Day Report does. This misses the real living dynamics of the human beings who live in these rural communities. Maybe some day some brave soul will institute a talk back session for rural people.

If you asked me to state the commonest problem of western society, I'd say without doubt it is depression or anxiety states of varying types. And I don't really believe that rural people are exempt.

With some problems rural people are very good indeed. What better group is there to help in cases of fire of physical injury? But its a quite different matter with personality problems, family problems or those that involve complex interpersonal relationships. I believe there are two reasons for this:

* We're all good at offering assistance in what we are accustomed to doing - cooking, cleaning, minding children, moving sheep, driving tractors.
* To have what in modern jargon is called a high profile in rural society is dangerous. It involves a dangerous exposure of one's self. Those who have to live in small communities for five or ten or even fifty years are subconsciously at least aware of this. They back off - they refuse to get involved.

Therefore trust at the personal level isn't good because confidence and knowledge of inter-personal relationships is low.

A great need is to increase this confidence by giving to rural people the required knowledge and skills to handle personality problems/personal relationship problems.

MYTH THREE

Work solves all problems.
Many rural dwellers are addicted to work. This work fixation may itself be a manifestation of a mental health problem. It also however, gives rise to other problems. These are seen within the family and in relationships with the wider community.

So much for the three rural myths. What I should like to do now is ask the question:

"Is there any one factor which makes for mental ill-health in the countryside?"

I believe there is. It is isolation.

I see it at three levels:

* Geographic isolation - particularly in the back country.
* Professional isolation - this is keenly felt by such groups as the doctors, the teachers, the postal staff and yes, also the clergy.
* Social isolation. At its extreme this is felt by the young rural wife, all of whose earlier experience has been suburban. But I believe virtually all rural people experience it to a certain extent. They all circulate within a too small social pool and accordingly lack the security to sustain them for 10 to 50 or even 60 years.

Isolation places a particular limitation on the help that can be given in four problem areas quite common in the country:

* The alcoholic.
* Marriage problems - compounded by the fact the marriage break up quite often also involves the sale of a farm.
* Acute depression.
* Bereavement - and particularly that arising from death of babies.

In all four cases listed above it is hard to get consistent, regular and specialised help.

THE IDEAL RURAL COMMUNITY

I'm sure we all have some views on what the ideal rural community is like. And it is good that we should. It gives us something to strive for. In fact we are unlikely to find all the ideal features in any one community. It is my conviction though, that in a warm and concerned rural community the really important human events in our lives should find free expression in that community itself. The complete rural community is one in which:

* There is no problem about babies being born at home.
* It's normal for the elderly to retire in the community.
* Adequate housing and care are available for the elderly and the sick.
* It's possible and normal to die at home sustained in familiar surroundings, by family, doctor, friends and minister.

It is a sad commentary on our present rural way of life that we don't know how to die because so few of us see anybody die. The events I have listed above are human events. If we lose them we lose part of our humanity.

COMMUNAL CONFLICT

There are three common areas of conflict:

* Closing a school.
* Closing a church or building a new one.
* Local authority affairs - at its simplest a matter like sealing this road rather than that.

Communal conflict can be constructive but also destructive. I have seen individuals and groups almost completely destroyed in these conflicts - people who have literally withdrawn from the arena. And the pain and memory lasts for years or even generations.

SUMMARY

There are four main community needs in the countryside:

* To get rid of myths, both those imposed from without and generated from within.
* To be constantly reminded of our humanity, to feel no shame in demonstrating it and to have the chance to

use it in the community.

* To receive help in matters concerning human relationships.
* To know how to deal with communal conflict.

I can do no better than to quote these few lines from Boris Pasternack.

Live and by the smallest measure,
Never step back from oneself,
But be alive fully alive,
Alive and only, to the end.

HEALTH SERVICES IN THE RURAL COMMUNITY

Mrs L.C. Gardiner
Member, North Canterbury Hospital Board

I should like to preface my remarks by saying that there is general concern in government financial circles about the continuing escalation in the cost of health services. Over the past 15 years, government expenditure on health in the public sector has risen from 4% to 5.7% of the gross national product. This is close to the limit of what it is possible to expect, unless taxation is increased, or the money claimed from some other sector. Thus, if new services are proposed or existing ones expanded beyond the range of the normal growth factor, there must be water-tight justification, and if additional funds are not made available, curtailment of another service must be considered. So when health administrators refer to "identification of needs", "planned development" and "allocation of priorities", these terms are not just unspecific verbiage, but basic principles which are at the same time an economic necessity and a logical means of ensuring the best use of available resources.

Fortunately planning is no longer done in isolation remote from those who provide the service or those who need it. Health planning now involves all health and social welfare agenties, general practitioners and voluntary groups. There is active participation by all groups, and strong support is given by the Health Planning and Research Unit of the

Department of Health.

I welcome this concept, because I think a planned approach to primary health care is something which has been lacking in the past. This is noticeably so in some rural areas where varying degrees of deficiency are apparent. One feature of life in these areas is the emergence of voluntary community support groups who deal with basic needs as they arise. This type of service is a lifeline and a credit to those who participate, but nevertheless it is not a situation we should be complacent about - these groups often need professional support and advice and access to services beyond their scope.

The injection last year into selected hospital board allocations of special grants for use in funding community health projects was timely. However, it was of a limited nature, and it is not known to what extent these grants will continue. There is no doubt that there are difficulties in planning to meet needs in a rational manner when there is not advance knowledge of the extent of the financial resources available.

That it is government policy that health services in the community should receive greater emphasis is beyond dispute, but that the cost will be less than the present type of health care is now thought to be unlikely.

THE SITUATION IN NORTH CANTERBURY

It is important to realise that rural districts in North Canterbury have problems in connection with the delivery of health care which differ in character and degree from place to place. Because of the diversity of need and the differing sets of circumstances, it has been necessary to maintain an adaptable approach when seeking to provide assistance. I propose now to outline some of the measures which have been undertaken, or which are being planned by the Board, in a number of different areas. I think these examples will illustrate this flexibility of approach.

Local Organisation of Health Care

In many rural areas the basic need is the provision of adequate medical coverage. If a number of doctors already practice in a district it is in their interests, and in the interests of their patients that they should function as a group. You have just heard of the Lincoln group practice and its consequential development to encompass and co-ordinate the health resources of the Lincoln-Ellesmere district.

In areas where the population is more scattered and resident doctors are not available, or serve more than one area, assistance has been given by the North Canterbury Hospital Board in a variety of ways, often by adopting existing facilities to meet present needs.

Oxford

In the absence of a resident medical practitioner the Hospital Board made premises available at the Oxford Hospital for neighbouring doctors. This is now a geriatric hospital with patients drawn from town and country and from which the services of a domiciliary occupational therapist are available for local elderly residents.

Rotherham

Those who live in the Amuri County will know that this practice has been without a resident medical practitioner for virtually fifteen years. In order to assist, the Board has altered the conditions of appointment of the special area doctor at Hanmer Springs who is a salaried employee of the Board, in order to enable him to undertake regular private practice surgeries at Rotherham. While this service gives relief, it is recognised that a permanent arrangement of a resident nature is what is required. To this end, the Board is offering services of an advisory nature to the Amuri County Council in their efforts to obtain a suitable person for the post, and are making available part time employment at Queen Mary Hospital to a resident Rotheram practitioner. The object being to provide a measure of financial security in an area which in the past, has been only marginally viable on a population basis and to diminish the professional isolation.

There is no doubt that if the Rotherham practice were filled, other health services such as district nursing and social work, would become a practical possibility. The medical practitioner becomes a pivot for a rational development and co-ordinator of services.

Queen Mary Hospital at Hanmer Springs
This is a specialist hospital for the treatment and rehabilitation of the chronic alcoholic, accepting patients on a national basis. However, it now has also considerable responsibility for local primary health care, in both general and geriatric fields. The special area practice which provides a resident medical practitioner service for Hanmer Springs, and the previously mentioned relieving service for Rotherham is administered from this hospital. X-ray and pharmaceutical services are included in its facilities. A clinic room is supplied at the hospital for the regular use of plunket nurse, and scheduled visits by a chiropodist have been arranged for the benefit of local elderly residents and patients.

Other supportive community services in the form of a home aid service and the supply of cooked meals for the dependant elderly are available. A limited amount of short term hospital in-patient treatment is available to assist in maintaining the elderly in their local environment. Plans for the future envisage the expansion of the area of responsibility of a social worker who is based at Hanmer, so that a service is supplied to Rotherham, Waiau and Cheviot, working in liaison with the local medical practitioners. An interesting local development at Queen Mary Hospital is the use of suitable community volunteers who after a period of in-service training, take part in some of the psychodrama treatment programmes for in patients. Research in the district, however, revealed no opportunities for provision of jobs for rehabilitation purposes.

Kaikoura

Kaikoura is at the present time being considered either in relation to the Hanmer based social work service, or with a resident part-time social worker. The needs of the district are at present being researched both in relation to the elderly and to the adolescent. This is being done in co-operation with other welfare agencies who are very active in health planning activities.

Kaikoura is fortunate in that the hospital has a wider range of facilities than is usually the case in rural areas. Besides having a maternity wing, there is a theatre for emergency surgery, x-ray equipment, and a physiotherapy department, all of which are available for community service. There is a section for geriatric beds and a day room for elderly patients.

A few years ago the Board converted an area of the hospital for the use of the two local general practitioners as surgery premises. Subsequently rooms and equipment were made available for a dentist to make regular monthly visits, thus filling an additional health need.

As with most of the other country hospitals, cooked meals are supplied for delivery to the dependent elderly who are living in the community.

Rangiora

The health and welfare needs of the district are at present being assessed in order to process an application for a grant through the Community Health Funding Scheme, with the object of establishing a counselling service.

A district nursing service has been established here through the agency of Nurse Maude and meals for the dependent elderly are supplied by the local maternity hospital in conjunction with volunteers and pupils of the local high school.

Cheviot

The recent conversion by the Board of the former maternity hospital to a medical centre is the first of its kind in the Board's area, and, we think, in New Zealand.

The objective here is to provide a better service by bringing all health resources together under one roof including doctor, practice nurses, x-ray unit, physiotherapist, plunket nurse, dentist and volunteer nursing service. It provides a more satisfactory professional environment for the general practitioner. For many years Cheviot has experienced grave difficulty in attracting and retaining a resident practitioner, and the Board feels that this type of development is in line with present needs and should help in promoting a more stable situation. These health professionals are tenants of the Board, they work on a private practitioner basis and are mutually independent. However, there are ample opportunities for co-operative consultation and liaison.

Chatham Islands

Here, the isolation from the mainland and the sparsity of the population present the Board with an unusual group of problems, and they are dealt with in the following ways.

A special area doctor is engaged by the Board on a salaried basis. He is usually a young doctor with a bond commitment and his term of employment is for approximately two years. He is responsible for all medical care on the Islands.

A small hospital, with a special dispensation from the Health Department to accept both maternity and general medical and surgical emergency cases, is maintained by the Board and staffed on a contractual basis by the Missionary Sisters of the Company of Mary.

Dental staff from the Christchurch Hospital, including a dental technician to attend to denture problems, pay yearly visits to the Islands. Specific needs are dealt with in an appropriate way as they arise. For example, there were indications recently that the incidence of diabetes was higher than that of the average New Zealand population grouping. A survey was undertaken which revealed that this was indeed the case. Measures will now be taken to deal with this situation.

MATERNITY HOSPITALS

Besides those already mentioned, maternity hospitals are maintained in the Akaroa, Darfield, Ellesmere and Waikari rural areas.

ADDITIONAL BOARD RESPONSIBILITIES IN RURAL AREAS

Kaiapoi
The possibility of supplying meals on wheels from Burwood Hospital is at present being investigated.

Loan Equipment
Assistance in the form of loan equipment and disposable nursing aids is made available to accredited groups or individuals who are providing a voluntary home nursing service to a rural community.

St John Ambulance Services
The Hospital Board has financial commitment to all ambulance services, and in rural areas is responsible for subsidising transport costs and ambulance replacement. The Board also makes provision for giving practical training within the hospital setting to local ambulance officers to supplement the basic training given at the National Training School in Auckland.

In-Service Education
In-service education and refresher courses are available for health care professionals in the community who plan to return

to the workforce.

Laundry

On completion of the new laundry complex at Sunnyside Hospital the Board will consider extending its present laundry service to the aged to additional areas of need.

PSYCHIATRIC SERVICES

I have been asked to make some comment on psychiatric services for rural areas.

In recent years there has been a movement away from the delivery of mental health care in large isolated psychiatric hospitals, to focussing service in the community, using general hospital based psychiatric units (as at the Princess Margaret Hospital) or community based mental health centres (Child Health Clinic). While there is still an important role for long and short term inpatient care, modern techniques emphasise early intervention to present hospitalisation whenever possible. There is an increasing emphasis on day and outpatient care as primary modes of treatment.

I realise that distance from the city is a major problem for country dwellers who are required to attend for treatment at these programmes and in order to help cases such as these, and others who require transitional accommodation, plans are underway to provide suitable housing with varying degrees of supervision and a co-ordinator of sheltered accommodation in the community is shortly to be appointed.

In addition, we propose that specialist mental health workers will travel to areas lacking specialist services and will provide specialist input to mental health workers involved locally. That is, they will visit health centres and groups of health professionals such as general practitioners, social workers and counsellors and give consultative advice.

Close association between hospital-based and community-based agencies, especially primary health care teams will be encouraged, and it is hoped that each general practitioner from a defined area will develop close links with a particular mental health specialist team in the city. These teams will be so organised that they have a clearly defined geographical sector of responsibility.

Unfortunately, there is a world wide shortage of psychiatrists and in the North Canterbury Hospital Board establishment, there is a shortfall of four. With such a shortage of specialist staff, extending the service presents problems.

I have already referred to proposed secondment of social workers and counsellors to certain rural areas which may be eligible for funding by a Community Health Grant. Rangiora is under investigation at the moment, also Kaikoura and there has been a preliminary approach from Kaiapoi. It is becoming very apparent, however, that funding apart, the demand for social workers is exceeding the supply.

I should like to stress that the Board sees as an essential feature of this type of placement, that there must be a continuing close liaison with the primary health care team, and with the appropriate advisory department of the Board.

DEVELOPMENTS PLANNED FOR GERIATRIC SERVICES

In recent years, problems connected with the care of the aged have been receiving increasing attention. Health and welfare services are provided by a complex array of organisations, statutory bodies and individuals. Health and social welfare are very closely related needs in connection with the well-being of the aged, and it is both impossible and undesirable to draw a clearly defined line between the two.

It has become apparent, that in spite of the tremendous amount of support and service being given, there are still areas of deficiency and need, and some degree of overlapping.

In order to obtain reliable information as to where the deficiencies lay, exactly what services were available and who provide them, and then to plan a co-ordinated approach to meet the needs, a Geriatrics Advisory Committee was formed. This is a multi-agency and multi-disciplinary committee whose function is to advise the North Canterbury Hospital Board on all aspects of geriatric services.

A great deal of work has been done by a number of sub-committees who dealt with specific areas of concern such as the accommodation sub-committee, the resource planning sub-committee, the sub-committee to evaluate the Geriatric Assessment and Rehabilitation Unit, the working party on service development and the psychogeriatric working party.

Some of the recommendations of the Geriatrics Advisory Committee are

* The appointment of a co-ordinator of geriatric and domicillary services.
* The establishment of a day hospital in association with the Geriatric Assessment Unit.
* The eventual replacement of Jubilee Hospital and the possible use of the Christchurch Women's Hospital for geriatric use.
* The use by the Board of contractural beds in some private hospitals for long-stay use.
* The concept of an integrated geriatric service within the Board's area of responsibility.
* The establishment within the Board itself, of a Department of Geriatric Medicine.
* Increased availability of community support services especially home aides and Nurse Maude.

HEALTH SERVICES IN THE RURAL COMMUNITY - A MEDICAL PERSPECTIVE

Dr J.P. Musgrove
Ilam Medical Centre
Christchurch

Dean Swift in 1720 noted in "polite conversations" that the best doctors in the world were Doctor Diet, Doctor Quiet and Doctor Merryman.

Today we think the best doctor is a well-trained competent person who is available when you need him. He may also advise about diet, prescribe peace and quiet and give you anti-depressants to elevate your mood and make you merry.

What sort of doctor do you want or need? What sort of nurses? What other health workers do you need? Are you quite happy taking what you are given, or have you thought what your needs and those of your community are?

I propose to give you some background statistics about population trends and trends in medical manpower, and then to discuss from an overall point of view, developments in health care fields. It will be general rather than the specific developments you have already heard about from Dr Fountain.

If we look at projections for New Zealand's population we can draw certain general conclusions. There is no reason to believe that there will be any marked change in the balance of population between the urban and rural sectors. It seems likely also that the total rural population will remain roughly constant. Against this background, if one looks at the changes in the number of doctors who are involved in the delivery of health care, we see very marked changes indeed. These are illustrated in table 1.

TABLE 1. PROJECTED OUTPUT OF MEDICAL GRADUATES FROM NEW ZEALAND MEDICAL SCHOOLS

Year	Auckland	Otago	Total
1975	47	122	169
1976	65	131	196
1977	48	144	192
1978	55	144	199
1979	58	185	243
1980	58	200	258
1981	120	200	320
1982	120	200	320
		and thereafter	

Note. 1. Registration dates from November each year.
2. The numbers 1975 - 1978 are accurate estimates.

Planning is now underway, for the first time in this country, based on such data as shown in table 1. One of the objectives of medical manpower planning is to produce more and better trained general practitioners. Gone are the days when a year or two of hospital training is considered an adequate preparation for general practice. The young practitioner will constantly note diseases he or she sees in practice are different from those classical disease descriptions he has been taught about.

GENERAL PRACTITIONER OR SPECIALIST?

Today, the general practitioner is becoming regarded as a specialist in his own right. A specialist not in the sense that he restricts his practice to a special branch of medicine, but that he has developed special skills which enable him to be a doctor of first contact, to deal with the health of a family as a whole and to be responsible for the continuing care of that family. He may have developed a special interest or expertise in one or more branches of medicine. He must be a co-ordinator of the whole spectrum of health professionals in their patients' care.

In New Zealand, "The Way You Want It", I am sure what you want is a doctor available and handy when you are ill. If there is, however, to be a doctor in every township that doctor may be temporary for the reasons suggested by Dr Fountain, not the least of which is professional isolation. The trend to groups of doctors serving large areas from a medical or health centre is most probably going to give you a much better service. One reason is that there are relatively more doctors in rural areas than there were ten years ago.

WHY HAVE HEALTH CENTRES?

Such grouping of doctors also allows the pooling of resources so that perhaps better equipment may be shared. It also acts as a focus from which liaisons with other health professionals such as nurses and social workers can develop. The building may be a privately owned medical centre; a Health Department funded health centre; a local body funded building or a converted hospital, but the origin does not matter - it is the function which does.

In Christchurch there is a Primary Health Care Planning Group comprised of general practitioners who have spent considerable time looking at the organisation of care in the community. This committee has defined the core team as the

PRIMARY HEALTH CARE TEAM

The General Practitioner
The Practice Nurse
The Practice Social Worker

Works with a diverse range of private individuals statutory and non-statutory agencies including:

District Nurses
Plunket Nurses
Public Health Nurses
Occupational Health Nurses
Psychiatric Visiting Nurses
Physiotherapists
Occupational Therapists
Pharmacists
Hospital Accident and Emergency Services
Country Hospitals
Family Planning Associations
Private & Church Counselling Services
Private & Church Social Worker Services
Private & Voluntary Organisations of all kinds

With a list such as this, it is obvious that some simplification is necessary and a Nurses' Association planning group is at present studying this problem. I must say that in this, the rural areas are showing the way to the urban areas, as in some places you have a public health nurse who is also a plunket nurse, which is never possible in the city. The district nurse, of course, should be in close co-operation with the doctors and this appears to happen more readily in the country than in the town.

The trend to training nurses in Technical Institutes rather than in the hospitals should produce a graduate with a much broader base of experience who could hopefully fill many roles in the community and be interchangeable amongst them. Perhaps a primary health care nurse could be developed, who even if she is not specifically practicing in the public health field, would understand the principles involved. The practice nurse, so-called, could also be the plunket nurse to everyone's advantage - mother, child, doctor and nurse.

Social workers are developing their professionalism as the newest in the list of health professionals. They are defining their standards and have established their training courses. They have presented a new perspective to patient care and could and should be more used in the community, rather than be confined within hospital walls. Whether a prerequisite for social work training should be a B.A. in sociology or a broadly based nursing training, has not been defined, but the most useful social worker in a team is one who is available and uses his or her expertise over a broad range of problems rather than one whose self-image is that he or she is a true consultant.

WHAT OF THE FUTURE?

We have then a group of health workers working together as a team in the community. In the future doctors should be more plentiful and will be better trained prior to entry into general practice. The nurses will have a broader basic training rather than being orientated purely to hospital nursing. The social workers are gradually developing their role. Although the rural population will most probably remain stable there should be a greater supply of health professionals. The organisation of these people to work together from a medical or health centre in a small town is certainly in the interests of the community, but the development of such an organisation is very expensive today and it may not be possible for a young doctor to finance such an undertaking when he has also to finance a house as well. This is where the hospital board and local town or country council should be involved in the best interests of the residents.

The biggest unanswered health care problems are :

* What do you want?
* What solution is in your best interests?

You may decide you want an old fashioned family doctor who has time to listen to you. With more graduates the doctors may be more plentiful but may be looking for the old fashioned patient who did as he or she was told and did not question the doctor.

Times have changed and it is better for people to know and understand their condition. It is also better that you understand how your particular doctor works and that he may not be able to speak to you when you want it as he has responsibility to the patient consulting him at that particular time.

LOOKING AT THE NURSING SERVICE

A survey carried out by the Nurses' Association in Nelson two years ago certainly came out in favour of a neighbourhood nurse who was in contact with the doctor but who could answer their enquiries without worrying the doctor. This type of nurse could, of course, be the practice nurse.

Finding what you really need is very difficult. A recent as yet unpublished survey of the people living in Parklands who had an inadequate general practitioner service, showed the great need for a district nurse.

You in your community may have a greater need for home aids, meals on wheels or baby sitting services. Only by local communities or areas organising themselves, as has happened at Lincoln, determining their own needs and their own woman or manpower, will improved care be achieved in this country. With such organisation, fewer people will need to leave the community for hospital with all the disruptions that causes, and hospitalised patients will be able to return home sooner.

To wait for the hospital board to do this will involve a long wait as it is largely involved with institutional care not care in the community. To wait for the government to do it for you will mean that you will be told how to organise your care and control may be taken from you.

To sum up - I have tried to show you, against a broad canvas of population trends, the changes in medical manpower and the developments in the nursing and social work fields.

You in your community can determine your needs and with the help of your health professionals, develop an organisation to fill your requirements. There is no need to wait for government or hospital board to determine your needs for you and to impose their answer on you.

PIG BREEDING AND FARMING

Mrs V. Mackenzie
North Canterbury

It has been said "be content with little and you will be given a lot", but I say "be discontent with little or you may have no lot". Although living on farms has many advantages and it is a very pleasant way of life, the economics of it no longer permit many young married women to live in idleness, and in any case idleness brings no satisfaction. Although I do not want to make comparisons between town and country it is obvious that the opportunities for trained or qualified women in the country are very few compared with our town friends. So there are really two reasons why young married women normally have to find not only an outlet which gives them an interest, but an outlet with a financial return. In my case as a registered nurse I had hoped to get nursing work but found it was impractical, and after considering the possibilities available I decided to breed pigs - something which would fit in with the farm work.

There are several choices with pig rearing which should be made fairly early. There is the choice of a low cost outdoor system, the alternative of buying in weaners and fattening them, or the possibility of going into a more scientific fully indoor system which would include breeding and fattening of the progeny. In our case we decided to start with two sows in a disused cottage and quickly found that the return for the amount of work involved made it a hobby rather than an enterprise. The decision was therefore made to go into a fully indoor system. This system has a high capital cost, not only in the buildings and silos, but also in the pens, farrowing crates and dry sow stalls. Because of this we built the unit in three stages and at the same time readjusted the farm programme to produce more grain until self sufficiency was achieved.

Even before this stage was reached a lot of investigation was carried out and it was considered that through pigs the gross income of the farm could be profitably increased. This was an acceptable form of vertical integration in the management of the farm. If any of you are thinking of undertaking an enterprise of this kind, decisions have to be made considering such things as labour, capital, the ability of the farm to grow grain and how grain production fits into the general farm management. In our case we decided that a 60 sow unit producing 1,200 baconers would be the right size. It must be understood that there is a fairly fine balance between the price of feed grain and supplements, and the final price of the baconers. Therefore we considered it essential to have a sophisticated type of pig rearing, to have pigs of only high quality and to have all recorded.

With such an index system we not only produce the highest quality baconer but get a higher price per kilogram and have high producing sows. This is even more essential in the pig industry than with sheep or cattle. The sow records relate to the sows fertility and the sow index relates to the progeny, the growth rate, conversion of feed and the grading. With this statistical information it is easy to make replacement selection for high production. Incidently, our herd is one of the only two indexed in New Zealand. The index system is based on the level of back fat measured in two places - loin and rump. These are added together and subtracted from the gross hot carcass weight, thus giving a comparative, positive figure. Every baconer which is sold is slap tattooed with a sow related number for individual identification on the cutting table.

People usually associate pigs with mud, smell and swill. But in this factory type unit the pigs are clean and the work pleasant, even for a woman. My training in nursing comes in handy as the pigs have to be injected and sometimes treated for disease. When the enterprise becomes more profitable, more sophisticated automatic feeding devices can be installed and this will lessen the work. Women can do all the work with the exception of the castration and serving, where a man is needed to handle the boars.

There is yet another avenue open for profit, in the use of very valuable effluent. This effluent has to be sprayed on to pasture for pollution control, but it should and will be used to grow specialist crops. At the present it has raised the stock carrying capacity from 13-45 stock units per hectare.

Selling is simple, as the pigs are all sold through one merchant. To give you a final indication of the time involved, a woman could manage a 25 sow unit under these conditions with about four hours work per day. With 60 sows it would be a full day's work.

Although this talk is essentially one of practical experience, I have mentioned the importance of good breeding, and stress that under today's conditions with the present costs of barley, versus the price of bacon, a scientific approach to the feeding and the record keeping, is the only way to ensure that the enterprise is run profitably.

Let me finish this statement of my experiences with a quotation from Barbara Babcock which concisely explains my approach; "Opportunities do not come with their values stamped upon them, every one must be challanged".

ANGORA GOATS

Mrs Virginia Blakely
North Canterbury

Why did I choose Angora goats? The main factor was, I think, the principle of having something of my own, be it sheep, cattle or whatever, which I felt fitted in with our family farming scheme. By this I mean something which involved me in the farm situation beyond the odd bit of feeding out, cooking for the shearers or any of the other dozens of small things farmers' wives do every year.

It was important to prove to myself, as I was a city person before I married, that I could do something on my own. I wanted to prove to myself that I could manage a scheme of a reasonably small scale initially, on my own and with a minimum of physical help from my husband or other farm workers.

The other factor involved communication. On our farm at present are my husband, my father-in-law, two married couples and a single boy. By the time my husband has discussed what's going on with his father, the shepherd or tractor driver and possibly the boy as well, it all gets a bit second hand and boring to go over it all again at home. Added to this is a fairly specialised farming enterprise with a large Corriedale stud, a Hereford Stud and commercial sheep.

I think the feeling is probably just in my mind as it were, but at least I feel I can hold my own, and that I am involved in more than a purely passive role.

Now for the goats themselves. I had thought about Angoras for about two years before I actually became involved, and I must say that I've only had them a few months.

They were of course first domesticated in Aukoia in Turkey, and flocks are to be found in considerable numbers in Kenya and other African countries as well as South Africa, Australia and the United States of America. The problem was to find a breed which fitted in with the general farming programme and didn't require a large capital outlay on the farm or any major upheaval. Family sanction was eventually given, probably to keep me quiet as much as anything !
I began with one pure Angora buck, nine Saanen females - the white milking goats - and three first cross females - half Angora and half Saanen. All females were pregnant to two other Angoras thus establishing three different blood lines.

At the end of last November the first kids arrived and soon the numbers were swelled by fourteen young. The bulk of these are halves, the three half bred females produced three quarter bred progeny, if you follow. A couple of months ago I added another base female so I now have thirteen running with the buck at the moment.

My plan is to build up through the females to pure Angoras as soon as possible, hopefully by having three kiddings in two years and building up from halves through three quarter pure and eventually to pure bred.

Obviously the numbers are going to rise quite rapidly at this rate, so I will cull out or selloff the base females and an increasing number of first cross wether kids retaining only those producing the best cross-bred fibre.

People tend to raise their eyebrows when I say that goats are really rather intelligent animals, far more so than sheep, and don't fall for the same trick twice. By the same token I am learning this year, and I hope that next year things may be a bit easier. The kid drop had to be tagged and for this I decided to use coloured plastic tags, the self piercing variety. I used yellow for female kids and blue for wethers; the adult females - the base females - have orange tags. The different colours will, I hope, make for easy paddock identification.

Obviously they must be tagged for the records. I had recorded the sex of the kids beside the doe's number at birth, but didn't tag them then as I now wish I had - the ears were so thin, I rather feared the tags would pull out. However, with weaning approaching, the job had to be done.

So, in line with the must-do-it-myself theme, and armed with a crook I decided to catch them while they fed out in the dry summer. Good in theory - this would only take three or four days and all on my own! Not so easy! Three the first day, one the second and the sight of the crook on the third made them rush for the other side of the paddock. They don't fall for the same trick twice. Much muttering of family togetherness as we ask father to bring the dogs and help us get them in.

Soon after Easter I decided it was time for weaning. I had two extra children staying the weekend and with my three, I thought it would be easy to get them out of their paddocks, across the next by the race and into the woolshed. From there I planned to put the kids out another door into a small paddock which I had already surrounded with an electric fence. The buck and does would then go back the way they had come and we'd all be home for lunch with time to spare. We tried driving them down tempting them with hay, and eventually got most of them into the shed and the kids out into their paddock. They were weaned for about ten minutes before the kids made a collective rush for mum and we were back to square one. The boys in the meantime had decided it was far more important to get some old wheels for a cart than go through the whole performance again. By this time I was beginning to agree. The light plastic and wire strings I had in the fence proved useless but I think we've fixed them with some high tensile wire. Keeping them in the paddock has been rather a problem and electric fencing is essential.

The wool-shed is important to the scheme of things. Although it is an old one, basically used for hay storage, it makes it a lot easier for me to do routine jobs like drenching - I can get them under cover whereas they will jump out of ordinary sheep yards, and it is also important for shearing and spring kidding.

They are shorn twice a year and this includes first cross to pures. They also have a habit of shedding the fleece in the paddock if left too long. Because they are very susceptible to cold and get pneumonia very easily, it is essential to provide shelter of some kind. High losses in kidding can also result during cold weather.

The genetic dominance of the Angoras is very obvious. In the first cross kids, the fluffy coat and drooping ears make them quite different from their Saanen mothers and the characteristics become more pronounced as the amount of angora blood increases.

The main product is of course, the mohair; it is the third most sort after fibre in the world, although there is some demand for wether kid meat from some ethnic groups, mainly in Wellington and Auckland.

Until the end of last year the mohair produced in New Zealand was largely taken up by spinners and weavers and indeed a large amount of the national production still goes in this way.

However, early this year a collection of many small clips was put up for tender by a stock firm in Christchurch and were sold for export to Europe.

Of this offering, the first kid described as "good, average quality, good length", made $4.90 per kilogram, first adult male $4.45 per kilogram and the stains - I suppose the crutchings is about the nearest equivalent - brought $1.95 per kilogram. Some figures from the first Australian mohair auction may also interest you. Mohair from pure bred kids brought $7.20 - $20 per kilogram.

The comparison with wool is obviously interesting but it must be remembered that although Angoras are shorn twice a year, the yield weight per animal is lower than with sheep. I think 3 - 4 kilograms a year could be expected from an adult.

So, what I am trying to do is breed a flock of quality animals with an emphasis on mohair production, while trying to get up to a pure bred state as soon as is practical. The most important factor to me personally is the feeling of having something of my own, involved in the farming scheme which is my responsibility.

And also, I must say, the satisfaction of seeing some of my own methods and endeavours actually work once in a while.

GENETICS OF COLOURED SHEEP

V.R. Clark
Senior Lecturer in Science
Lincoln College

The genetics of coloured sheep is a topic complicated by such things as the range of colours, colour patterns and environmental modification.

There is little New Zealand information on the topic as black, coloured or spotted sheep are traditionally culled from our flocks. Markets for New Zealand wools are primarily for white crossbred wool and any suggestion of coloured wools being included in the national clip could well jeopardize traditional markets. Generally, research has therefore been carried out in other countries where coloured sheep are more common and sometimes of economic importance.

ENVIRONMENTAL FACTORS

Because of environmental factors, fleece colour can only be described accurately at birth - before these factors have a chance to modify depth of colour or pattern.

Environmental factors include

* Bacterial populations in white fleeces which cause blue, pink or green colouration.
* Moisture and heat causing yellowing.

CHANGES IN COLOUR

Black wool fibres can change in colour due to :

* Ageing. As a sheep gets older its fleece becomes lighter in colour.
* Bleeching by the sun will reduce colour intensity.
* Zinc deficiency can reduce colour intensity.
* Copper deficiency or molybdenum excess can lead to reduced colour intensity. Copper is essential in the conversion of the amino acid tyrosine to the pigment melonin, which gives fibres their coloured appearance. Excess molybdenum can tie up copper in the body and thereby limit its availability for the process of pigment production.

WOOL FIBRES

To assist in understanding wool production it must be appreciated that a fleece is made up of many individual fibres each of which is produced from one follicle which in turn is influenced in its production by nutrition and the activity of that follicle. A particular follicle can produce pigmented wool at one time and white wool at another time. White and pigmented fibres may grow from adjacent follicles. It is also uncommon to find all fibres on a pigmented skin region to be coloured.

INHERITANCE

Just as follicle activity and nutrition can influence the resulting fibre the mechanisms of inheritance can influence the resultant animal and its production. Inherited characteristics are passed to offspring with a high degree of chance.

The fertilised egg of a ewe contains 27 pairs of chromosomes. One chromosome of each pair has arrived at random, one from the ewe, one from the ram. The random arrival of each chromosome is basic to the distribution of some characters as expressed by offspring. On each chromosome are genes which determine the appearance and production of an individual. Some genes on each chromosome are dominant for a particular character while others are recessive. If an animal receives one dominant gene and one recessive gene for the same character, the dominant one will be expressed.

In the case of coloured wool dominant and recessive genes play important roles.

In the Merino and most British breeds:

* the trait for white colour is dominant
* the trait for black colour is recessive.

Because of this some sheep will have white wool but carry a gene for black. They are said to be heterogygous.

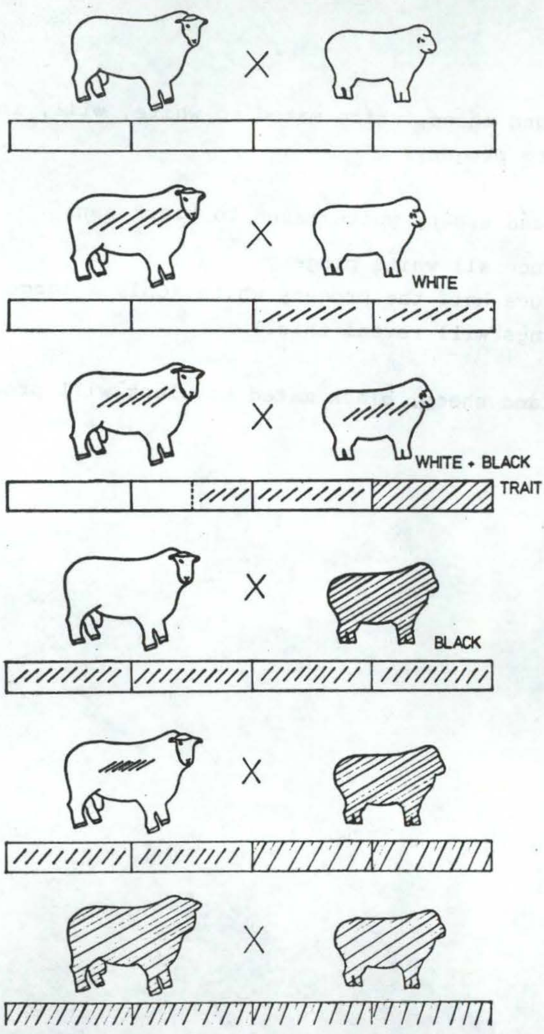
Sheep carrying two genes for the colour they are expressing, black or white are said to be homogygous. White-woolled sheep carrying the recessive gene for black are indistinguishable from genetically pure whites. Only when white sheep are test mated together and the resulting progeny scored for colour in the ratios in which they occur, can homogygosity or heterogygosity be established.

COLOUR PATTERNS IN SHEEP

Completely white fleeces	(dominant)	
Completely black fleeces	(recessive)	
Black mouflan pattern	(white underside)	(recessive to white dominant to black)
Black badger-face pattern	(black underside)	(recessive to white dominant to black)

Black badger-face/mouflan pattern is an example of the many

Fig 1. Coloured Wool



Ratios of progeny from parents of varying combinations of genetic inheritance for white or coloured wool.

partial patterns which are not well explained - black spots, black heads and legs, or white markings on black sheep.

SUMMARY

In New Zealand sheep, white mated to white, will, in most cases produce white progeny.

In New Zealand sheep, white mated to black can:

* produce all white progeny
* produce half the progeny white. (Only a large number of matings will reveal this.)

In New Zealand sheep, black mated to black will produce black progeny.

BLACK SHEEP AND OTHER ANIMALS

Mrs V.M. Lucy
North Canterbury

BLACK SHEEP

Our interest in black sheep all began when the children were given a black lamb as a pet some six years ago. I had just bought a spinning wheel so we decided to leave him as a ram and see what happened. His early days were not without incident as a horse kicked him on Christmas Eve and broke his leg - fortunately the vet happened to be in Amberley at the time, and having young children of his own, understood the crisis! It took him about 10 minutes to set the leg and put it in plaster but some three weeks later when it was time for the plaster to be removed, it took our inexperienced efforts about two hours and we tried everything from hacksaw to breadknife, before successfully removing the plaster cast without cutting the leg underneath!

The Breeding Flock

The following year we bought in twin black ewe lambs, and put our pet, now grown into a fine young ram, out with the 50 or so white Romneys we had then. He was scarcely tolerated by the white ram we had then, but the following year he more than proved himself by leaving high class lambs and many twins. I have not made a study of genetics but we were intrigued by the number of twins where one was black and one was white, and by the number of white ewes throwing a black lamb. When the time came to change our ram, we were fortunate in being able to borrow a good Romney for the season to run with our own sheep, but we retained the original pet ram separately. He received his own harem of visiting wives in a different paddock. All our farmer friends were so scathing about our idea of breeding black sheep in the early days but now many of them bring down the odd black ewe to our ram, but they have yet to admit to owning them and always make some excuse about them belonging to their wives so obviously the black sheep continues to remain a second-class citizen in conservative farming circles!

It must be remembered that we have only 10 hectares so I can hardly justify speaking to you as a "farming wife" - just as a country one - and the black sheep are my hobby and interest. The numbers involved are not large - in fact we seldom have more than 70 ewes, about 70% of these being black.

Selling the Offspring

In this year of drought and shortage of feed, having black lambs to dispose of was a godsend. Instead of having to wait our turn to get them into the works all we had to do was to put an advertisement in Saturday's Press and between 30 and 40 lambs had disappeared by lunchtime for a price of a couple of dollars above the going rate at the works, and with no transport cost to ourselves. Buyers were all keen spinners, or potential spinners. Many of them lived on 10 acre blocks and felt that if they were only going to have a handful of sheep, they might as well have some that were a bit different.

Wool Production and Sale

In our case, disposal of the wool presents no problem as the whole lot goes to the local spinning group organiser. Some of the best has been exported to America, but in the two most recent years we have found that the fleeces from the ewes have had a break in them so this time I'm afraid we shall have to pre-lamb shear. The fleeces from the ram and the lambs have been perfect so one is forced to the conclusion that in our case the break in the wool must have resulted from lambing in such awful wet conditions. As the sole reason for having black sheep is to provide coloured wool for spinners, this factor of a break in the wool is a major problem. Pre-lamb shearing, improved shelter and better feeding often cure it, but sometimes some sheep have a break in their fleeces every year regardless of every precaution and effort being made to prevent it. In this case, the only real solution is to cull those particular sheep from the flock. It is simple when there is only a handful, but more difficult in our case with about forty being shorn together and consequently hard to match a bad fleece to the particular sheep at fault. Wool with a break in it can be sent to a Southland carding machine and for a relatively low cost - about $2 a kilogram - can be returned in near perfect condition for spinning.

Until this year we have kept to Romney breeding, though at one time we did use a Southdown ram over the original white ewes. This year we are using a stud Corriedale ram which the spinning experts tell us should produce better wool still. The quality of black wool is never equal to that of the best white, apparently because black sheep are throw-backs to their forebears. But I hope that with more careful breeding this state of affairs will be improved. Black and coloured wool, varying through all shades of brown and grey variations will always be the spinners chief material for working jerseys.

An average good fleece would weigh between four and five kilograms, enough for several jerseys and be priced this year at about $2 a kilogram. Any breed of sheep with a good, open and most important of all, clean fleece, without a break, will produce wool suitable for spinning. Merino wool has always been thought of as being the most suitable for babyclothes, but this is probably not really the case as it is inclined to felt with repeated washings.

Black is Beautiful

There is now a Black Sheep Society in Masterton, with branches in other parts of the North Island, and one in South Canterbury. Classes for both black sheep and coloured fleeces, have been included at the Methven, Hawarden, Cheviot and Mayfield Shows, and Amberley has apparently succumbed this year, though ultra-conservative farmers find a black sheep very hard to tolerate under any guise. Methven show had 15 entries in each class so there is obviously plenty of support. There was a sale in the North Island this time last year on the Masterton showgrounds where 350 sheep passed under the auctioneer's hammer; and not one of them white! And earlier there was a black wool sale at Fairlie.

As to the finances of the undertaking, I honestly can't quote any exact figures as the proceeds go into our joint account and are usually channelled in the direction of school fees - but I can state that it is definitely profitable! We grow sufficient hay for our own needs, and until this year have never had to buy any in; shearing, crutching and drenching costs are small for this number of sheep, and there only remains the cost of procuring a suitable new ram every two years. In our case transport of the lambs we sell, and of the wool, is no problem as all are collected by the purchasers. As to the amount of help needed from a husband, again I'm not really certain - mine helps in the shed for shearing and crutching and does the tailing and drenching, but if you wanted to be totally independent none of these jobs would be impossible for a woman to manage on her own - tailing would probably be the most difficult. At lambing time, whichever of us has half-an-hour to spare goes round the sheep morning and evening. In our case, as I said, the profits go into the account, but run by the wife as an independent enterprise a small flock of black sheep can notonly be of great interest and enjoyment, but certainly an excellent and not too time consuming source of pocket money.

DONKEYS

I have also been asked to mention donkeys as we are certainly rather more notorious for the breeding of these than for the more usual black sheep! I won't say much about donkeys as it can be frustrating for those of you who might be looking for an interest outside the house and children; here in New Zealand it is virtually impossible to obtain breeding stock. All breeders in both Islands have waiting lists of three years or more, and to import donkeys from Australia, now that shipping costs have escalated so much over recent years, would mean a considerable capital outlay. This could perhaps be justified when one has set ones heart on a donkey as a pet or member of the family, but not an economically sound proposition for a country wife hoping to make some pocket money. Our experiences with donkeys could, perhaps, be adapted to some other species which is in very short supply here - I've often thought there would be a big demand for the Jack Russell terrier which is a short-legged, usually short-haired, and very sporting little dog which has all the easy maintenance of a little dog but the big heart, courage and stamina of the bigger sporting breeds. It is just a question of finding something you yourselves will enjoy and which is currently not readily available but for which there might be a demand.

Getting Started in Donkeys

We didn't set out to make money from our donkeys - in fact, I would say that no donkey owners, certainly in Canterbury, are in it for money. Very few could say that their donkeys even paid for themselves. We all got our donkeys, because we wanted them for themselves not for financial gain. We set out to search for a donkey for our children shortly after we arrived from England; there everyone had a donkey. This arose from the heartbreaking trade in shiploads of live donkeys for meat, and chiefly for salami sausage, between Ireland and the Continent.

A Donkey's Character

The child's pony is usually sold when outgrown, a donkey seldom leaves its adopted family and some of the most successful donkey homes have been those consisting entirely of adults. A donkey is closer to being a dog - it needs people and company, and will come to see you, for your sake, not just to see what food might be in your pocket. The cruellest thing one could do would be to buy a donkey and then turn it out miles from anywhere - it needs to be needed. And they can be most useful - they are excellent in harness, and it is here that I believe their real future lies. They are very strong as pack animals and with well made panniers can carry all sorts of loads. I read of a family in America who loved tramping but while the children were small they had to miss out on this hobby, until they bought a donkey which with its sure-footedness could go anywhere they went, carried the young childrens' pack and when short legs started to ache the child was given a rest by riding on the donkey's back. Only this week I saw a photo in an English magazine of two prize-winning show donkeys harrowing a steep hillside in Wales. Our cart is not very showy but more the workman-like type, and ideal for carrying a few bales of hay or shifting the heaps of leaves from the garden on those few occasions when the children have been browbeaten into raking them up. One of the donkeys we bred is living and working in the Sounds, carrying tree seedlings up otherwise inaccessible slopes and very much earning his keep - in fact his owner regards him as totally indispensable.

We set out to find a donkey as a first ride for our then very small children and at this time, some eight years ago, we found that very few remained in New Zealand and those that did were very largely inbred. They had been brought to this country in the early days for the breeding of mules as pack animals. It is said that they were never needed here in greater numbers as there are so few areas of New Zealand which could not support a horse. We then joined with two friends and after endless effort and delay managed to obtain wild donkeys from Australia. A Southlander was attempting to import some about the same time and his came to Lyttelton whereas ours, only a week or so later, were diverted when already halfway across the Tasman, to Bluff! Though they had been totally wild before their long and exhausting journey to New Zealand, the donkeys were quick to accept us and it was not long before we could handle them. They are far more amenable than horses and, if handled from birth, present few problems - they aim to please and their reputation for stubbornness is, I believe, unjustified. They have a far greater intelligence than the horse and if they refuse to go somewhere or do something there is often some good reason - too heavy or a badly distributed load, boggy ground, unsafe bridge - but they do have an inherent fear of water and it takes a lot of patience to reach the stage where your donkey will readily ford a stream.

Careing for Donkeys

A donkey's needs are similar to those of a horse and as such there is nothing that a woman cannot manage, though often a man's help is much appreciated. They need regular worming and attention to their feet about every six weeks. They need to eat roughage, especially in spring when the grass is richer than they either like or need. Roughage such as blackberry, gorse or dry meadow hay is good. If this is not made available this is the time when the trees may get barked and gates and fences chewed, damaged and sometimes totally destroyed! One weekend when we were away we foolishly left a little car trailer with a homemade wooden crate on it in the donkeys' paddock. We returned to find only the uprights of the crate remaining! A donkey cannot digest meat in any form - a ham sandwich could be a killer - but loves kitchen scraps and a particular delicacy to some donkeys is a banana skin.

What Do You Get From Donkeys

When I was asked to give this talk, I was told to cover three points - how we started with black sheep, or in this case donkeys, whether a wife could manage the sideline herself, and the rewards. I think the implication of this last heading was intended to be financial, but in the case of the donkeys few people could claim to make money from them. However, the rewards from our donkey breeding have been great - but much more from the angle of the fun and pleasure we have derived from the animals themselves and also from the friends we have made through them.

We have enquiries from all over New Zealand for our foals but as the gestation period of a jenny is 13 months, we are able to satisfy very few of these wishful donkey owners. Someone who wants to own a donkey, or perhaps more accurately, be owned by a donkey, as they are terribly time-consuming, is someone a bit different - someone not satisfied by daily chores and domesticity and usually someone who doesn't in the least mind being laughed at. Often donkey owners are thought of as eccentric and odd but its really a compliment and it would be very sad if donkeys were commercialised to the extent where the present great friendship among owners and breeders was lost.

At present the champion donkey at the Christchurch Show does not win enough to cover the cost of his entry fees, so showing is purely for enjoyment and we hope it will remain this way. In some cases very high prices are asked for donkey foals, and this is, I suppose, inevitable when something has a scarcity value. But we have held our prices for four years and hope to continue to do so as that way a donkey remains within the reach of those who really want it and is not just available to those who can afford to pay over the odds.
A breeder has to charge enough to cover their costs, and anyway, when I bred Labrador dogs I became a firm supporter of the theory that something given was never fully appreciated or looked after. We learnt that one should never give a puppy away, even to charge much less than the usual price seemed to guarantee better treatment of the animal. Breeders can't afford to be philanthropists entirely, but as long as

my donkeys break even, the credit side is more than made up by the enjoyment they give to the whole family and the friends throughout the whole of New Zealand, and even Australia, which they have made for us.

A COMMUNAL APPROACH TO THE PRODUCTION AND SALE OF HANDICRAFTS

Mrs P.M. Harper
Central Canterbury

Rural women in general are noted for being very capable and able to turn their hand to a variety of skills. These range from being wife, mother, cook, housekeeper and gardener to shedhand, hay carter, truck driver and shepherd. There are also the many different crafts that are undertaken by these women during the long winter evenings.

HOW IT BEGAN

It was because of this, that four years ago three friends and I decided to hold a shop in Mt Somers for one week at the end of November. We hoped to create an outlet for locally produced crafts at a time that would catch the Christmas market. There being little opportunity for country women to obtain employment such as their city sisters, we hoped that this would help to give the local women an opportunity to make a little money from the crafts they enjoyed creating.

As for ourselves, the venture was not undertaken with the idea of the possible financial gain that could be made, but more with the thought of the tremendous personal satisfaction that could be had from making a community venture such as this a success. Our husbands were doubting Thomas's at first but without their help and advice we would not have succeeded.

From May until November be used "bush telegraph" as our major form of advertising. Word travels fast and the enthusiasm with which our idea was received was incredible. By November we had sixty three people who wished to sell their various crafts. Last year there were over seventy contributors.

GETTING STARTED

We hired the local scout den as the venue: hence we called our shop "The Craft Den".

Yards and yards of scrim were dyed dark brown to be used to cover the walls. Yards of brown and white gingham were made into cloths for the table. Apple boxes of various sizes were stained to be used for the pottery display. Dried flower arrangements were made for decorations and butchers hooks made to fit long rails hanging from the ceiling on which bags and novelties were hung.

A large dray wheel was resurrected to use for displaying the leather goods and a wrapping paper dispenser was created by using a cardboard box and half the handle of my best broom.

The week before we opened, we either collected the goods for sale or they were delivered to us. Then followed many hours of cataloguing and the numbering and pricing of each article.

RUNNING THE BUSINESS

Our method of book keeping would probably have made most accountants turn grey overnight. However, although laborious, we at least could keep a thorough check on all goods in our possession.

As we were not buying the stock outright and were only selling on behalf of the contributors, we had to have a reasonably foolproof system of cataloguing. Each contributor was given a separate number; thus each item belonging to a particular person had that person's particular number and the relevant price on it.

As each article was purchased the number, price and a description were entered in the account book. Each night the account books were taken home and the appropriate article crossed off in the catalogue in ink.

At the end of the week all stock left was also checked and crossed off in the catalogue in pencil. Thus we had an idea of what was missing - in other words, how much shop lifting there had been. This, of course, was paid for out of the commission.

One of our foursome turned out to be a most capable, unflapable and efficient typist and it was her mammoth task to type the catalogue.

The first year we had approximately $4,000 worth of goods and last year approximately $6,000, so her task was not an enviable one.

We charged 10% commission to cover costs and these included insurance, a large stationery bill, very large phone bills, the hiring of the scout den, petrol and the decorations.

OPENING DAY

The day before "D Day" was spent decorating the den and putting goods out on display. Tempers were frayed well before lunch time. The first year it took only one day, last year it took two full days to complete the task.

On the first opening morning we were staggered to see queues of people waiting for the Craft Den to open. It was worse than Ballantynes sale and by lunch time, in only two hours we had taken over $1,000.

The first day of course was our biggest trading day but by the end of the week, many cups of coffee and chocolate biscuits later, we had taken over $2,500 - a lot of money to change hands in a small township in one week. The next year we took over $3,500 and last year just over $3,000. People came from as far as Christchurch and Timaru.

The range of crafts offered for sale and the standard of workmanship on the whole had to be seen to be believed. There was pottery, canework, denim clothing, childrens and adults clothes, smocking, pen and ink drawings, paintings, macrame, jewellery, leather bags and belts, soft toys, childrens jig-saws, place mats, novelties, woven mats and bags, candles, patchwork, sheepskin rugs, wall plaques and spinning. There was an incredible variety and it was generally of a standard equal to that in any craft boutique in New Zealand.

The first year our insurance company would not insure for burglary, so our respective husbands took it in turns to sleep at the den at night in pairs. I think they were all terrified of being hit over the head in the dead of night and were very glad when the week was over. Needless to say, we changed insurance companies.

Unfortunately we have held the Craft Den for the last time. It had become too big an undertaking for us to handle in such a short time and as mothers of young children and farmers' wives with many other commitments, it is not possible at the moment to make the Craft Den a more permanent venture and thus perhaps ease the pressure.

THERE'S MORE IN BUSINESS THAN MONEY!

Apart from the tremendous personal satisfaction gained from the success of the Craft Den, it was also a thrill to see how a venture such as this could draw people of all ages and from all occupations together in a small community, giving them all a common interest.

In an age of who's who, where you came from, what you were and where you are, it was a thrill to see a small rural community such as ours with one common interest, bringing everyone together.

FARMING UNDER HIGH INTEREST RATES

Mr G.F. Tate

Senior Lecturer in Extension,
Lincoln College

"Neither a borrower nor lender be for
loan oft loses both itself and friend
and borrowing dulls the edge of husbandry"

Hamlet.

For many well established farmers in this hall the rise in interest rates will affect you no more than it does a well paid university professor, civil servant, or member of the meat workers union. But for some young farmers recently established on, or about to purchase a farm, the rise in interest rates certainly will "dull the edge of husbandry".

These keen young farmers are the people most likely to want to increase production for their own good, and of course in doing so help the national good. It is these same young keen farmers who are likely to be severely handicapped in their efforts by high debt servicing charges through high interest rates.

FARM PURCHASE FINANCING

A farmer fortunate enough to buy the New Zealand Meat and Wool Boards Economic Service statistical average farm in 1970/71 would have had to finance an all up capital ingoing of \$112,000. To buy the same statistical average farm in the autumn of 1976 would have required a capital ingoing of \$242,000 with virtually no change in the number of stock units carried.

Assuming the purchaser could have borrowed 60% of the ingoing at the average mortgage interest rate charged on all registered mortgages excluding government lenders, the following position would apply.

TABLE 1.

	1971		1976
Ingoing	\$112,000		\$242,000
Cash 40%	45,000		97,000
Borrow 60%	67,000		145,000
Interest (7%)	4,700	(10%)	14,500

If our keen young farmer had to repay his borrowings on the basis of a table mortgage over a 20 year period, his debt servicing of interest and principal repayment would have almost trebled from \$6,300 to \$17,000 per year. A very dulling edge to his husbandry experience!

RISE IN INTEREST CHARGES

Two factors account for the rise in interest charges payable by a farm purchaser.

Interest Rates

One is the rate of interest charged. The following table shows the average rate of interest charged on all new mortgages registered excluding government lending.

TABLE 2. AVERAGE RATE OF INTEREST ON NEW MORTGAGE REGISTRATIONS (31 MARCH YEAR)

Year	*Percentage*
1970	7.15%
1971	7.32
1972	7.9
1973	8.1
1974	8.23
1975	8.82
1976	9.68
1977	10.62

Source: Reserve Bank Bulletin

The above figures do not relate solely to rural mortgages. They exclude current account or non-mortgage advances. They also exclude the Rural Banking and Finance Corporation, the largest single lender of money for farm purchase whose rates have not increased to the same extent as non government lending.

While individuals may be faced with paying rates substantially above those quoted, the average position has not risen to the extent often imagined.

PRINCIPAL SUM BORROWED

Besides interest rate the other component of interest bill is the principal sum borrowed.

A rise in capital has several dimensions. It helps the seller; it probably helps the man who already is an owner - it makes it harder for the buyer.

The change in farmland sale price has been presented by the Valuation Department in the form of an index.

TABLE 3. FARM LAND SALE PRICE INDEX
(BASED ON OPEN MARKET FREEHOLD SALES OF RURAL FARM LAND. BASE 1960 = 1000)

Year Ended 31 December	*Number of Sales*	*Index Number*	*Annual Percentage Charge*
1970	4210	1715	
1971	4517	1754	2.3
1972	4638	1880	7.2
1973	6632	2346	24.8
1974	5094	3478	48.2
1975	3193	3999	15.0
1976	3844	4404	10.1

Since 1970 farmland, on average, has almost trebled in value. Those farmers who purchased before 1970 are relatively wealthy as a result. Those who have first bought since the 48%

increase in land price that took place three years ago are faced with a totally different capital situation. A situation where interest payments are likely to be of major concern.

HOW SERIOUS IS THE INTEREST RATE POSITION

For the statistical average farmer the position now is no more difficult than in past years. Data provided by the New Zealand Meat and Wool Boards Economic Service shows that for the three years ending 30 June 1978, interest rate as a percentage of net farm income will be a lower percentage than was the position for the three years to 30 June 1968.

The time series is listed below:

TABLE 4. INTEREST PAID PER FARM AS A PERCENTAGE OF NET FARM INCOME

Year to 30 June	*Net Income* $	*Interest* $	*Interest as % of net Income*
1966	*5,987*	*1,104*	*18.4*
1967	*4,226*	*1,292*	*30.7*
1968	*4,778*	*1,381*	*28.9*
1969	*5,956*	*1,570*	*26.3*
1970	*6,338*	*1,672*	*26.4*
1971	*5,822*	*1,889*	*32.4*
1972	*7,108*	*2,164*	*30.4*
1973	*18,819*	*2,331*	*12.4*
1974	*14,258*	*2,692*	*18.9*
1975	*5,368*	*2,912*	*54.2*
1976	*13,625*	*3,506*	*25.7*
*1977 **	*20,800*	*3,650*	*17.5*
*1978 ***	*14,100*	*4,000*	*28.4*

** Provisional* *** Estimate*
Source: NZ Meat & Wool Boards Economic Service Sheep farm survey

Interest as a farm cost has increased between January 1977 and January 1978 by some 17.1% - a movement above the average of movements for input prices on New Zealand sheep and beef farms. As a percentage of expenditure it is of increasing significance. If net income fails to maintain the upward movement of recent years then the effect of rising interest rates can be expected to affect a much wider section of farmers.

I think there are a few basic truths about interest rate that we need to consider. A principle premise is that interest rates below the rate of inflation discourage savings and encourage speculation. Artificially low interest rates encourage speculation as they enable fixed assets to be purchased and held for capital gain rather than as a source of production.

I wonder how many farmers who have bought additional land in the past ten years have done so for the production taken off the land, or how many bought it because capital gain was felt to be assured. In other words, land was seen to be a safe repository for capital funds.

Where the interest rate is less than the rate of inflation, everyone who saves and lends money subsidises the person who spends or borrows money. At an interest rate below the annual rate of inflation the real return to the lender is negative - he is, in effect, paying someone to borrow his money. I certainly don't see that as being equitable.

FUTURE ACTION ON INTEREST RATES

* Farmers this year have already reduced part of the interest burden on ingoing young farmers.

  The price of breeding stock this autumn was substantially less than the prices paid last year. That has helped the chap buying his farm in 1978 but not those who bought last year.

I cannot see many people being very happy if the price of land falls in the same way as stock prices have. So it seems to me that the young farmer I am concerned about is stuck with the land price farmers have imposed on him. Even if interest rates fall in response to reduced inflation the man buying in cannot avoid the new plateau of land prices that has been created in the mid 1970's.

* Under high interest rates my young farmer needs every help he can get.

At present there is an investment allowance on new plant and equipment. Mr "well-established farmer" paying high tax gets a lot of advantage from this government incentive to buy new equipment. The keen young man bursting with enthusiasm to work and develop, who can very likely make most use of top quality equipment, is unlikely to be paying tax at the maximum rate or anything like it. If he is not paying the maximum tax rate he is not getting as much benefit from investment allowance as the wealthy farmer who is paying high tax but may well not be using the investment incentive in the most productive way.

I believe the investment allowance should be changed from qualifying as a tax exemption to the form of a tax rebate. In this way the young farmer who is in his most productive stage gets equal advantage to the older chap who buys machinery to impress the neighbours.

We already recognise the significance for equity between taxpayers of the tax rebate principle for young family taxpayers, personal exemptions, and the like. Why not also recognise the more equity it would give the young farmers buying equipment? The effect would be to reduce the capital cost of new equipment for the farmer not on the maximum tax rate and in so doing reduce the effect of interest rate on his cash flow.

* Interest paid on credit funds. At some time of the year most farmers have a credit in their current account, at other times a debit. If the funds sit in the trading bank cheque account no interest is paid on funds at credit. I suspect the same generally happens with the stock firm.

In Christchurch today there are a number of very respected, well established financial institutions who accept cash on a daily call basis and who pay 9% on call. For deposit terms longer than call the interest rate is correspondingly higher.

If a farmer deposits his wool cheque of $10,000 and has that money lying at credit in current account for four months without attracting interest, he has foregone $300 of income that it could have earned put out at 9%.

The farmer concerned about how much interest he is paying should make sure that he is getting the best deal possible for his occasional funds at credit. He should ask his seasonal financier what interest he is receiving on funds held in credit. If this is not reasonably in line with market rates, taking into account any other services provided by his seasonal financier, the funds should be more prudently employed.

* I know farmers who sit with credit funds for nine months to avoid going into overdraft with the bank or firm for three months.

This to me is poor management. The cash credits could be placed in much more productive investments and earn a return for twelve months.

It surely is better to receive investment return for twelve months even if overdraft facilities are required for three, than to forgo return for nine months in order to save three months interest.

* At this conference last year Professor Ross proposed a system of finance that seemed to me to have tremendous advantage for equitable lending of money.

Why people, particularly young farmers, up and down the countryside have not debated and pressured for a system of inflation indexed mortgages as recommended by Professor Ross, I cannot imagine. The indexed mortgage system means protection of the purchasing power of capital. If the lender knows his purchasing power is being protected he will accept a much lower fee for the use of his money.

Interest rates under an indexed mortgage system would be unlikely to exceed 2 or 3% - this would mean a tremendous cash flow advantage for the young farmer in his early years on the property. This is the time when under the present system interest rates are likely to be most crippling, yet it is also the time when often there is real opportunity for productive investment to be made.

Because farm lenders would see their capital being protected, the flow of funds into farming would be increased. Capital gains from farming would become much more closely related to the farmer's ability to produce income or to productively improve his land. This would increase the attractiveness of farm development rather than just squatting on land to achieve capital growth.

SUMMARY

For most farmers the rise in interest rates if of general but not crucial concern. For the young farmer about to buy his farm or about to refinance short term loans, interest rates may well be of crucial concern. Any further upward movements will raise doubts about these farmers continued ability to remain viable.

Under such a situation wise planning of cash flow to reduce overdraft peaks and to make maximum use of credit funds becomes very important. However, in the longer term a re-structuring of taxation incentives to give equity between those paying high and low marginal rates of tax where productive investment is being encouraged, and a re-structuring of farm finance to encourage additional capital into farming from private lenders while at the same time preserving equity between borrower and lender in the face of inflation, offers greater prospect of reducing the effects of high interest rates.

FARMING UNDER HIGH INTEREST RATES

Mr S.H. Hinton
Canterbury District Manager
Bank of New Zealand

The very mention of interest rates always gives rise to emotive reaction. The hardship faced by some borrowers in meeting interest payments suggests that interest rates are higher than they should be while the losses suffered by savers when they invest at interest rates much less than the rate of inflation indicate that interest rates are too low. The tremendous difficulties faced by young married couples in meeting mortgage payments particularly when a dual income family is reduced to a single income are brought to our notice every day.

Perhaps not the same prominence or understanding is given to the position of you, as farmers, in borrowing to finance fixed assets, machinery or your seasonal requirements.

The natural reaction is, as I said at the outset, to assume interest rates are higher than they should be.

Various opinions are held as to the reasons for the increase in interest rates which had until March 1976 been held in the controlled sector at artifically low rates by government decree.

It is necessary therefore, to emphasise that the March 1976 change in monetary policy was not a high interest rate policy -

rather it was a flexible interest rate policy accompanied by measures to encourage competition in both deposit taking and lending between financial institutions.

Specifically government has raised government and local government interest rates to make them attractive to investors and reduce its reliance on captive institutions.

The government has also removed controls on deposit and lending interest rates (paid and charged) by banks, savings banks, building societies and finance companies. These institutions are now free to compete in these areas and as a result competition between them has progressively intensified - a trend which will become particularly apparent in 1978, on the lending side - you will be aware of BNZ's recent significant entry with the lending for housing field.

One of the problems in gaining public understanding of the 2nd March 1976 change in monetary policy has been that 1977 was a period of particularly tight money and high interest rates - a reflection of the overall economic situation. Similar periods of tight money had previously been experienced for instance in 1974 and of course earlier too.

Tight money in 1977 would have occurred even if there had been no change in monetary policy in March 1976, the difference being that the financial system would not have so successfully withstood the severe strains placed upon it whilst previously uncontrolled interest rates would have been very much higher than was actually the case.

FACTORS AFFECTING HIGH INTEREST RATES

In examining financing, be it farming or whatever, under high interest rates a number of points should be made:-

* Interest rates are high because of high rates of inflation and because we are short of savings in

relation to the demand for investible funds.

Saving is discouraged if deposit interest rates are well below the rate of inflation.

If savers are to be paid interest rates which will encourage savings, borrowers must of necessity pay related interest rates - we can't have high deposit rates and low lending interest rates.

* Certainly there are many farmers who are 'benefitting' from higher deposit interest rates as there are many 'suffering' from higher lending interest rates, be they long or short term. But certainly the burden falls on the farmer, often young, and recently entered the industry. Equally likely is the burden to fall on the man who has expanded and whose debt load is higher than before. Nonetheless there are many farmers who earn these higher interest rates from their often considerable savings and seasonal surpluses.

* New Zealand is short of capital - obvious by extent of overseas borrowing. Capital is a scarce and precious commodity and should not be wasted or used indiscriminately. We do not wish in our present circumstances to encourage uneconomic development in the farming sector or any other sector, or put pressure on land prices either urban or rural.

* It is unrealistic to expect farming to be prosperous and maintain high rates of investment when the terms of trade are almost back to 1930 levels.

In the past the urban sector has not suffered when there has been a farming downturn, but this is not the case today - 30,000 unemployed, nearly 30,000 net migrants and retail spending per head back to 1971 volume.

BANKING SERVICE TO FARMING SECTOR

The banking sector is very well placed to meet the seasonal and medium term needs of farmers which it has done on an increasing scale over the past number of years.

The banks in the last few years have overtaken stock firms as the major source of short and medium term credit to farmers.

The Bank of New Zealand is the major source of short and medium term finance after the Rural Bank and Finance Corporation - we currently have some 45% of all bank farm lending. This, I submit, points to our confidence in this vital sector of our economy.

Most of you will have experience of bank lending on a seasonal basis and will know how in many cases your seasonal patterns have changed. From a former pattern of starting from a good credit basis for a few months you slowly moved into overdraft, clearing sometimes a number of times from income over the season, making for often a relatively short time in overdraft with attendant low cost. There are still accounts which operate like this. However, many of you will have found that your budgets, however carefully prepared, have been made a mockery of and income lags far behind costs already incurred as you try to cope with inflation increasing costs of all inputs - both revenue and capital. Industrial unrest resulting in delays in killing lambs, cull ewes and cattle, and the difficulty in getting firms to take delivery of grain and seed crops, have certainly not helped. As a result your seasonal requirements are higher for much longer and an additional cost is incurred. In fact your account frequently does not show much fluctuation for months on end.

We know this causes concern to farmers and my advice to you would be to keep in closest possible touch with your bank manager - communications at such time are paramount. Many people depend on you as you depend on them - your storekeeper, garage, engineer, veterinarian, carrier, contractor and the like. If you withhold payments from them beyond a certain point their position can become critical and service can be withheld or disappear.

As I said earlier, banks are a large source of medium term credit to farmers - term loan 3-5 years and sometimes longer for purchase of new machinery, capital stock, development and land purchase. Repayments and interest on these and other capital loans can become a cause for concern when income delays have thrown your budget totally out of line. Again I say keep in touch with your bank manager.

The figures quoted in tables 1 and 2 illustrate the extent of the funds required to support the farming sector.

TABLE 1. LOAN LEVELS

	Banks	*Stock Firms*
Dec. 1975	\$194m	\$161m
Dec. 1976	\$221m	\$158m
Dec. 1977	\$268m	\$194m
Increase	\$74m	\$33m

TABLE 2. BANK LOANS TO STOCK FIRMS

Dec. 1975	\$59m
Dec. 1976	\$70m
Dec. 1977	\$102m
Increase	\$43m

It is probably at this time too that notices of increases in interest rates on existing mortgages or loans come in or advice that a mortgage has fallen due and must be renewed or refinanced on harsher terms than before.

There is a definite need for sources of long term finance to farming for farm purchase, in addition to those at present financing this sector. These include the Rural Bank and Finance Corporation which does a tremendous job but whose assistance is limited usually to the first farm and also limited as to amount. Vendor finance, solicitors, trust companies, and insurance offices all contribute. However, much farm lending for land purchase is of too short duration - three to five years - after which the need for refinance comes up. This is a costly business when it is finally arranged and the arranging can be a most traumatic experience - as many of you will know.

I, and many of my managers, spend a lot of time with clients seeking ways and means to arrange refinancing and when you succeed you feel great but when just nothing can be turned up there is a sense of failure and disappointment leading again to a loss of confidence by the farmer.

It is this lack of confidence by the farming sector itself which causes me great concern, and this has its cause in direct relation to the factors I have outlined above. In my view, it is necessary for farmers to have and to exhibit in large measure their own confidence in their industry. With all the things that presently beset them it is very possible to make a powerful case against the continued viability of farming and the lack of confidence engendered thereby. There are many including many farmers very ready to make such a case.

By the same token, it is possible to demonstrate to farmers the enormous support there is for their industry by a wide section of the community both commercial and government.

I have total confidence in farmers and farming or I would not be here today; so does the bank I represent and other banks, Rural Bank, the stock firm, the insurance offices and all the organisations which find finance. Enormous inputs of technical assistance are provided by the public and private sector. It can be argued that government could and should do more, even in the face of the very wide ranging assistance given. We await the forthcoming budget with great interest.

Continue to make representations through your farm leaders and any other effective means as you are, but for the sake of the future of your industry and your place in it grasp the nettle and use to the full all the wide range of means available and demonstrate to government and the rest of the community the pre-eminent place farming must occupy. I would suggest that this would make your representations more likely to bear fruit, make your own situations more viable and perhaps most important of all, give a return to the confidence which is so essential for the well being of our industry.

We are going to continue to farm - this is without question.

I say we because I regard farming as very much of a shared endeavour - people in situations such as my own, your stock firm, accountant, advisor, M.A.F., Rural Bank, solicitor, in fact the multiple of people who exist to support your farm operation. The most important ingredient in this mix of people is the farmer who is inclined to sell himself short and no amount of support will succeed if his confidence is lacking.

FARMING UNDER HIGH INTEREST RATES

Mr W.J.L. Simpson
General Manager
New Zealand Stock and Station Agents Association

The points I want to cover in these brief comments can be listed under the following headings.

* The Stock Companies' financial role.
* The position before and following the amendment to the Money Lenders' Act.
* The effect of interest rates on farm costs and profitability.
* The cost of development and its effect on the Stock companies.
* Some short term remedies.

THE STOCK COMPANIES' ROLE

The myth persists that stock firms are capitalist enslavers of farmers, "The old company store" concept. That is just not true today - if in fact it ever was - for the type of debt envisaged in the myth is *hard-core* debt, and that's the last type of debt any stock company wants. The stock firms are holding some $50 million of hard-core debt now and we don't want any more.

Latest forecasts indicate an average negative cash flow of $1500 per sheep farm for the year ended June 1978, and this could result in a total of $40 million of additional farm debt. The stock firms could not take that. If an adequate level of farm maintenance and expenditure is to be undertaken next season, stock firms forsee - based on present revenue and cost trends - a massive operating cash deficit on sheep farms during 1978-79. But farmers today react more quickly to market signals, and it seems likely expenditure will be reduced in an attempt to minimise excessive increases in current debt which accrue from negative cash flows. We forecast a reduced but still serious increase in farm debt and inadequate maintenance, the worst of both worlds.

Stock firms are not financially geared to handle long-term debt. We are *seasonal lenders*, but the recent massive inflation and low profitability of farming has vastly increased the amount of *hard-core debt* owed. The inflationary spiral, plus the delay in the amending of the Money Lenders Act, gave the companies a headstart downwards compared with the farmer.

THE MONEY LENDERS ACT AND CURRENT INTEREST LEVELS

The cancellation of the Interest and Deposit Regulations occurred in March 1976, and from that moment stock firms had to pay their banks more for their overdrafts, and increase the interest rates they paid to clients who had short or long term deposits invested with the companies.

The result was that over the next twenty months - to December 1977 - the cost to the companies of their average overall borrowings was to rise appreciably in excess of the 9.5 - 9.75% which, under the restrictions of the Money Lenders Act, was the ceiling interest rate they could charge their farmer clients. Very quickly it meant that short term unsecured advances became cheaper than secured first mortgages. As the cost to the firms of borrowing continued to escalate - one firm was paying as high as 17.5% for short term money - and because stock firms were of necessity cheap suppliers of money, there was a distinct tendency to pay them last and to borrow more from them.

The firms took a beating.

I believe too that the policy of low interest rates helped initiate the escalation in land values and thereby created another of the problems facing both young farmers and financiers alike.

Look now at interest rates being currently charged by the firms. The normal or basic rate for arranged loans - that is loans whic have been discussed and arranged by the client - is around 12 - 12.5%. In addition, there is a penalty rate outside the limitations of the Money Lenders Act. This applies almost entirely to stock purchases, for which the terms of payment under the Conditions of Sale are not met, and where no arrangements for credit have been made. In short, if a farmer goes ahead and buys stock without consulting his stock firm, and fails to pay within the period of grace, he's going to be met with a 15% penalty interest rate of 15%.

The Effect of High Interest Rates on Farm Costs and The Cost of Development and its Effect on the Stock Firms.

Younger or newer farmers who have bought at present high land values and who have borrored to buy land, stock and plant will really feel the effect of these increased rates. Another group will be those developers who have borrowed under similar circumstances.

It is with this aspect of farm development that I wish to deal.

It should be realised that the stock and station industry has reached, if not exceeded, the limit of its capacity to provide a banking service for clients. The industry's total debt owed to it by the farming community was $254m at December 31, 1977. Meanwhile credit balances and deposits declined by $12 million over the year. By the end of next month - that is the end of June 1978 - we expect the position to have deteriorated still further compared with the June figures of 1977.

What I am telling you is that despite high interest rates which one would think would force down the demand for money, we have a crisis in farm and stock and station industry liquidity of quite major proportions and it is essential steps be taken immediately to face up to this situation.

Reasons for this situation include:

* The higher level from which this years advances started - due largely to the impact of the high inflation of farm costs and in spite of last year's higher revenue returns. The compounded increase in farm costs from 1973-74 to 1976-77 was nearly 72% and a further increase of 15% is expected this year.
* The skim off of farmers' revenue into stabilisation and income equalisation accounts.
* The effects on our advances of the funding of livestock increase and development programmes.
* The heavy taxation payments made on behalf of clients in March 1977 - payments which many clients have not been able to repay.
* A noticeable lack of suitable outside term loan finance other than that provided by the Rural Bank.
* On top of the above we are now faced with an inadequate cash flow culminating from lower wool and lamb prices; later lamb kill because of industrial action and the effects of drought in many areas.

These then are some of the background factors to the liquidity crisis.

SOME SHORT TERM REMEDIES

This final topic is the one which you are probably most interested in. *What is the remedy?* Let me say straight away, there is no easy solution, but the critical one for the average farmer is to watch his expenditure pattern with a critical eye.

To alleviate the interest burden on farmers, it is essential that a way is found to restructure farmers' debt on a term basis and at reasonable interest rates, to enable the seasonal financier to perform during the coming season.

The stock and station industry estimates that its non-seasonal advances at 30 June, 1978 - even after receipt by farmers of Rural Bank finance - will be at least $50 million. Yet there are many sound accounts which for a variety of reasons do not qualify under the current guidelines for Rural Bank refinance. These and others should have their debt restructured on a long-term basis to reduce their excessive on-call borrowings.

Secondly, the crisis can be alleviated by providing a source of long-term mortgage funds, which can be secured on second or subsequent mortgage, for farmers who are financially sound and able to service term borrowing at commercial or near commercial rates of interest. Prudent restructuring of these farmers' indebtedness will reduce the danger of production and development schemes foundering through a lack of working capital. Furthermore, the refinancing of existing accounts will release essential funds for future seasonal finance needs.

Thirdly, it is in the national interest to ensure that an adequate supply of seasonal finance is available at all times. To facilitate this, institutional lenders, trustee companies and life assurance companies must be encouraged to resume an active role in rural lending, possibly by being given tax benefits on interest received or by active participation in some form of rural bond.

Fourthly, it seems illogicial that the Rural Bank should be restructured as part of the Housing Corporation. Furthermore, whil[e] it is vital that the Rural Bank should continue its present role of providing funds for initial farm purchase, development and debt restructuring, the stock and station industry believes it is now time for the Bank to develop a commercial arm, a joint venture between government and private finance organisations, but administered by the Rural Bank.

The stock and station industry envisages member companies, banks and insurance companies taking up equity capital. Other organisations and individuals would participate through the sale of Rural Bonds which could be sold as a competitive investment security on the market. Farmers themselves could be involved through investment of some funds from the various farm stabilisation accounts, and private investors would be encouraged to deposit funds with the Rural Bank by receiving tax concessions on interest.

I can tell you that the idea of a commercial division being added to the Rural Bank has been discussed in some depth already by the stock and station industry which has taken the initiative. Our industry is at present sounding out government reaction, that of the various finance institutions, farmer representatives and so on.

Farmers and, indeed, the whole nation should understand that the capital required to finance the expansion of farm output already approved is not available. This is because of the reduced cash flow farmers can expect this season and next, and because the stock companies have reached the limit of their ability to provide working capital and development finance.

The stock and station industry believes its concept of a new rural lender, under the wing of the Rural Bank, would provide a short term solution to the problem of ensuring that farming receives adequate access to finance, particularly seasonal finance.

The long-term problem, that of profitability, must be studied and solutions found, for without answers the future strength of the whole economy is in jeopardy.

The establishment of a commercial division by the Rural Bank needs to be implemented quickly. Concurrently a special task force should be set up to study the problem of farm profitability.

QUALITY CONTROL IN MILK PRODUCTION

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INTRODUCTION

Quality control is a technique used in the management of many enterprises. In milk production the quality of the ex-farm product is determined by a battery of tests at the factory. The management decisions and actions that must be taken to correct any shortfall in quality are within the area of milking management.

It has been estimated that on a dairy farm 83-94% of income earned is from sales of milk (Hutton, 1977). Penalties for inferior quality can therefore have considerable effects on profitability. The financial returns generated by the milking process become a measure of dairy farm efficiency, are used to determine profitability of changes in whole farm management; and yet is also an area that is capital, labour and energy intensive.

This paper considers

- * Milking process and areas where milk contamination can occur.
- * The tests that are conducted on milk and the management information they can yield.

* Methods of minimising contamination of milk that are feasible with labour and capital restrictions being experienced within the farming community.

MILK

Milk is widely recognised and promoted as a desirable human food in either its liquid or processed form. Standards for human food are becoming increasingly more stringent. Milk has the potential to serve as an excellent carrier for disease organisms and has been associated with some major epidemics in the past. This has been significantly reduced in recent years and the lead set by institutions such as Lincoln has demonstrated the effectiveness of control programmes for TB and Brucellosis. Milk is still probably one of the most regulated and inspected food products available to the public. The legislation defining milk and conditions of its production, manufacture and sale are comprehensive.

Milk drawn from the healthy udder by aseptic puncture or surgically implanted catheters can be demonstrated to be sterile but under practical milking management conditions this cannot be achieved. Milk is the only food commodity produced in a public lavatory and this, along with other practical considerations ensures that quality control in the milk harvesting process does not demand sterility.

BACTERIAL CONTAMINATION OF MILK

Udder and Teats

In the removal of milk from the udder of a healthy cow the first contamination with bacteria occurs as the milk passes through the teat canal. This canal is a primary defence structure aimed at preventing udder infection. During milking the flushing effect of the milk passing through this orifice can remove bacteria that have become lodged in the canal.

Teat and udder skin are known to be colonised with large numbers of bacteria. The pulsating liner can remove some of these bacteria during the milking process as the teat surface is washed with milk. Udder preparation methods using water for washing does very little to eliminate contamination from this source. A short wash with soap and water may merely soften the soil enabling it to move more readily into the milking machine. Washing is not effective unless carefully carried out and for maximum effectiveness a sanitiser is required (Cousins, 1972). Justifying washing on the basis of stimulation is no longer an issue and removing gross contamination only should be the objective of washing. Milkers hands become contaminated during the milking process but there are limited opportunities to directly infect the milk. One important avenue of contamination could well be the spreading of bacteria, particularly those associated with mastitis, from the teat skin of cow to cow.

Milking Process Hygiene

Poor control of hygiene during the milking process can also add to the contamination. Factors such as allowing cups to touch the ground, failure to wash clusters after they have fallen off and touching milk contact surfaces can all add to contamination of the milk produced.

Milking Machines

The milking machine itself is the most important contributor to unsatisfactory milk hygiene. The machine represents an ideal environment and can support large bacterial populations. Any insufficiency in the cleaning programme can quickly cause quality problems. The hygiene of both machine and vat are of paramount importance in maintaining optimum milk quality. (Twomey, 1969.)

Milk Storage Facilities

The importance of milk storage lies in maintaining quality;

not substituting for quality. The larger the contamination load in the milk the quicker that deterioration in milk quality will occur.

TESTS FOR BACTERIA

The most accurate way of testing for bacteria in milk is to count them. This is possible with modern techniques and part of the work of the National Dairy Laboratory has been to reduce the labour input into these direct counting methods and make them easier to conduct. This laboratory labour input has been one major limitation to the widespread adoption of direct counting methods.

Since the 1930's an indirect test for bacterial numbers has been used to grade milk, the methylene blue reductase test (MBRT). This test involves mixing a sample of milk with a dye - methylene blue, holding it at 30^{o}C for a number of hours and seeing whether or not in a predetermined period, the dye had been decolourised. Really the MBRT estimates two things - both bacterial numbers and their activity. Activity is difficult to define, but the difference between 15 people in the library reading room and the first XV is immediately obvious. So it is for the MBRT. Since the 1930's our more efficient cleaning systems and farm refrigeration have resulted in selecting different bacterial types. These bacteria have less activity against the methylene blue. Effectively this means that finest grade could be masking a serious quality problem. The MBRT test gives no information for quality control; if you are failing it is for a serious reason and the answer is no longer quality control but crisis management.

At the current time, the MBRT grades more than 95% of samples finest whereas the true situation should be around an 80% pass rate as determined by actual bacterial counts.

The other reductase test that is sometimes used, the nitrate reductase test (NRT) has many of the limitations of the MBRT. Its use lies in its selective activity, it measures another attribute of the bacteria and more specifically those that pass through the wide net cast by the MBRT. But again, failure on the NRT requires crisis management and a special effort to prevent constant downgrading. The reductase tests provide a definitive answer and no additional information that can be used in quality control.

The tests that determine the number of bacteria within the milk are more use in quality control. These are the standard plate count - a determination of total bacteria, or the thermoduric plate count - a selective count of only certain bacterial types. In the future another technique known as the plate loop count will be heard of more; this is the method developed at the National Dairy Laboratory. As automation decreases the labour input into these methods it is likely they will become more common.

Grading standards set by the Dairy Division for the standard plate count are :

Finest	less than 200,000 bacteria/ml
First	200,000 - 1 million bacteria/ml
Second	more than 1 million bacteria/ml

These results can be used to monitor progress of the management practices used at milking, be they cow preparation or milking machine cleaning. Valid information is provided for management decisions.

THE UNHEALTHY COW

The most common disease condition affecting the udder is mastitis. Commonly recognised by farmers as flakes or clots in the milk or changes in the secretion to a straw coloured watery consistency, is one form of mastitis, *clinical mastitis*.

Even to the untrained eye it is immediately obvious that the quality of the milk is markedly altered.

Mastitis is the result of a bacterial infection of the lactating gland. The invasion and multiplication of bacteria has caused these gross alterations to the secreting tissue and milk composition. *For every case of clinical mastitis that is seen there are between 15 - 40 cases of subclinical mastitis.* Changes have occured in the milk and even though they are not visible, milk quality is reduced and bacteria are present.

One of the changes is the number of white blood cells in the infected milk. These are present as the result of an infection and are a useful and commonly used infection indicator. As cell count rises yield of the infected quarter decreases; serum nitrogen and salt content rise while lactose and potassium fall. This is demonstrated in figure 1.

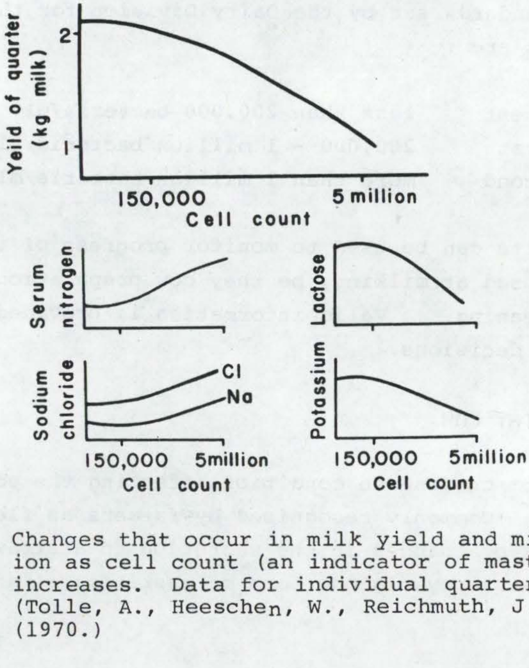

FIGURE 1. Changes that occur in milk yield and milk composition as cell count (an indicator of mastitis) increases. Data for individual quarter samples (Tolle, A., Heeschen, W., Reichmuth, J. & Zeidler, H. (1970.)

These changes overall tend to decrease total solids and have been demonstrated to be associated with undesirable flavours and consumer rejection of processed milk. (Elliot and Emmonds, 1973.) White blood cells are not detected in any bacterial test for milk quality. Their effect is to reduce bacterial numbers by phagocytosis so milk with large numbers of white blood cells will probably grade better than milk without. This is not a desirable effect; the problems associated with their presence far outweight this dubious advantage.

The milk from an infected quarter contains bacteria and numbers can fluctuate greatly; in the range of 0-100,000 bacteria per millilitre. This infected milk is mixed with milk from uninfected quarters and their contribution to total bacterial content is small. Mastitis is incorrectly blamed for many instances of milk grading. The bacteria that cause mastitis are a small proportion of the total population; they are poor reducers of methylene blue and in fact for many of them there is total inability to reduce methylene blue even slowly. (Nilsson and Sundberg, 1964.)

A major quality problem associated with mastitis is antibiotics in milk. Good milking management techniques will prevent this becoming a problem.

TESTS FOR MASTITIS

The only specific test for mastitis that is conducted, apart from antibiotic residues which are a result of mastitis, is the bulk milk somatic cell count. This is a count of the white blood cells in a sample of the milk in the vat. White blood cells are elevated when a cow has mastitis; if the white blood cell count of the bulk milk is high then many cows in that herd are suffering from mastitis.

Generally, the following guide to herd mastitis levels can be made.

TABLE 1.

Cell Count	*Herd Mastitis Levels*
Less than 250,000 cells/ml	Satisfactory
250,000 - 500,000 cells/ml	Moderate
500,000 - 750,000 cells/ml	High
More than 750,000 cells/ml	Severe

Experience over several years has determined that figures less than 500,000 cells per millilitre are readily attainable and levels less than 250,000 cells per millilitre are attainable with a little more effort. By considering the trends in these figures over time the mastitis situation will effectively be monitored.

QUALITY CONTROL IN MILKING MANAGEMENT

Milking management involves allocating available resources to tasks in a defined order of priority. If the farming objective is to gain maximum returns, milking management must be vitally concerned with two areas; returns and costs.

Emptying the Udder

The area of primary importance is in emptying the udder. This may seem obvious but the efficiency of milk removal determines the total lactational yield. This has been demonstrated in calving management (Copeman, 1975), and also in general milking management (Brandsma, 1978). This has a definite requirement for an effective milking machine which will provide stimulus to the udder and milk without causing any damage. The effectiveness of emptying the udder quickly and efficiently has a marked bearing on total returns.

Milking Machine and Storage Vat

To maximise returns from milk produced it must be sold for the highest price. This means the best quality.

Quality problems associated with bacteria arise mainly within the milking machine and storage vat. A cleaning system must be devised for these that is both cost conscious and effective. Cleaning of any type involves energy; be it chemical, mechanical or thermal energy. Within your plant with its own limitations the cheapest mix of these energy sources should be applied to keep the machine clean enough to produce finest grade milk.

Teat Skin

Other sources of bacteria are of less importance. Teat skin can provide many bacteria but this can be controlled by post milking teat spraying for mastitis control (figure 2).

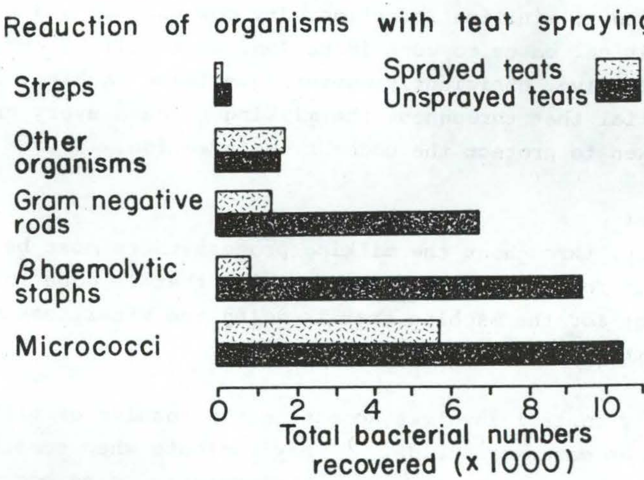

FIGURE 2. Reduction of bacterial populations on teat skin as a result of teat spraying with a sanitiser. Results taken prior to subsequent milking.

When this technique is used it is probably necessary to remove gross contamination from teats before putting the cups on. Teat spray formulations do have the side effect of making udders easier to clean so less stringent teat preparation methods are in order. A token wash with soap and water is no good; to be effective washing must be thorough and accept the disadvantage of carrying contamination from cow to cow during preparation.

Mastitis

Mastitis is an udder specific disease of dairy cattle. Clinical mastitis demands treatment and when a cow is being treated there is a remote risk of antibiotic residues reaching bulk milk. Mastitis decreases production, reduces profitability and causes undesirable changes in milk quality. Bulk milk somatic cell counts give a measure of mastitis incidence in the herd. Control of the disease is achieved through teat spraying to minimise infection, dry cow therapy and treatment of clinical cases to cure infection, some culling and having an effective, efficiently operating milking machine. It is essential that throughout the milking process every precaution is taken to protect the udder from infection.

Respect

Finally, throughout the milking process there must be respect. Respect for the cow and in everything that is done for her and respect for the machine that is doing the vital task of milk harvesting.

Quality control involves accepting the results of milk grading tests as management aids. They indicate when something in the system is not adequate, never the esoteric, mind boggling factor, but something simple in the chain that is creating the problem. Care must be taken to empty, protect and respect the udder and this will maximise profitability and reduce costs.

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THE USE OF CONCENTRATES ON THE DAIRY FARM

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CHARACTERISTICS OF CONCENTRATES

Concentrates are high priced feeds based mainly on cereal grains and are high in starch, low in fibre, have a high content, or should have a high content, of available energy. They contain variable amounts of protein depending on their source.

The water content of the various feeds available for feeding cattle vary widely and as water has no feed value, the amount of dry matter supplied by the feed is of major importance. The dry matter concentrations of various feeds are given in table 1. The extent to which this dry matter is available to the animal also varies widely between feeds and the amount of available energy in the dry matter of feeds is a major limiting factor towards attaining high levels of animal production. When a feed is eaten, varying amounts of energy are lost in the faeces, urine and gases from the rumen, depending upon the feed. The energy that is left and absorbed, is available to the animal and is known as the metabolizable energy of the food. Values for metabolizable energy or available energy are given in table 1. These available energy values are expressed also as the amount of available energy in the dry matter of individual feeds,

TABLE 1. FEED VALUES OF SOME COMMON FEEDSTUFFS

FEED	DRY MATTER CONCENTRATION %	AVAILABLE ENERGY (MJ ME/KG DM) 1	ME VALUE LEAFY PASTURE ÷ ME VALUE OF FEED (KG DM) 2	CRUDE PROTEIN (%)
Leafy Spring Pasture	14-17	12	1	22-26
Pasture Silage	15-25	8-10	1.5-1.2	12-20
Pasture Hay	85-88	7.5-9.5	1.6-1.3	10-18
Maize	85-88	14	.86	10-11.5
Barley	85-88	13	.92	11-14
Oats	85-88	11.5	1.1	12-13
Peas	85-88	13.0	.92	25-30
Bran	85-88	9.9	1.2	17-18

1. Megajoules of metabolizable energy per kilogram of dry matter.
2. In terms of energy finally available for production, after processing in the body, less would be available for feeds such as hay and silage than for leafy pasture or concentrates.

relative to the available energy in one kilogram of dry matter from leafy spring pasture. For example table 1 shows that 0.92 kilogram of barley grain dry matter contains the same amount of available energy as one kilogram of leafy pasture dry matter, whereas 1.5 kilograms of poor hay contains the same amount of available energy as the one kilogram of pasture dry matter. An important point to note is that most of the concentrates have available energy values little different from that of leafy pasture. In terms of feed value, keeping in mind the fact that energy is the major limiting factor in animal production, leafy pasture is not deficient nor do concentrates possess superior magical powers.

COSTS OF ENERGY

With a knowledge of the dry matter concentration, the amount of

TABLE 2. A COMPARISON OF THE COSTS OF CONCENTRATES AND HAY

		Concentrates	*Hay*
Price/tonne	=	\$150	-
Price/bale	=	-	\$2
Dry Matter in 1 tonne (85% of 1000kg)	=	850kg	-
Dry Matter in 1 bale (85% of 22kg)	=	-	19 kg
Cost/kg of Dry Matter	=	$\frac{\$150}{850}$	$\frac{\$2}{19}$
	=	17.6c	10.5c
Available Energy Value/kg DM	=	12 units	8.5 units
Cost per available unit	=	$\frac{17.6}{12}$	$\frac{10.5}{8.5}$
		12	
	=	1.47c	1.24c

available energy and the price we have to pay for these various feeds we can then compare their costs in terms of units of available energy.

An example for illustrative purposes, as the price you pay for your concentrates or hay may be different, is given in table 2. Hay produced on the farm is considerably cheaper than the example given but here we are considering the use of bought in feeds and it is well known that when feed is short, so the price of hay goes up. In the example given there is a small difference in price in favour of the hay but it must be remembered that hay will not support milk production to the extent that concentrates will. Where the price differential is greater, in favour of hay, then it forms a more attractive alternative to the use of concentrates, despite its lower food value.

Crude protein values for the various feeds are also included in table 1. Leafy pasture is high in crude protein and supplies a surplus of protein to the animal, and as concentrates are used as a supplement to pasture, the lower levels of crude protein in the cereal grains do not create a nutritional problem. The only exception to this might be in a dry summer, where dry stalky pasture can also be low in crude protein.

THE EFFECT OF CONCENTRATE FEEDING ON MILK PRODUCTION

If 100% of the energy of a concentrate, high in available energy, were used for milk production, then 0.5 kilograms of the concentrate should give one litre of milk with a milk fat content of 4%. For a variety of reasons it is not possible to obtain this level of response in practice.

Concentrate Supplementation

With the lactating cow, feed is partitioned between the requirements for maintenance, milk production and liveweight gain. The extent to which extra feed is diverted to milk production will determine the response to the extra feed. This is affected by the previous level of feeding of the cows as well as the current level of feeding and the genetic capability of the animal to produce milk. The current level of feeding, particularly the availability of pasture, is a major factor affecting the response to concentrate supplementation. The greater the amount of pasture available to the animal, the less is the response to the feeding of supplements such as concentrates. This is because the concentrate substitutes for the pasture. In a trial carried out at Massey (Taparia and Davey, 1970) cows were given ample pasture only in a control group and ample pasture plus 2.7 or 4.0 kilograms of concentrate per cow per day to the treatment groups. Supplementation with the concentrates decreased the intake of pasture dry matter by 0.63 and 0.66 kilograms per kilogram of concentrate dry matter fed at the lower and higher level respectively. This level of substitution has been observed in other experiments also and while there is a pasture sparing effect resulting from the concentrate feeding, it does mean that substitution will effect the response to the added concentrate. Where the concentrate being fed has a lower energy value than the pasture it is substituting, then the increased in energy intake may be minimal so that the response in terms of increased milk production could be negligible.

Wallace (1957) fed 2.7 kilograms of concentrate per cow per day to cows receiving a restricted amount of pasture over a period of eight weeks in early lactation. In another trial conducted a year later, the concentrates were fed along with an ample supply of pasture. In the first year the response was approximately 0.8 kilogram concentrate for an increase of one litre of milk, whereas in the following year the response was 2.7 kilograms for the production of one litre of milk.

In many experiments carried out at Massey University where concentrates have supplemented pasture for autumn and spring calved cows in early as well as mid-lactation, the responses have varied from 1.3 kilograms of concentrate up to six kilograms of concentrate for the production of one litre of milk. The response of 1.3 kilograms concentrate to one litre of milk (McIntosh 1970) is the best we have achieved and was obtained in mid lactation, in a drought when pasture was in exceedingly short supply. The greatest responses to concentrate feeding in these trials and at Ruakura (Hutton, 1967) have all been obtained when pasture availability was low.

Likely Response to Supplement Feeding

An appreciation of the likely responses to concentrate feeding is essential in determining whether or not concentrate supplementation is likely to pay. Table 3 summarises the costs of producing one litre of milk assuming a range of responses and costs of concentrate.

TABLE 3. COST IN CENTS OF PRODUCING 1 LITRE OF MILK WITH VARYING RESPONSES AND COSTS OF CONCENTRATES

Price of Concentrate (c/kg)	*Response (kg of concentrate/litre of milk)*		
	1	*1.5*	*2*
10	10	15	20
12	12	18	24
14	14	21	28
16	16	24	32

A response of one kilogram of concentrate per litre of milk is an extremely good one and is only likely to occur where pasture is in very short supply (e.g. Wallace, 1957). Most experiments in fact show that the immediate returns from an increase in milk production from feeding concentrates do not cover the cost of the concentrates. Even with returns of milk of 14c. per litre, the break-even point only occurs at the unusually good response level of one kilogram of concentrate per litre of milk at a price of 14c per kilogram of concentrate. With a response of 1.5 kilograms of concentrate per litre of milk, it would cost 21c. to produce one litre of milk with concentrates at 14c. per kilogram.

Economic Benefits and the Carryover Effect

The key factor in determining the economic benefits of concentrate feeding lies in whether or not residual or carryover effects on milk production occur beyond the period of concentrate feeding. Thus Wallace (1957), in the experiments referred to earlier, observed a substantial carryover effect in milk production after concentrate feeding had ceased. The results of his first experiment, where pasture was in short supply during the period of concentrate feeding, are summarised in table 4.

TABLE 4. IMMEDIATE AND LONG TERM EFFECTS OF FEEDING CONCENTRATES

Wallace (1957)

Group 1 - 2.7 kg concentrates/day for 8 weeks + limited pasture

Group 2 - Limited pasture only for 8 weeks followed by ample pasture for both groups

Difference between groups (litres of milk)
Group 1 minus Group 2

Difference per day		=	3.2 litres
i.e.	2.7kg concentrate	$\longrightarrow$	3.2
	0.8kg concentrate	$\longrightarrow$	1
Difference 8 weeks		=	180
Difference whole lactation		=	670

i.e. Total effect approx. 3.5 x short term effect.
Response over whole lactation approx. -

	0.25kg concentrate	$\longrightarrow$	1
	Cost of concentrate	=	16c/kg
i.e.	4c spent to gain 1 litre of milk		

The results are presented as differences in milk production between the control and the concentrate fed group over the eight weeks of concentrate feeding, as well as over the whole lactation. The total carryover effect was approximately 3.5 times the increase observed over the period of concentrate feeding. Thus a response of 1.5 kilograms of concentrate per litre of milk in the short term becomes something like 0.5 kilograms of concentrate per litre of milk over the whole lactation. The break even point at this response, with meal at 14c. per kilogram, would occur with a milk price of 7c. per litre.

The question now to be asked is, how certain can we be that the carryover effect will be three to four times greater than the immediate effect or that a carryover effect may even exist at all? The existence of carryover effects have been well demonstrated in Broster's work in England (Broster, 1972) and also in experiments carried out at the Dairy Research Institute in Palmerston North (Flux and Patchell, 1954). However, there is evidence that a carryover effect cannot always be guaranteed, certainly not of a magnitude three to four times the immediate effect. In an experiment at Massey University, which formed the basis of an honours project conducted in Autumn 1977 by J. Bluett, a much smaller carryover effect was noted where autumn calved Friesian cows had been subjected to a high and low level of feeding. The high group received mature pasture supplemented with hay and silage. The high group produced approximately 140 litres more milk than the low group over the six weeks during which the two groups were fed differently. The two groups of cows were run together at the end of the six weeks experimental period. Milk production continued to decline in both groups over the winter. Only in the first herd test, two weeks after the groups had been brought together was there any substantial difference in milk production in favour of the high group. A shortage of pasture and heavy reliance on hay and silage feeding over the winter may have been responsible for this lack of a carryover effect, although this explanation is speculative. Many experiments, quoted by Gordon (1977), carried out in Ireland have also shown only small or non-existent carryover effects resulting from differing levels of feeding in early lactation.

To summarise, the presence or absence of these carryover effects and the extent of them, are of major importance in the consideration of the economic benefit of feeding concentrates. The evidence shows that these carryover effects cannot always be guaranteed.

FURTHER POINTS ON CONCENTRATE FEEDING

For the town supplier, the economic benefits have to be weighed against the consequences of failing to meet quota production both in the short term loss of income and in the long term, the likelihood of losing quota. Concentrates may also be used as a means of increasing quota in the future. To be considered also, is the variation in the price received for quota milk and the extent of the surplus involved at different times of the year and how concentrates can be used to gain maximum benefit resulting from these factors peculiar to the town milk industry.

Given these circumstances and that the unforeseen effects of climate have resulted in a shortage of pasture, then the use of concentrates in this context is an emergency measure, introduced to minimise losses. If this is a recurring situation thought should be given in the future towards increasing pasture productivity, using pasture to better advantage to avoid waste, and using cheaper alternative feed sources. One advantage of concentrates is the flexibility with which they can be used to fulfil the role of plugging a gap in feed supplies. They are immediately available, although a waiting period may be necessary, to allow the cow to reach full consumption of the concentrates offered. Other alternatives such as the use of fertiliser nitrogen requires a longer waiting period before benefits can be obtained.

If it has been decided to feed concentrates to fill a gap in feed supplies, then the decision must be made early before milk production has fallen substantially. The concentrates must be fed at reasonably heavy levels to be worthwhile and they must be fed for sufficient time to effectively bridge the gap in feed supplies.

The use of concentrates should be thought of as an adjunct to pasture, hay and silage and all efforts should be made towards increasing pasture productivity and stocking with a sufficient number of cows to ensure high levels of utilization of the pasture grown.

Cattle should be introduced to concentrates gradually over a period of 2 weeks, and situations where individual cows have access to more than their ration, should be avoided. Digestive upsets can occur if these precautions are not taken, resulting in the cows' losing their appetite with a sudden drop in milking production as well as the possibility of diarrhoea occurring.

SUMMARY

* Compare the costs of concentrates with other feeds.
* Short term responses to concentrate feeding are unlikely to be profitable.
* If carryover effects occur, and if they are substantial feeding concentrates can be profitable.
* There is no guarantee that carryover effects will always be substantial and will always occur.
* Consider alternatives to concentrates.

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REARING OF REPLACEMENT STOCK ON SOUTH ISLAND DAIRY FARMS

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During periods of poor profitability it is very easy, unintentionally, to neglect the rearing of young stock. Feed normally allocated for the rearing of calves may instead be used by the milkingherd in an attempt to increase returns. It is very difficult to quantify the effects of poor rearing of replacements. However, poor rearing may actually result in higher rearing costs because of delayed puberty, poor yields in the first lactation, remating problems and small mature size.

There are four basic principles in rearing young stock:

* Reach target weights at weaning
* Achieve puberty before 15 months
* Feed well prior to calving
* Keep deaths to a minimum

Minimum weights acceptable in terms of New Zealand standards for young stock (Bryant 1977) are outlined in table 1.

The average growth rates required to achieve these targets are approximately 0.5 kilograms per day. These are one third to half of the potential rates of gain, and therefore can be readily achieved.

TABLE 1. MINIMUM WEIGHTS FOR YOUNG STOCK (kilograms)

	Age Months	Jersey	Friesian
Weaning	2	50	70
Mating	15	200	280
Calving	24	320	410

TARGET WEIGHTS AT WEANING

Many methods of rearing calves are practiced, all with the aim of obtaining desired growth rates at minimum cost. Thus it is desireable for the calf to obtain its requirements from grass as quickly as possible.

At birth the calf, like the adult ruminant, has a stomach of four compartments, although the rumen in the young calf is largely non functional. While the calf is still suckling, liquid passes directly to the fourth stomach or abomasum via the Oesophageal groove. The age at which transition to the ruminant method of digestion occurs is largely dependent on the diet that a calf receives. (Preston 1963). When solid feeds are eaten these enter the rumen and microbial digestion begins. The end products of this digestion further stimulate rumen development (Khouri 1966, Stewart 1962). To enable this process to take place rapidly liquid feeding should be restricted and solid food intake encouraged at an early stage. Provided the calf is offered solids from birth the rumen will be fully functional by eight weeks of age (Leibholz 1975).

To servive and grow well the calf must receive colostrum immediately after birth. Colostrum contains a high concentration of immunoglobulins from which the calf receives antibodies which protect it against infections to which the mother has been exposed (Hardy 1970). Evidence provided by Kruse (1970) indicates that the calf's ability to absorb immunoglobulins diminishes rapidly following birth whether it suckles or not. Therefore, for maximum disease protection, calves must receive colostrum as soon as possible after birth.

All systems of calf rearing demand that the calf is offered a liquid diet in the first three to five weeks of life.

Methods of providing this consist of:

* nurse cows
* hand rearing

NURSE COWS

Dairy cows provide far more milk than is needed by a single calf to grow at 0.5 kilograms per day so that multiple suckling, either continuous or twice daily feeding is feasible. The second system while more labour intensive appears to be more economical. Cows and calves can be penned together or the calves allowed to suckle the cows under the rails of a race. Flexibility is also greater in that calf numbers can be adjusted according to a cow's stage of lactation. Under commercial farming conditions Everitt and Evans (1970) found that 8% of artificially reared calves died during the rearing period, compared with only 1% of multiple suckled calves. The latter also show resistance to internal parasites and grow at faster rates (MLC 1975). Cows with chronic mastitis can make excellent nurse cows.

HAND REARING

This requires the use of milk from the vat or a reconstituted milk replacer.

The present prices of milk substitutes compared with whole milk are presented in table 2.

TABLE 2. COMPARISON OF MILK AND MILK SUBSTITUTES ON AN ENERGY BASIS*

	Energy Equivalent	Price (Cents)	Solutions Equivalent to whole milk
Whole Milk	1 l	7.0	-
Skim Milk Powder	185g	9.3	1 part milk:4.5 parts water
High Milk Fat Replacer	145	8.5	1:5.5
Meal	320	4.8	

* Fresian Milk 2.85 MJ ME/kg

On present day prices whole milk, provided that on town supply farms, it is surplus to quota, offers the cheapest means of rearing calves over the first three weeks.

Requirements based on the commonly accepted standard used of one kilogram of whole milk per 10 kilograms liveweight are misleading since they penalize the smaller calf while favouring the heavier ones (see table 3). A more realistic rationing system based on the actual requirement for gain is given in table 3.

TABLE 3. WHOLE MILK REQUIRED (KG/DAY) FOR MAINTENANCE PLUS LIVEWEIGHT GAIN FOR THE PRE-RUMINANT CALF*

Liveweight	Liveweight Gain (kg/day) 0.25	0.5	Whole at 10% of Liveweight
30	2.8	4.1	3.0
40	3.3	4.6	4.0
50	3.6	4.9	5.0
60	4.0	5.3	6.0

* Maintenance: 0.410 MJ ME/kg 0.75 per day.
Liveweight gain: 11.4 MJ ME/kg and 13.4 MJ ME/kg for liveweight gains of 0.25 kg and 0.5 kg respectively.

To encourage rumen development pelleted concentrate meal should be offered from the first week of life. It should be offered in small quantities and replaced regularly to prevent staleness and encourage high intakes at an early age. From four weeks of age diets of equal amounts of milk and concentrate on an available energy basis promote similar growth rates to simple milk diets (Hughes 1977) - table 4.

TABLE 4. THE REQUIREMENTS FOR FRESIAN CALVES ON MILK AND MEAL FOR VARYING BODYWEIGHTS AND LIVEWEIGHT GAINS*

Weight of Calf	Liveweight Gain kg/day 0.25		0.5	
	Milk	Meal	Milk	Meal
50	2.5	0.44	3.3	0.58
75	3.0	0.54	3.8	0.68

* Maintenance = .41 MJ ME/kg$^{0.75}$; Gross Energy Milk = 3.0 MJ/kg (Fresian milk); G.E. Pelleted Concentrate =.8MJ/kg metabolizability of the diet = .78, 50% of ME milk from the other 50% from meal.

Apart from its low cost the additional advantage of meal is that it promotes rumen development, thus ensuring subsequently, high intakes of pasture and small post weaning checks.

From time to time the cheapness of skim milk powders have made milk replacers appear attractive. There are certain factors in processing which may influence the quality of these products and suitability for calves. Those with additional fat appear to reduce the incidence of scours particularly in young calves (Radostits and Bell, 1970). High temperatures during processing also damage the whey proteins. This prevents curd formation in the abomasum (Davey 1974), and allows the proteins to pass rapidly from the abomasum without digestion thus providing bacteria in the hind gut with conditions for multiplication (Tagari and Roy 1969). The result is nutritional scours. Milk powder may be tested by warming in solution and adding rennet, the material used for making junket. If curds fail to appear the material is unsuitable for feeding to young calves.

ACHIEVE PUBERTY BEFORE 15 MONTHS

Calves must be weaned according to weight rather than age. Checks in growth rates do occur at weaning depending on the level of solids fed prior to weaning. The restriction of milk and the extra provision of concentrates before weaning enhance rumen development and minimise this check by ensuring high pasture intakes soon after weaning.

Puberty in cattle is related to liveweight rather than age. To maintain adequate rates of growth on grass to achieve puberty at an early age it is essential to encourage high intakes and avoid pastures heavily infested with parasitic worms. Herbage intake of calves appears to be more limited by the height of the herbage on offer than its density, with rotational grazing promoting greater intakes than set stocking (Hodgson 1977). Therefore, to promote high intakes erect growing, highly digestible pastures with a high proportion of leaf are preferable.

Older cattle develop a degree of resistance to infection with parasitic worms. Yearling cattle are not quite so resistant and are therefore a potential source of contaminate on the pasture. Calves grazing contaminated pasture are highly susceptible to infection, especially those hand reared. Poor early nutrition increases a calf's susceptibility to worm infection. Drenching at weaning and the use of uncontaminated pasture is the best method of control. This is achieved by avoiding pasture recently grazed by other young or yearling stock. In practice this is provided by rotational grazing ahead of the milking cows or set stocking over most of the farm with two to four calves in each paddock (MLC 1975).

Regular inspections of replacements are required to ensure that weight or condition is not allowed to deteriorate to the extent that targets at mating cannot be achieved. Meal supplements and preferential grazing of heifers in poor condition will ensure that they reach target weights at mating (Halford pers comm.) and therefore calve as two year olds, thus keeping rearing costs to a minimum.

FEED WELL PRIOR TO CALVING

Adequate preparation for lactation requires the provision of sufficient feed to meet the demands for growth of the heifer, the developing calf and provision of sufficient energy reserves as body fat for use in early lactation. The penalties of inadequate preparation appear during lactation. They include a reduction in feed intake, milk yield and milk fat content which may together amount to a 10-20% reduction in total production (McMeekan 1964). Cows in poor condition may also find it harder to get back in calf and compete with older cows in the herd. The body condition score to aim for is five, however heifers can be overfat before calving -

condition score six and above on a ten point scale. This results in increased incidence of calving difficulties, reduced food intakes due to high levels of abdominal fat, and reduced milk yields because of the high levels of fatty tissue in the udder.

KEEP DEATHS TO A MINIMUM

Most of the common calf disorders can be prevented or at least reduced in severity by careful management. Particular attention should be paid to adequate feeding beginning with colostrum, good hygiene and draught-free housing. Rearing of calves is a skilful operation requiring great patience. This may be why farmers wives and their children produce better results than the farmer or hired labour.

Exposure to the elements especially wind plus rain is detrimental to growth (Holmes and McLean 1975). Under these conditions the calf redirects energy from growth to compensate for the extra body heat losses. Because of their denser coats and higher tissue insulation Friesian calves are more tolerant to bad weather than Jerseys. An extensive survey of calf mortality revealed birth and rearing as the most critical period relating to calf survival (Everitt and Evans 1969). Calf losses from birth to first calving totalled 13% with the greatest single wastage 8%, occurring between birth and weaning in artificially reared calves. The principle causes of death during this period were starvation and nutritional disorders. Scour is one of the most common diseases and causes of ill thrift and death. Scouring results from a rapid multiplication of bacteria in the hind gut leading to the loss of a great deal of salt, water and undigested feed. The scouring calf should be isolated, its milk withheld and replaced by liberal amounts of water containing added salts. Drugs to control scours are available and consultation with a veterinarian on their use should be sought. Other causes of mortality during this rearing period are pneumonia and salmonellosis. Whenever a disorder appears serious, the animal should be isolated and veterinary advice sought.

Objectives mentioned can be achieved provided that prior to weaning the calves receive colostrum within six hours of birth and adequate milk or milk replacer subsequently. Good hygiene is essential and protection should be provided from inclement weather and other stress. From two weeks of age the calf should have access to high quality pasture with low levels of parasitic infestation.

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METABOLIC OR PRODUCTION DISEASES IN DAIRY CATTLE

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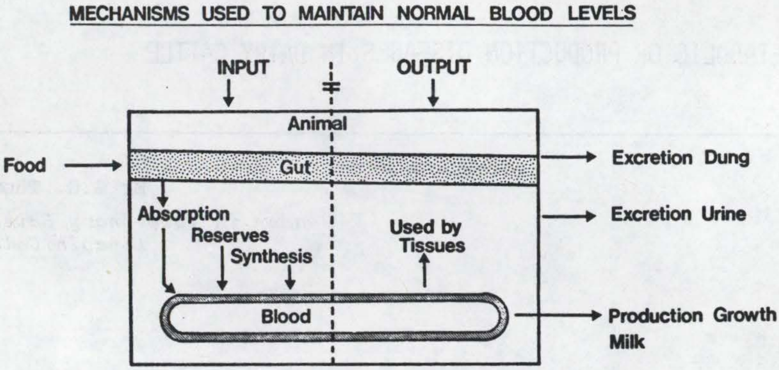
The diseases most likely to occur at calving time as a result of feed shortages are the metabolic or production diseases. They develop mainly as a result of differences between the "input" and the "output" of essential body metabolites. They may also occur as the result of biochemical and physiological changes taking place within the cows at that time. All of the production diseases are associated with the onset of lactation and they develop maninly because the food intake is unable to supply the raw materials needed by the mammary gland to produce milk.

The udder is really "parasitic" upon the cow and it frequently demands more from the cow than she is able to provide without damaging herself. The cow can only meet the demands of the udder if she can obtain and digest enough food or if she has a large enough reserve of raw material available which she can utilize. In order to prevent these particular conditions from developing it is essential that the cow maintains in her blood fixed levels of certain metabolites. To do this there must be a balance between the substances entering and those leaving the cow. The normal situation can be summarised by figure 1.

Figure 1



The blood levels of metabolites are basically maintained by the "input" contribution of the food eaten. The amount of food eaten at any one time depends upon the type and quality offered and the appetite of the animal. The appetite is influenced by the brain, the type of food and the health of the animal. About the time of calving the appetite is often less than normal due to stress and to the presence of hormones such as oestrogens. Should the food be deficient in a substance such as magnesium then low blood levels of it will occur. Low blood magnesium depresses the appetite still further. The situation then develops into a vicious circle until eventually the affected animal will not be eating enough to get the magnesium it needs. Once food is ingested it does not mean that all of an element in the food will reach the blood because the lining of the intestines does not absorb all of an element present. For example the gut cells normally absorb only about 20% of magnesium and about 50% of calcium found in the food. Sometimes these low absorption rates can be further depressed by such factors as variations in the pH of the gut and the level of other substances in the food. For example high levels of nitrogen, potassium and calcium all depress magnesium absorption. Two other factors can also affect blood levels of metabolites. These are the stores or the reserves of the metabolite which the animal possesses and the physiological ability of the animal to either mobilise such reserves or to manufacture the metabolite from other substances.

The "output" of metabolites from the cow involves excretion into the dung and urine, the amount used by the animal for its tissues and the quantity required for the production of milk.

The conditions to be discussed relate to reduced blood levels of magnesium, calcium and glucose. While all three can be present in low concentrations at any one time, each one will be dealt with as separate entity.

MAGNESIUM

Magnesium is essential for the formation of an enzyme required for the transportation of glucose into the brain cells which depend upon glucose to provide their energy source. If glucose is not present the brain will act abnormally.

Figure 2

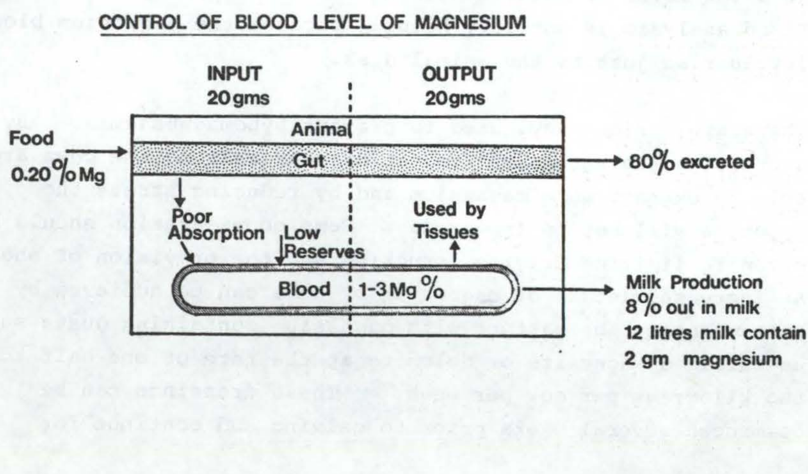


Figure 2 illustrates the factors involved in the maintenance of normal blood magnesium levels. Normally the levels of magnesium in the food is less than 0.3% of the dry matter. Grasses contain very much less magnesium than do clovers. To get enough magnesium the cow has to ingest large amounts of pasture after she calves and if she does not then her intake of magnesium will fall.

Unfortunately in the later winter and early spring the pasture levels of magnesium are at their lowest being less than 0.18% of the dry matter. If these amounts were normally absorbed it is doubtful if they would supply the needs of the cow. The situation is further complicated by the fact that young spring grasses often contain high levels of nitrogen potassium and fatty acids all of which interfere with the absorption of magnesium by the gut. Cows have virtually no reserves of magnesium so if the "output" of magnesium into the milk exceeds that which is absorbed from the intestines hypomagnesaemia may develop quite quickly.

The symptoms of hypomagnesaemia appear to be due to the upset in brain activity and are seen as irritability, aggression, struggling and sudden death. There are very few post mortem changes and often the only confirmation of the cause of death is a low level of magnesium found in the cerebrospinal fluid. Blood analysis is not very helpful because the magnesium blood levels rise just as the animal dies.

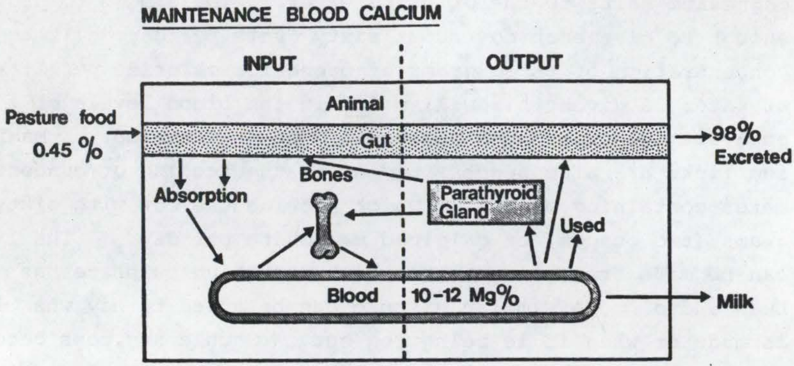
There are various ways used to prevent hypomagnesaemia. By increasing the amount of food at or near calving the cows are able to extract more magnesium and by reducing stress the appetite will not be impaired. Some consideration should be given to limiting driving, trucking and the provision of shelter. An increased intake of magnesium by cows can be achieved by contaminating the pasture with magnesium containing dusts such as calcined magnesite or dolomite at the rate of one half to two kilograms per cow per week. These dressings can be commenced several weeks prior to calving and continue for several weeks after calving. Some research work indicates that in addition to preventing hypomagnesaemia this also increases milk production. Another method is to add magnesium salts to the drinking water. The aim is to provide enough to give each cow about sixty grams per day. If a concentration of three grams of magnesium chloride per litre of water is given this will maintain the blood levels of magnesium so that hypomagnesaemia does not develop. Magnesium licks are also successful, as is the feeding of concentrates containing magnesium which provide the cow with sixty grams (two ounces) of calcined magnesite per day. The licks can be made from molasses to which magnesium sulphate has been added. A similar mixture can be added to hay when it is made or when it is being fed out. Should any cows become affected they should be quickly injected with solutions containing both calcium and magnesium. In order to prevent a recurrence after treatment magnesium should continue to be available either as drench, licks or is fed in concentrates.

CALCIUM

Calcium is essential for the correct functioning of the cell membranes of muscles and nerves and it is also needed for the blood clotting process. Without it nerve and muscle cells fail to either conduct or contract.

Figure 3 summarises the maintenance of blood calcium levels. Here again pasture contains less than 0.45% of calcium and it is also lowest in the spring. After food is ingested only about 50% of the calcium in the food is actually absorbed, but this can be increased by vitamin D and the parathyroid hormone produced by the cow. Unfortunately calcium blood levels can be reduced by low feed intakes, by oestrogens circulating in cows around calving and by stress factors.

Figure 3



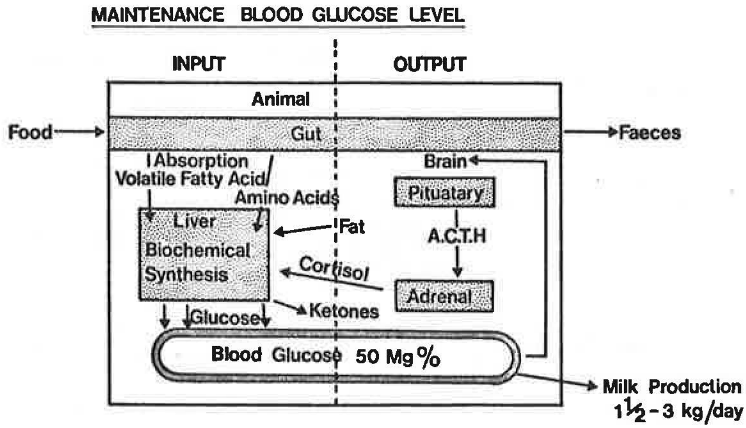
Normally blood calcium levels are kept steady at about 10 milligrams per 100 millilitres of blood by a regulating mechanism involving the parathyroid gland. Should the calcium level of the blood fall this gland releases its hormone and this stimulates a release of calcium from the bones until the levels are brought back to normal. At calving the udder springs into action producing colostrum milk and this draws off large quantities of calcium from the blood. Two litres of colostrum contains almost as much calcium as is normally present in the whole of the blood. All cows suffer a drop in blood calcium to about 5mg% at calving. Experimental cows whose udders have been surgically removed do not experience this fall in blood calcium so this indicates the part played by the udder in the pathogenesis of hypocalcaemia. Fortunately only a few cows react badly to this fall and show signs of the disease. The parathyroid glands in some cows do not quickly respond and are slow to raise the blood calcium level. If affected cows are given calcium salts solutions to tide them over this period they will recover and the normal mechanisms will eventually take over and they will remain normal. Those cows which become affected by the low calcium levels show abnormal nerve and muscle function and so collapse to the ground and if they are not treated they will die. The methods used to prevent hypocalcaemia are not all specific. In America it has been demonstrated that if low calcium diets are fed to cows prior to calving this stimulates the parathyroid glands to be very much more active and less cows become affected. While it is possible to feed low calcium diets using grain based feeds it is not so easy where pasture or pasture based feeds are fed. It would no doubt be helpful to reduce the feeding of lucerne hay which contains high levels of calcium just prior to parturition. Another suggestion is to milk the cows sometime before calving and by so doing this stimulates the parathyroid glands to increased activity at calving time. By doing this there will be a loss of colostrum for the calf. Other suggestions involve not over milking cows too soon after calving, the injection of older cows with vitamin D which increases the absorbtion of calcium and an increase in the phosphorus intake also increases the absorbtion of calcium from the gut. A reduction in stress is also said to be helpful.

CARBOHYDRATE METABOLISM

A fall in the level of blood glucose is also likely to occur at calving and during lactation. Figure 4 briefly describes the methods used to maintain blood glucose levels. In cattle very little glucose reaches the blood direct from the food. The carbohydrates in the food have first to be degraded by the rumen bacteria into volatile fatty acids such as acetic, propionic and butyric acids. A lot of the acetate is used by the udder to produce milk and the propionic and butyric undergo biochemical changes to glucose.

The blood glucose level is kept at about 50 milligrams per 100 millilitres of blood and is used to produce heat and energy for most of the tissues. Glucose is also stored in the liver

Figure 4



Glucose is also stored in the liver as glycogen and can be used from time to time as a source of glucose. Blood glucose levels are kept steady by the absorbtion of the volatile fatty acids and by a mechanism involving the brain, pituitary gland and the adrenal glands. When the blood glucose level falls this is noted by the brain which stimulates the pituitary gland to release the hormone A.C.T.H. (adrenocorticotrophic hormones) which then stimulates the adrenal glands to release cortisol. Cortisol stimulates the changing of fats and amino acids into glucose. This mechanism comes into action when the udder is producing lots of milk because the udder requires three or four kilograms of glucose daily. It is this mechanism which causes the tremendous loss of body condition which is often seen in cows early in lactation. When the absorbtion and the regulating mechanisms fail to supply glucose as fast as the udder uses it then hypoglycaemia or acetonaemia develops. This usually happens during the first four weeks of lactation, the blood glucose level drops and not enough glucose reaches the tissues and the brain and so the affected animal may become very dull or may become excited and lose condition. Ketones appear in the blood, breath and urine as a result of the animal trying to use its fat as a source of energy. Few cows actually die of the condition, but there is always a drop in milk production.

The treatment of affected cows can be achieved by relieving the drain of glucose by stopping milk or by providing glucose intravenously or by drenching the cow with substances which the animal changes into glucose. These are such things as glycerine and sodium propionate. Because part of the problem appears to be due to a failure of the adrenal glands to produce cortisol another treatment is to inject affected cows with cortisol and this appears to be very helpful to some cows.

The prevention of acetonaemia involves increasing the quantity and quality of feed following calving and by reducing as much stress as is possible. Dairy farmers should be on the look out for cows which become sleepy and sluggish, are losing condition and develop a sweet smelling breath. When such cows are observed relieve the strain on them by not milking for a couple of days and drench them with glycerine or ketol.

All the metabolic diseases can result from a reduced supply of food and the incidence of them lessened by good feeding around calving. Since the problem this year is likely to be a lack of home grown foods it would appear that this discussion will not be very helpful, but at least it should give an understanding of what takes place in metabolic disease and this should be of assistance in helping the few animals which develop one or other of these conditions.