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Ploughshares and Pruning Hooks

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> . . . and they shall beat their swords into ploughshares and their spears into pruning hooks.[1]

It must have been a blacksmith who transformed the weapons of the Old Testament Jews into farming and horticultural implements. As an agricultural engineer, it is from the blacksmith that I trace the origins of my profession—not from Imhotep and his pyramid builders of 20 centuries before Christ, whence spring our civil engineering cousins; nor from James Watt and the great engineers of the Industrial Revolution in Britain, whose offspring are today's mechanical engineers, and other cousins; but from some humble farrier, nearer in time to Imhotep than Watt, whose name is lost to history.

Blacksmiths knew well the three major bases of their trade: the sun's energy stored in the fuels that fired their forges; the iron and other materials with which they worked; the animals and the crops their customers tended. Energy, engineering materials and farming; these too are the stock-in-trade of the agricultural engineer. A feature which distinguishes agricultural from most other engineers is this intimate linking of things physical and biological in their technology.

Farmers and engineers can work together to overcome limitations on farming techniques. Fencing can be made more convenient and effective, planting and harvesting can be mechanised, water can be provided by irrigation or taken away by drainage. Engineering can also provide new opportunities to diversify traditional husbandries, by making it easier to convert different crops and animals, their by-products or wastes, into food, fuel, fibre or chemicals.

In New Zealand's farming history, this engineering has not always been carried out by people recognised as engineers. The very word 'engineer' comes from a Latin verb meaning 'to create', and much engineering on farms was and still is done by creative farmers and others. We shall examine some of those engineering contributions to farming as we trace the development of farming systems in New Zealand.

The pioneers of farming in New Zealand brought knowledge, skills, techniques, and equipment with them from their own countries: Polynesia, England, Scotland, Ireland, Scandinavia, Australia. . . . Maori subsistence farming before the mid-nineteenth century gave way quickly to European crops, methods and iron farm implements. With rapid mastery of these new ideas the Maori farmers and their missionary advisers probably produced the greater part of New Zealand's internal and export trade in agricultural produce between 1830 and 1860.[2] Indeed, some early missionaries seem to have vied with Him they served in their creativeness! Samuel Marsden, son of a Yorkshire farming family and himself farming in New South Wales when his visits to New Zealand began in 1814, introduced metal tools (and the first farm livestock). His protégé and fellow missionary, John Butler, imported the first plough, and proudly recorded his use of it on 3 May 1820: 'with a team of six bullocks brought down [to Keri Keri] by the S.S. *Dromedary*'. John Morgan 'arranged the construction of a water-powered flour mill' near Te Awamutu about 1845 for the wheat which Maoris in that area were growing.[3]

That Maori farmers learned these missionary-engineering skills quickly and displayed their own ingenuity is made obvious by information about Te Whiti-o-Rongomai, the prophet of Parihaka.[4] He was educated at Riemenschneider's mission school at Warea, and set up a flour mill there when he left school (about 1850?). In his later campaigns of passive resistance towards European settlement of confiscated Maori land, his followers' use of the plough was hardly to the settlers' liking: they ploughed up roads and newly-sown pastures!

From the beginning of European settlement until the present time, New Zealand has had a temperate climate

with abundant and frequently alternating sunshine and rainfall, and an educated, affluent, yet not highly industrialised society with low population density. These factors have made it possible for animal and crop growing to be carried out with a very high output per farmer on millions of hectares of arable and pastoral land. This efficient production has now been the basis of New Zealand's agricultural-export-based economy for more than a century. At first the early farmers based their farming on systems brought with them from Europe. Then, following the Australian example, settlers disillusioned with trying to persuade small, arable farms out of large, aggressive bush areas took to large-scale sheep husbandry for wool growing. New Zealand's dependence on grass production had begun. From about 1845 onwards, wool became more and more lucrative, and large stations grew up in Wairarapa, Canterbury and Otago. The first woollen mill was established in Mosgiel in 1871. There were probably demands for technological developments associated with the labour-intensive aspects of sheep husbandry: stock-handling, wool packaging and transport, and possibly too for improved fencing. But the most important engineering development at this time was undoubtedly machine shearing, making it possible for each skilful shearer to harvest wool from several hundred sheep per day.

If we are to believe the historians, the 'engineer' and the 'farmer' took turns leading to the next important phase in farming. Harvey Franklin has stated[4] that 'the deteriorating quality of the tussock pastures [in Canterbury] *necessitated* ploughing' (my italics) and 'this became the important factor in the expansion of the bonanza wheat farms'. Gordon McLauchlan opines[3] that 'gold and its direct effects, management problems with sheep, price flutterings for wool *and the development of cultivating and harvesting machinery*' made the 1870–90 period the age of wheat.

Clearly, the machinery would have been developed (in Europe and North America) in *response* to farmers' needs. But whatever caused it, the wheat bonanza period was very affluent, and required development of storage and transport systems. Yields eventually declined with the 'mining' of soil fertility and destruction of soil structure, although not before important steps towards mechanisation of farming had been made. Many ploughs, seed drills, reapers and binders were imported, some made locally, and no doubt all much repaired by blacksmiths and tradesmen engineers. A Scottish immigrant, John Anderson of Christchurch, provides a nutshell example of the New Zealand agricultural engineer's heritage:

> Anderson set up as a blacksmith in 1850, and in 1857 began making farm implements, many of them to his own design. He sent his two eldest sons home to Edinburgh in 1866 and they returned a few years later with degrees in civil and mechanical engineering.[3]

These early steps towards mechanisation had important consequences in the later adoption by farmers of labour-saving machinery, especially tractors, of which New Zealand now has more per farmer than almost any other country in the world. But it is unfair to claim, as Gordon McLauchlan has done,[3] that: 'Country people have been drawn into the towns by family ambitions and *forced there by increasing mechanisation*'. That is too simplistic a view of the chicken-and-egg relationship between labour shortage and mechanisation. It is fair to acknowledge that in assisting farmers (to mechanise, to diversify, to overcome constraints) the agricultural engineer takes on a part of the responsibility for both the foreseen and unforeseen consequences of his assistance.

The next major engineering contribution with a profound effect on farming systems occurred before the turn of the century. It might be unpalatable history to some New Zealanders that Australian engineers over 100 years ago provided the breakthrough which allowed today's all-important fat lamb and dairy product export trade to develop, almost out of the ashes of the soil-depleting, labour-demanding, relatively unprofitable wheat farming bonanza. The breakthrough was refrigerated shipping. As I write, it is 100 years exactly since the s.s. *Dunedin* sailed from Port Chalmers on 15 February 1882 with a cargo of 4908 frozen sheep and lamb carcasses, 22 pig carcasses and some dairy produce. In 1877 the first-ever successful cargo of frozen meat had been shipped from Buenos Aires to Le Havre. A year later the Australians delivered their first shipment of 40 tons of edible beef and mutton to London. They had built a freezing works in Sydney in 1861 and had sent an unsuccessful shipment to London in 1876.[3]

Some influential runholders spanned those three periods, making their own engineering contributions as they moved from wool to wheat and, when the downturn came, back to sheep, this time with meat to the fore. They were men like John Grigg of Canterbury. In 1864 he moved on to 13,000 hectares of impassable swamp and set about draining it, first with open drains then with ceramic tiles manufactured on the estate. By 1900 there were over 240 kilometres of tile drains. Another person who 'backed his practical skills and foresight by moving into wheat when the time was right and back strongly into sheep again when refrigeration looked a long shot'[3] was Duncan Cameron, who farmed Springfield Estate near Methven until 1909. He was a pioneer in water race construction for stock water supply. Water races of another kind had been constructed in Otago in the 1870s and 1880s, for hydraulic sluicing by goldminers. Soon after, these were turned into irrigation supply channels for orchards and small farms, especially along the Clutha River. Work began in 1912 on the first government-sponsored irrigation scheme in New Zealand, in the Ida Valley. There were large schemes begun in Canterbury around 1935, when the government needed to provide productive employment.

When today's dairying areas, particularly Waikato and Taranaki, began to emerge from the North Island bush and the effects of Maori/Pakeha struggles in the 1880s and 1890s, they very rapidly took over from the early South Island dairy produce exporters to provide the bulk of exports to Australia and Britain.

The ritualistic, repetitive nature of dairy farming is probably a strong incentive for labour-reducing ingenuity to be applied, and it certainly has been. Mechanical separators and machine milking were to dairying what machine shearing had been to wool farming. Tightly-scheduled pasture management with electric fencing, highly mechanised hay and silage making and feeding, and further world-leading developments in low-labour milking, characterise New Zealand dairy farming. The transport, processing and marketing arrangements are part of 'an extraordinarily compact industry'.[3]

Arable farming of crops, including cereals, has grown less spectacularly than meat, wool and dairy farming. But there is now a wide variety of arable crops demanding their own machinery to be supplied or developed. Recently, horticulture has grown in importance very rapidly. The high value of horticultural crops and their high labour requirements have resulted in many engineering inputs for trickle irrigation, frost protection, artificial shelter, chemical spraying and machine harvesting.

From the first years of settlement in New Zealand there were more farm workers and labourers immigrating than the large sheep runs and cereal farms could accommodate. The 'one man, one farm' principle was established very early, and is one of the reasons that there are now so many farms of the mixed cropping type, with livestock alongside arable crops, in a unit sized to give an economic return to one family. These farmers have a use for all kinds of technological innovation: machinery and mechanisation, fencing, farm structures and services, water management by conservation, irrigation and drainage, chemicals application—the whole gamut of agricultural engineering.

These then were some of the early influences on the relationship between engineering and farming in New Zealand. 'New Zealand grassland farming as it is known today developed most during the first two decades of this century. Developments since have been mainly refinements, many of them made possible by technological advances in farm machinery—electric fences, tractors, trucks—the whole range of appliances and machines made possible by the wider use of electricity and the internal combustion engine.'[3] There were important developments between 1920 and 1960, such as the development of aerial topdressing following World War Two, but they fitted on to the basic mix of farming patterns that had been set earlier.

New Zealand was locked into a farming system of low inputs (manpower, nitrogenous fertilisers) but high intermediate costs (transport, processing, storage). It supplied distant, seemingly secure and unchanging markets.

But then the United Kingdom moved to join the European Economic Community and the oil-producing countries flexed their price-controlling muscles. Quite suddenly in the 1960s and 1970s the peculiarity and vulnerability of New Zealand's farm-export-based economy in an oil-hungry world became apparent.

Perhaps it is too soon to view these events in perspective. Gordon McLauchlan describes the 'spectacular performance' of farmers in the 1960s, including a 38 percent growth in stock units, and their 'national go-slow' in the 1970s (only 4 percent growth). Whatever the reasons for changing *farmer* attitudes, some of the problems of *farming* are clear. The men of the land of yesterday are mostly in the cities and larger towns. Less than 30 percent of the population now live outside cities and boroughs, although farm-based exports still account for some 63 percent of the total. Inflation is rampant, input costs are rising quickly, some intermediate costs (like transport) are sky-rocketing. Demands for products and potential export markets are shifting like a kaleidoscope. Farmer, processor, transporter, marketer, politician—and engineer; their combined ingenuity is needed to run faster just to stay in the race, and not fall over 'environmental' or 'conservation' problems while doing so.

Engineers *can* work with farmers to overcome limitations, and they *can* provide opportunities to diversify traditional husbandries. It is no longer sufficient to rely on occasional creative ideas from people of various skills associated with farming—although such ideas will continue to be valuable. Today's lifestyle and rate of change demand a well-organised effort to ensure that farmers and engineers work together in national, and even global, interests. So what sort of engineers are the agricultural ones being specifically trained for these tasks? What is the state of agricultural engineering today? What is its future?

With the establishment as early as 1888 of the Canterbury

School of Engineering, and the evolution between 1906 and 1948 of a second fully independent engineering school at Auckland, there must have been many graduates of those schools whose subsequent careers involved them in some way with agriculture.[5] Many central and local government, catchment board and power board engineers have been concerned with roading, river control and electrification in rural areas. It is quite certain that many agricultural or horticultural science graduates and diplomates from Lincoln College and Massey College (now University) had much more than a smattering of engineering in their training, as is also true today. Since 1967, there has also been a professional course in agricultural engineering taught jointly by Lincoln College and the School of Engineering at Canterbury University. The first Bachelor of Engineering (Agricultural) graduates of this programme completed their courses in 1970.

The programme of education for these young engineers is in accord with the origins outlined in my opening paragraphs. There are aspects included of civil, mechanical and biochemical engineering; agricultural, horticultural and environmental science.

It is ironic that in a country so dependent on agriculture, agriculture's own professional engineers were so long in coming, compared with countries like France or the United States of America, where this branch of engineering is comparatively ancient. One important reason for the delay was the very abundance of people *practising* agricultural engineering: missionaries, farmers, blacksmiths, civil and mechanical engineers. Anyone who doubts that the tradition has continued need only look at recent copies of journals like *N.Z. Farmer*, or the *N.Z. Journal of Agriculture*, to see the mechanical inventions, machinery, fencing methods, farm structures, waste and water management techniques being developed, designed and put into practice by a wide variety of people.

That variety is still apparent among those people and organisations at present contributing to the impact of engineering on New Zealand farming. The New Zealand Agricultural Engineering Institute, located at Lincoln

College in the South Island, and at Rukuhia (near Hamilton) in the North Island, is provided with central government and research contract funds to carry out research, development and extension work in all aspects of agricultural and horticultural engineering. These include machinery and mechanisation, farm structures and services, soil and water engineering, agricultural aviation, and crop processing. Another agricultural engineering research and development group, with particular responsibilities for servicing the engineering needs of agricultural research scientists, is located at Ruakura Agricultural Research Centre.

The Ministry of Agriculture and Fisheries Advisory Services Division has a small group of professional agricultural engineers working in cooperation with a larger, country-wide group of Farm Advisory Officers in Agricultural Engineering, who are mostly agricultural science graduates or diplomates with an emphasis on agricultural engineering in their training. Apart from the Agricultural Engineering teaching departments at Lincoln College and Massey University, there is also a group specialising in Agricultural Mechanisation within the Agronomy Department at Massey University.

Specialist industries related to agriculture have tended to employ engineers from other branches: chemical engineers in food processing, especially dairy products; mechanical engineers in the meatworks. There are also specialist research and development organisations related to these major industries: The Meat Research Institute, the Dairy Research Institute, the Wheat Research Institute, and the Wool Research Organisation, to name a few, and engineers are employed alongside scientists at many of them.

Although I have presented an evolutionary view of the professional agricultural engineer's development from blacksmiths, I have not forgotten that the blacksmiths themselves continued, developed and became today's tradesmen agricultural engineers. Indeed, to many these are the *real* engineers still, who actually build the ploughs, seed drills, harvesting machinery, irrigation equipment and much more.

Now it is 100 years since the beginning of New Zealand's export trade in refrigerated meat and dairy products; 30 years since commercial quantities of superphosphate were spread from the air and practical electric fences were provided for better control of grazing. 'So 60 years on from 1920, New Zealand remains basically what it was then, and what it will likely be 20 years from now—predominantly a producer and exporter of temperate zone livestock products.'[3]

And so engineers continue to work with farmers to overcome limitations and find new opportunities in the farming systems which have developed in New Zealand. Deer farming went ahead in the 1970s; it needed high fences and redesigned stock-handling enclosures. Horticulture is booming, but so are the costs of chemical sprays, labour for harvesting, materials for support structures and shelter fences. Traditional supplies of rock phosphate (for making superphosphate) are running out. New sources provide a product which is not only chemically different but physically different, requiring new spreading methods. Direct drilling of crops with specialised equipment and without extensive prior cultivation shows promise of reduced fuel use and greater timeliness, but it often requires weed control with increasingly expensive chemicals whose possible side-effects are regarded with suspicion by some people. Water for irrigation still abounds, but it is also coveted by fishermen, canoeists, city folk escaping just to enjoy 'wild and scenic rivers' and those who would harness the water hydro-electrically to provide energy for industrial, domestic and transport use. The possibility of farmers 'growing' liquid fuel is being explored, with an eye to providing a strategic supply for agriculture, and helping to reduce New Zealand's throttling dependence on imported petroleum.

There obviously remain many needs to which engineers, especially agricultural ones, can respond. Three present-day examples will illustrate the kind of response engineers are making to farmers' needs. One example is primarily concerned with a resource (water) and livestock, the second primarily with horticultural crops and engineering materials turned into harvesting machinery, and the third with fuel energy from crops, thus illustrating up-to-date agricultural engineering against a backdrop of the blacksmith's ancient knowledge.

Agricultural engineers have played their part in the development of large, community, surface irrigation schemes, especially in Canterbury, Otago and Hawke's Bay. They have also taken part in the rapid growth in sprinkler and trickle irrigation systems on individual farms in the last 20 years. They have been almost entirely responsible for the development of methods for the investigation and design of water resource systems in farming areas of limited water supply, where strategic irrigation for livestock production is a worthwhile development option.

Storage regulation of summer-dry water resources on individual farms was studied on a regional basis in Nelson in the late 1960s, and in Otago in the early 1970s. The work was further developed into the community irrigation scheme concept with the Glenmark water harvesting and irrigation scheme in North Canterbury. It was designed in the late 1970s and is now under construction. It involves diversion of winter stream-flow and field run-off into about 28 earth-embankment storages on farms, allowing irrigation of approximately 1500 hectares. The Glenmark scheme was a pilot study and agricultural engineers are now leading a multi-disciplinary study of opportunities for similar development in the Hakataramea Valley, South Canterbury, using new and more sophisticated methodology.

In developments of this kind, other potential users of water resources are sometimes put at a disadvantage. There is seldom only one 'correct' use for a water resource, but in the past a predominant use has often been established by the simple strategy of being 'first in'. There is a danger now that beneficial and complementary uses could be prevented or delayed because of a backlash against earlier developments now seen to have prejudiced other potential users. That is why new methods are being developed to allow examination of many combinations of users at different levels of use: for example, various levels of irrigation abstraction in the light of fishing, hydro-electric and scenic uses. Although better methods will not themselves remove conflict, they will allow better-informed adversaries to compete and discuss prior to political decisions being made. This example illustrates a case where agricultural engineers are not only trying to assist farmers, but consciously trying to do so in the context of other users of shared resources.

If Eve had needed to harvest the fruit from a large orchard of knowledge trees to tempt Adam, Man might never have fallen into sin! Fruit harvesting often involves picking huge numbers of individual fruits from plants which must remain undamaged to bear again. Whether the fruit is for food, food products (juices) or other products, (e.g. dyes from blackcurrants) it is often of sufficiently high value to justify either a high labour cost or expensive mechanisation. Because this work is seasonal, monotonous and often physically demanding, there is a tendency in New Zealand for fruit-harvesting labour to be hard to attract.

Horticultural scientists at Levin in the 1960s began to experiment with growing blackcurrant bushes specifically for mechanical harvesting. Agricultural engineers were called in and designed a harvester for New Zealand conditions. Although the same basic harvester has now been manufactured commercially for nine years, it has also spawned variations and prompted the importation of larger, overseas machines which would probably not have been contemplated when labour problems were causing a lack of confidence in berry-fruit growing 10 years ago.

The blackcurrant harvester also led the agricultural engineers on to harvesters for horticultural crops as diverse as raspberries, tomatoes, apples and kiwifruit. They are now working in close cooperation with horticultural scientists, so that the crops can be adapted for mechanical harvesting, as well as having machines adapted to the crop.

Horticultural crops have recently grown rapidly in volume of production from less than $1M in export earnings in 1950 to about $155M in 1981. Kiwifruit plantings alone have increased in area from 850 hectares in 1974 to 5370 hectares in 1980.

New sub-tropical and temperate fruits are being tried as candidates for export earnings, and many will need continued development of mechanical harvesting equipment.

Among the temperate-climate countries of the world with strongly developed agriculture, New Zealand is unusual in not producing its own sugar. Nearly 100 years ago there was a sugar refinery in Otago, and sugar beet has been grown spasmodically until the 1970s. But for reasons seemingly political and economic, our sugar has been supplied from cane grown in Australia, Fiji and other places.

In the 1960s agricultural engineers developed mechanised growing and harvesting systems for fodder beet, like sugar beet a variety of *Beta vulgaris*. It was intended for stock food and some farmers, dairy farmers in particular, found advantages from growing it and do so today. With the first 'oil shock' of 1973, beet was one of the crops identified by agricultural engineers as possible suppliers of farm fuel from farm crops.[6] Beet grown in New Zealand can produce 8-12 tonnes of sugar per hectare, and this sugar is readily converted to ethanol (ethyl alcohol). Ethanol has been known for 80 years to be a good fuel for spark-ignition engines, although lower in energy density than gasoline (21 MJ/litre compared to 32 for gasoline). Following the second oil shock in 1979 a working group on energy farming of the N.Z. Energy Research and Development Committee confirmed the beet/ethanol option as very promising among other contenders for supplying liquid fuel from renewable resources in New Zealand.

Initially the emphasis of this research and development programme was on obtaining, from agriculture, fuels to keep agriculture operating in a fuel-short situation. The tractors, harvesters and trucks on which farming depends must either continue to be supplied with fuel from petroleum, much of it compression ignition fuel (diesel) at present, be supplied with some alternative fuel, or be operated with different engines. Ethanol for spark ignition engines is one obvious candidate and it is important to have some research and development work carried out in advance of a possible future crisis. It is apparent that ethanol from beet is also one among other options for use as an extender of gasoline supplies for motor cars, and could quite readily be used in gasoline/ethanol blends.

Currently, the programme in which agricultural engineers are involved is aimed at establishing the viability of a beet/ethanol industry in New Zealand by investigating beet harvesting and storage, sugar extraction technology and the alternative uses or disposal of co-products and waste products from the ethanol production. Already it is clear that overseas exchange shows a net benefit, net energy production is higher than has been reported from grain ethanol production in the U.S.A. and some co-products are economically useful. It is also clear that waste management does not need to be a disaster, as some writers have said that it is for cane sugar/ethanol production in Brazil.

It is too soon to know where this particular alternative for renewable liquid fuel production lies in relation to other options based on silviculture, aquaculture or even other agricultural options. Both methanol and ethanol production from wood are being investigated by other scientists and engineers, and there is work in progress on methane (gas) and vegetable oil production as fuel from agricultural crops. It is also too soon to be sure how the supply of *renewable, liquid* fuel could be complemented or replaced by nuclear, direct solar, hydro, wind or wave energy, for example. The economic availability of present non-renewable resources of petroleum, gas and coal will be very important factors for several decades yet. But it is clear that farmers and agricultural engineers are utterly dependent on stationary energy and portable fuel availability for their operations in agriculture and horticulture, and are capable of providing more than they take. It seems likely that agricultural engineers will be involved for some years yet, investigating both energy production and conservation.

Bioculture is not an attractive collective noun and not much used. But its members—agriculture, aquaculture, horticulture and silviculture—are extremely important activities in New Zealand, even if 70 percent of the population have only passing glimpses of them. New Zealand seems likely to remain for many years a country of low population density and good climate for growing crops, whether they are animals or plants, fish or trees. The quality of life of New Zealanders will depend vitally on how effectively these crops can be provided, for our own use, and as trading commodities for the goods and services we either cannot provide or do not produce efficiently.

It has long been apparent that progress in farming is very dependent on good research in agricultural science, and New Zealand has been well provided for in its relatively short history. Until the last few decades there has not been the same quality of engineering research, development and application to farming. As farming has become increasingly sophisticated, mechanised and specialised, it has become more dependent on technological developments. The importance of agriculture and horticulture to New Zealand demands that there should be an adequate professional engineering presence to respond to their needs. This presence is only just being established, and its importance is not always recognised. (Technological back-up for aquaculture and silviculture is even less well-recognised.)

'Engineers are not everybody's favourite people,' understated the *Christchurch Press* editorial of 10 February 1982. 'The extent to which New Zealanders depend on engineers getting their calculations right is shown occasionally by the disastrous results when they get their calculations wrong.' But in more kindly vein the editorial noted that engineering is a profession 'to which New Zealanders owe much of the convenience, and safety, productivity, costs and savings, and some of the disadvantages of their late twentieth century lives'.

The overall impact of engineering on farming in New Zealand has been aimed at providing benefits in response to needs. Whether professional agricultural engineers or Christian missionaries, the people involved have been concerned to work with farmers in overcoming constraints or accepting new opportunities.

What is needed now is carefully planned and carried out research and development in agricultural engineering, with effective application to horticulture and agriculture. It will only be possible if the importance of this work to all New Zealanders is recognised: by farmers, scientists, advisers, educators, businessmen, civil servants, politicians and even the reluctant, tax-paying citizen.

Drawing on both physical and biological sciences to link energy, engineering materials and farming in developments beneficial to New Zealanders and other inhabitants of our planet can be seen to be a demanding task. No doubt the early blacksmiths were mostly responsive and responsible to their farming customers' needs. Today's agricultural engineers must be also, if the economic performance and quality of life in this agriculture-based country are to improve. Professional agricultural engineers must apply their creative skills and training in working with other contributors alongside farmers to ensure that the future impact of engineering on farming in New Zealand is a responsible and beneficial contribution to society.

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