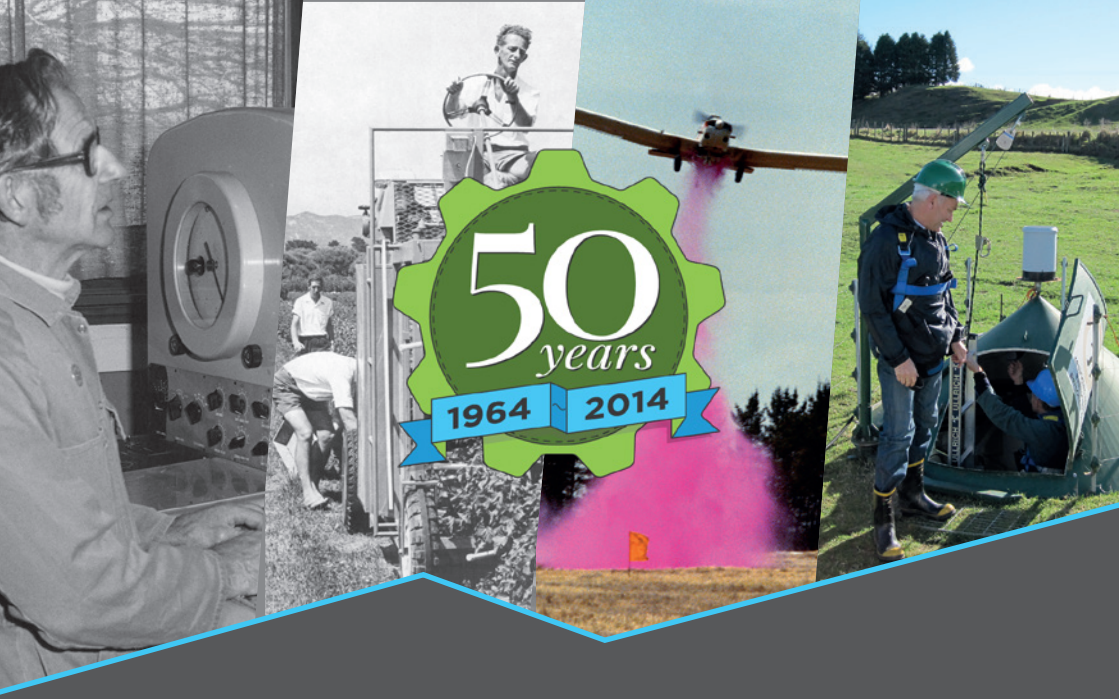


50 years of Lincoln Agritech

1964-2014

A celebration of New Zealand
Agricultural Engineering and Innovation

LINCOLN AGRITECH LTD

The blackcurrant harvester.

Contents

LINCOLN AGRITECH LTD

Introduction
by the CEO of Lincoln Agritech Limited

It is with great pleasure that we bring you this commemorative booklet celebrating Lincoln Agritech (and its predecessors) in its 50th year of operation. In 1964, the New Zealand Agricultural Engineering Institute (NZAEI) was formed to undertake applied research and development to support agritech innovation by New Zealand's primary sector. The New Zealand Cabinet approved the formation of the Institute at Lincoln College (now Lincoln University) in October 1963 and the first staff member joined in October 1964. Financed primarily by Ministry of Agriculture grants, early research concentrated on tractor safety frame testing, fencing, carcass disposal, farm water supply and agricultural aviation. In 1994, Lincoln Ventures Limited was created through merging the NZAEI with Lincoln University's Kellogg Farm Management Unit and the Centre for Resource Management. In 2012, the company changed its name to Lincoln Agritech Limited to better reflect its position as an agritech-focused science and engineering research company owned by New Zealand's only specialist land based university, Lincoln University.

The success of Lincoln Agritech comes from the scores of dedicated staff who have worked here over the years with a passion for the discovery and introduction of new agricultural and environmental technologies, and who have been striving to ensure applied research is taken up by the sector. None of them, or Lincoln Agritech, has become rich off their inventions, but we would like to think our inventions and research have enriched the country.

There have been many successes and some failures. While most will be forgotten over time, many of these were cutting edge and made a significant difference in their day. The early days of NZAEI saw a strong emphasis on extension with demonstrations

at field days commonplace – something that seems to have dwindled with changes in science funding in recent decades. This booklet brings together some of those stories long forgotten, or never known, to share and celebrate what we have achieved. Staff, both past and present, can be proud of their contribution through research to the technological advances in agriculture, industry and the environment that have emerged from Lincoln Agritech and its predecessors.

The company continues to perform strongly 50 years after its inception and currently employs over 40 staff, including scientists, research engineers and software developers. It conducts applied research and consultancy for the agricultural, industrial and environmental sectors, with current research focused on sensor and measurement technologies, groundwater research, precision agriculture, including agricultural spray drift, and irrigation software design (IRRICAD).

We have some really smart technology under development and we have very capable staff. I have never been more excited about Lincoln Agritech's future than I am today. We look forward to supporting New Zealand's primary sector and environment through another 50 years.

Peter Barrowclough
Chief Executive

Business Manager, Kevin Hurren, and Chief Executive, Peter Barrowclough, unveil the new company name and logo.

Introduction
by the Vice-Chancellor of Lincoln University

Farming doesn't succeed by biology alone. Soils, freshwater, sunlight, mico-organisms, plants, livestock and people are all important components, but on their own they are insufficient. Also essential is human ingenuity in the form of inventions that allow us to plough or direct drill soils; protect and then harvest plants; contain, protect and then milk, shear or slaughter livestock; and measure, model and manage all these processes. This is achieved through the application of technologies and engineering, activities that have been absolutely essential to agriculture since its invention in Mesopotamia c.10,000 years ago at the end of the last ice age. Agri-technologies, as we now call them, ended humanity's nomadic, hunter-gatherer existence and allowed the development of villages, then towns, then cities – ultimately leading to the industrial revolution and then the information revolution. Without agricultural technologies and agricultural engineering, our species would still be wandering the planet in a largely unsophisticated manner and at times in a state of privation.

That is how important the role of agri-technologies and agri-engineering is – absolutely vital. Lincoln Agritech Limited is New Zealand's specialist agricultural technology and engineering research and development company, owned by the country's specialist land-based University. Celebrating 50 years of contributing to helping people feed the world, protect the future and live well speaks highly of the staff who have worked for this venerable institution over that time. They have been, and continue to be, special people whose skills and contribution are needed both in New Zealand and globally. In fact, the intensity of that need is mounting. Therefore, I am confident – as is Lincoln University - that in 50 years' time people will be celebrating a centenary of contribution by Lincoln Agritech Limited. Fifty years is just the start.

Dr Andrew West
Vice-Chancellor

Dean Waller and John Milne work on testing tractor safety frames.

1963-69
Formative years

In 1963, the New Zealand Cabinet adopted a proposal to establish an agricultural engineering testing and research institute at Lincoln College (now Lincoln University). Detailed proposals were approved in August 1964 and a Management Committee met for the first time on 12 October 1964. The first staff member, Graham Garden, was appointed in October 1964, with further staff appointed in 1965. The New Zealand Agricultural Engineering Institute (NZAEI) activities were formally initiated in a ceremony at Lincoln College on 15 April 1965.

The Management Committee was a sub-committee of the College Council and NZAEI staff were permanent employees of the College. The Management Committee Chair was Mr John Boyd-Clark and the first NZAEI Director was Professor John R. Burton, who was formally appointed on 5 March 1965. There were eight inaugural staff members, increasing to 15 by 1969. Lincoln College staff from the Agricultural Engineering Department worked closely with NZAEI staff on joint projects.

The main areas of activity were testing, research and development, and information and extension within the broad field of agricultural engineering in New Zealand. Driven by tractor fatalities and Government legislation to fit all tractors with safety frames, the major focus for the fledging Institute was to develop tractor safety frame testing methods. Other early projects included carcass disposal, farm water supply and agricultural aviation. Projects were almost entirely funded by an annual grant from the New Zealand Department of Agriculture. As the decade progressed, work extended to fertiliser spreaders, milk meters, row crop production, farm transport vehicles, field drainage, fence post testing and the construction of farm dams for stock supply and irrigation. By 1966, soil and water research had started and this greatly expanded as staff numbers increased. The same year also saw the beginning of work

Nothing changes

Experience has shown that it is difficult to adhere to a planned research and testing programme because of the number and variety of short-term testing and consulting projects, and ad hoc research and development tasks, with which the Institute is confronted, often at short notice.

(John Burton, Director 1969)

Clockwise from top left:

Fertiliser spreader testing in the still air lab.

John Boyd-Clark, Chair of the Management Committee 1964-1980.

Terry Heiler at the NZAEI newsletter stand at National Machinery Field Days in 1969.

The new workshop block completed in 1966.

Vehicle fertiliser testing.


WRIGHT BROS
2
WRIGHT BROS
LAURISTON


NEW ZEALAND AGRICULTURAL
LINCOLN COLLEGE
RESEARCH
DEVELOPMENT

on introducing precision farming methods aimed at increasing mechanisation, particularly for horticulture.

The recruiting period for staff, buildings and equipment was largely complete by March 1966. The Institute's first building, the workshop block, was completed in early 1966. In 1967, the Government approved extensions to the workshops, a stress-analysis lab and a still-air shed for fertiliser distribution research. However, a shortage of accommodation and equipment through insufficient finances hampered the Institute's ability to deliver the increasingly wide range of testing and projects requested by Federated Farmers, government departments and other agricultural organisations. At the close of the decade, building and equipment were noted as 'inadequate' and a 'major limiting factor' to the Institute's activities.

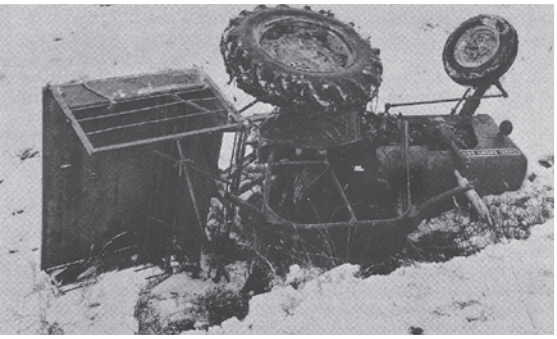
Information and extension with the farming community was an important aspect of the Institute's work. This was facilitated through a newsletter series and a membership scheme (94 members by 1969), as well as participation of staff in field days, talks to farmers' groups and training courses. A television sequence depicting the Institute's safety frame testing was aired in Christchurch in June 1966 – the first of numerous broadcasts about the Institute's work.

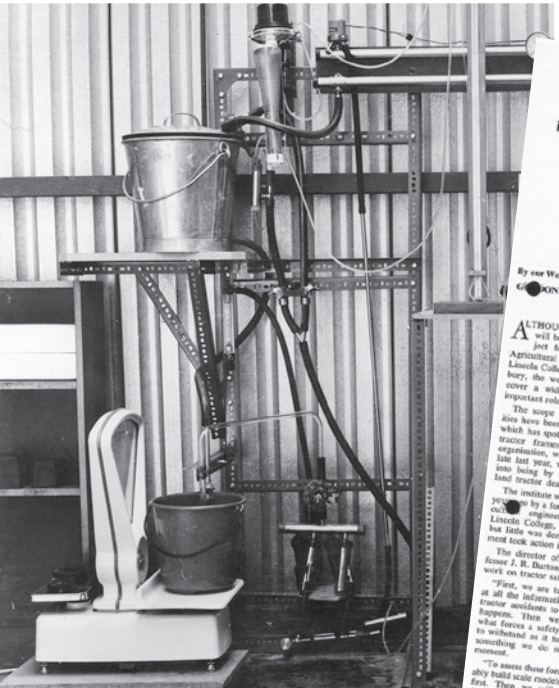
NZAEI staff were not immune to the lighter side of life, however. In 1968 at the official opening of Lincoln College's Hilgendorf Wing by Governor-General, Sir Arthur Porritt, two NZAEI staff members (Garden and Harwood) used a remote controller to manoeuvre an unmanned tractor sedately past the Vice-Regal party. Alarm ensued when the machine began to weave eccentrically and a policeman, jumping on the tractor, found no steering wheel. The wayward machine finally stopped close to the official car. Strong words ensured that future pranks be notified to security police prior to the event!

Accolades

A significant event was the attendance of Principal Research Officer, Mr E. M. (Mike) Watson, at the International Standards Organisation meeting in Paris on safety frame testing. The results produced by the NZAEI were enthusiastically accepted and have formed a basis for further research in America… and has been a tremendous factor in the international recognition and reputation of the Institute.

(J. Boyd-Clark, 1969)





Clockwise from top left:

Rex Gibbs at work in the project lab.

NZAEI signage.

Journal of Agriculture (August 1965) article introducing the new NZAEI and director, Professor John Burton.

Milk meter testing, 1967.

This accident was not fatal; the tractor was fitted with a safety frame.

Journal of Agriculture Aug 1965

Many farm problems, including tractor safety, will be investigated by new

AGRICULTURAL ENGINEERING INSTITUTE

at Lincoln, Canterbury

By our Wellington Staff Correspondent
GORDON McLAUCHLAN

ALTHOUGH farm tractor safety will be the major research project for this year at the new Agricultural Engineering Institute at Lincoln College, University of Canterbury, the work of the institute will cover a wide field in fulfilling an important role in agricultural progress.

The scope of the institute's activities have been obscured by publicity which has spotlighted work on testing tractor frames. The new research organisation, which began operations late last year, was admirably helped also being by the tragic New Zealand tractor death toll.

The institute was first mooted many years ago by a former head of the agricultural engineering department at Lincoln College, Mr A. W. Riddolls, but little was done until the Government took action in 1963.

The director of the institute, Professor J. R. Burton, in referring to the work on tractor safety, said—

"First, we are taking a close look at all the information we can get on tractor accidents to see exactly what happens. Then we will investigate what forces a safety frame will have to withstand as it turns over. This is something we do not know at the moment.

"To assess those forces, we will probably build scale models and work them first. Then we will go further than that," he said. "We will be concerned with recommendations on the design of frames and the type of materials to be used in their construction.

"But we will go further than that," he said. "We will be concerned with recommendations on the design of frames and the type of materials to be used in their construction.

PROFESSOR J. R. BURTON, aged 35, the first director of the New Zealand Agricultural Engineering Institute at Lincoln, was formerly a senior lecturer in civil engineering at the University of New South Wales. His particular interest there was in the conservation of water resources and its relation to farming. At Lincoln, Professor Burton combines his research post with a teaching role as professor of agricultural engineering on the staff of Lincoln College, University of Canterbury.

its side and repositioning the fuel tank and battery.

"We have bought a tractor and are planning to rebuild it in this way and then check its stability and performance," said Professor Burton. "The aim will be to make with existing components minor modifications which can be done in New Zealand.

"I understand the problem is largely created by the fact that most tractors we see out here are built for farming fairly flat country in Britain and the United States."

Another aspect of tractor safety which the institute's research team will look at is the provision of power take-off guards.

"We plan to build an experimental guard, which has been designed by the Department of Labour, and test it for them," said Professor Burton.

Because of its dramatic associations with death and injury, tractor safety research has been unduly emphasised and the work has become the sole image of the institute in the eyes of many farmers.

This image is unreal and, if the institute is to fulfil its important role in agricultural progress, the extent and depth of its work should become better known.

For example, Professor Burton said, the institute would start this year in a small way investigating problems of farm water supply in Canterbury — first to see what the real problems are and then to find

1970-79
Rapid expansion

Notable features of the NZAEI in the 1970s were an increase in staff numbers (33 in 1971 to 40 by 1979) and a widening sphere of interest. Work on soil and water projects continued to expand. Testing and consulting services were increasingly in demand by government departments and commercial organisations – projects included mechanised production and cropping, tractor safety frame testing, irrigation design, aerial application of insecticides and fertilisers, and low cost fencing. Extension work also increased with numerous requests for field days, demonstrations and conferences, input into radio and television broadcasts and for bulletins, journal and press articles.

Due to these increasing demands, but with a capped budget, a technical sub-committee was established in 1972, including representatives from MAF and other associated research organisations, to prioritise and manage the Institute's work programme.

Examples of the extensive range of work carried out at NZAEI during the 1970s included:

- Testing tractor noise levels, with NZAEI advocating fully enclosed cabs to mitigate against permanent ear damage for drivers.
- Development of a fully mechanised method for growing fodder beet (the Dutch harrow) by adapting a European implement for precision seed bed formation.
- Introduction of a seed calibration service to help growers optimise precision drills. The Institute raised beet seed on Lincoln College's cropping farm and by 1971 this government certified seed provided the bulk of the New Zealand supply.
- Work on herbicide drift from aerial spraying – in particular forestry spraying – with the NZAEI completing a number of trials for the Agricultural Chemicals Board.
- Testing the application of fertilisers and pesticides – both aerial top dressing and bulk fertiliser applicators – led to increased interest in machines that applied pesticides directly to the ground and the Institute initiated a calibration service for these machines.
- Development of a self-propelled side-roll irrigator with commercial units produced by several companies, including Harvin Industries (Christchurch).
- Fencing research emphasised low cost fencing systems, plus testing strength

Clockwise from top left:

The blackcurrant harvester.

Les Anstice and the orchard cab, protection from chemical spraying.

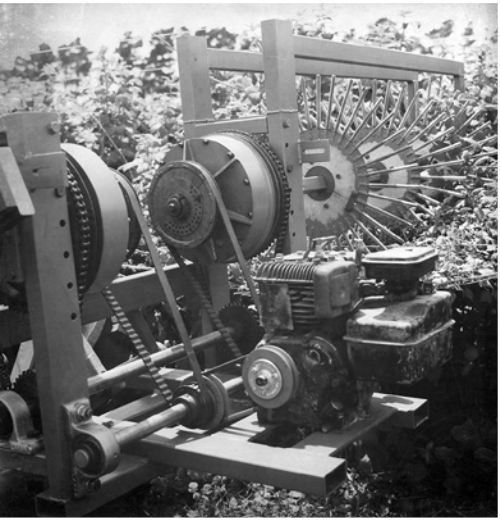
The side-roll irrigator.

Terry Heiler in action.

Geoff Warren tests the fence batten machine.

Mechanical raspberry harvesting.


484
INTERNATIONAL



and durability of posts and wires. NZAEI developed and patented a fence batten machine to fit vertical wires to a fence, later manufactured and sold by Aitchison Industries. By 1978, this research extended to include electric fences.

- Work on farm waste management, particularly for dairying, included slurry irrigation, lagoon systems for disposing of waste, and investigating groundwater contamination by nitrogen and organic matter from slurry lagoons.
- Publication of the Field Drainage Guide to encourage good drainage practice.
- Initiating a frost protection programme using water sprinklers in lieu of traditional oil burners, initially for kiwifruit in Hawkes Bay.
- Completion of the design for the Glenmark Irrigation Scheme for Waipara County Council. This was followed by water resources surveys of the Opihi River catchment and Hurunui River.

Although the workshop, measurement lab and still air lab were completed in the late 1960s, the remaining Institute facilities and staff continued to be housed in temporary accommodation and this remained a continuing source of frustration throughout the decade.

The growth of the Institute's reputation saw numerous distinguished engineers visiting NZAEI. By the mid-1970s, the Institute was contributing to training professional engineers and scientists and

At no other period have the ground rules relating to agriculture engineering research and development been changing at such a rapid rate.

(GT. (Tony) Ward, Director, 1973)

was recognised by the New Zealand Institute of Engineers for providing the practical training required for professional engineers to be registered. It also became responsible to MAF for training newly qualified Ministry agricultural advisory officers and was gaining a reputation as an academic centre, contributing to supervising PhD and Masters projects from the Agricultural Engineering Department at Lincoln College.

Founding Director, Professor John Burton, resigned in 1970; his replacement was Professor (Gerald) Tony Ward (PhD Ag. Engineering, University of Durham), who arrived from McGill University (Montreal) in June 1971. Under Tony's guidance, and through appointments of additional staff, the Institute grew its reputation in specialised areas of irrigation and water resource management growing "probably the strongest team of specialists in hydrology and its related disciplines available to any institution in this part of the world" (J. Boyd Clark, 1971). The Institute developed photographic techniques for measuring drop size distribution of water discharged from irrigation sprinklers under still-air conditions.

Clockwise from top left:

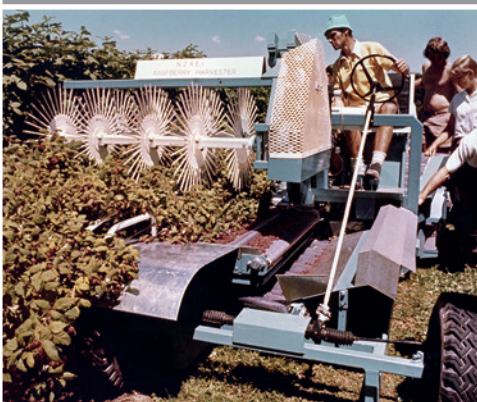
The bale buggy.

Subsurface drainage guide.

The raspberry harvester.

John Milne and Lins Kerr test safety frames in the NZAEI workshop.

Aerial fertiliser spreader trials in the still air lab.



This, plus meteorological data, was used in computer models to predict the effect of wind on sprinklers under field conditions. New work also focused on sprinkler and trickle irrigation – the latter introduced to New Zealand after a trip by NZAEI staff to Israel and Australia.

The mid-1970s saw rising costs and fluctuating export returns for the farming sector as well as the energy crisis. This drove research into labour saving techniques for the sector and Institute staff focused on promoting mechanisation and developing the associated engineering hardware. A black currant harvester was designed and trialled in 1971 that straddled the bushes and used (patented) oscillating, rotating fingers to shake off the black currants. Additional machines were constructed in 1973 and a licensing agreement negotiated with Peco Limited for commercial manufacture of further machines. A canopy growing system for raspberries, boysenberries and apples, as well as prototype harvesters for these crops and for field tomatoes, were developed. The Institute also surveyed and tested methods of conserving hay and tested a number of hay handling systems. Staff used these tests to develop their own self loading 'bale buggy', introduced in 1977; the buggy was commercialised and sold through a number of companies including Stephen Engineering (Rangiora) and Duncan Industries (Taupo).

In 1977, there was a change to the management structure and an independent Director, staff member Mr Mike Watson, was appointed to the Institute (formerly Burton and Ward were jointly Professors in Lincoln College's Dept Agriculture Engineering as well as NZAEI Directors).

Most significantly, 1979 saw the establishment of a sub-station at Rukuhia, Hamilton under the management of Mr John Maber. Hamilton was selected for its proximity to a wide range of agricultural industries and the existence of an agriculture research centre. Five staff transferred, joining three engineers already stationed there. No additional government money was forthcoming to establish the unit and all expenses were paid from existing NZAEI resources. The office is still operating today.

Awards:

- Dutch harrow - Canterbury A&P Show, 1967
- Blackcurrant harvester – Silver Medal, Canterbury A&P Show, 1972
- Precision drill calibration rig – Canterbury A&P Show, 1972
- Fence batten machine – Field Days, 1975
- Raspberry harvester – Field Days, 1975

Above:1971 NZAEI staff

Back row (L to R)
Andy Dakers, Martyn Stolp, Mel Cole, Gordon Winters, Graeme Harrington, Keith Humphries, Dick Harwood, John van Boven

Middle row (L to R)
Russell Horrell, George Davies, David Painter, Terry Heiler, Jim Chapman, David Jamieson, Fred Lees

Front row (L top R)
Graham Garden, John Dunn, Bev Atkinson, Tony Ward, Polly Sebeck, Max Webb, Bob Gilbert

Right: New Zealand Herald (5 January 1980) article reporting the new NZAEI Hamilton sub-station and its manager, John Maber.

SECTION 1

New Research Base to Open In the Waikato

Herald Agricultural Correspondent

North Island farmers and companies, specifically those in the Waikato and Bay of Plenty, are to get more direct help this year in the developing fields of agricultural machinery and engineering.

The Canterbury - based New Zealand Agricultural Engineering Institute is shortly to establish a sub-station at Hamilton with a nucleus staff of five engineers.

Initially, work will be concentrated on horticultural engineering, especially spraying and harvesting, and on farm buildings and agricultural aviation.

The substation will be first based at Ruakuba in a workshop and on land which is part of Ruakura Agricultural Research Centre. Later it will be on the main Ruakura station.

The director of the institute, Mr E. M. Watson, said yesterday an expansion to Hamilton had been contemplated for some time as there was an obvious need for ... machinery research and development in one of the ... work in fields where New Zealand needs differ from those overseas.

Wide Field

It has kept a close watch on overseas developments and, where applicable, encouraged their introduction in New Zealand. It has also helped makers of agricultural equipment and other groups to solve their problems.

The work of the institute has covered a wide field including cultivation and harvesting machinery, ground and aerial fertiliser distribution, tractor safety frames, fencing, farm dams and water supply, irrigation, drainage and waste disposal.

In charge of the new substation will be Mr J. Maber, a senior research officer for the institute at Lincoln, who was previously a farm adviser in agricultural engineering in Hastings.

The institute is financed mainly from an annual Government grant but maintains a large measure of independence by being administered from Lincoln College.

Mr Maber

major New Zealand centres of agriculture.

Set up in 1964 at Lincoln College, the institute has carried out much original research and development

1980-89
Oil shocks, extension and funding constraints

In December 1980, Mr John Boyd-Clark OBE retired having served as Chair of the Management Committee since the establishment of NZAEI in 1964. Sadly, he died a few months later. Professor Tony Ward was appointed Chair. The Management Committee, comprising representatives from farming, agricultural machinery industry, government departments, Lincoln College and the University of Canterbury, continued to direct the work undertaken by Institute staff. In 1983, Dr Terry Heiler was appointed Director of the Institute.

The early 1980s saw economic uncertainty and constrained government expenditure. The 1981 Annual Report noted the last grant received for building construction was in 1968, with the total amount received since 1964 only $53,400. Staff remained housed in a variety of temporary buildings and limited laboratory working space was hindering the execution of some projects. After continued lobbying by successive Directors, the Ministry of Agriculture and Fisheries (MAF) approved a one-off $1 million grant to fund a new office building and extension to the still air lab for testing full-size fertiliser spreaders and irrigation equipment. The buildings were opened on 31 July 1985, with the office building appropriately named the Boyd-Clark building. Lincoln Agritech staff are still housed in the building today.

The newly established Hamilton sub-station concentrated research efforts on horticultural spraying and agricultural aviation, as well as providing engineering advice and assistance to farmers, manufacturers and scientists in the region. Agricultural spray safety, including personal protective equipment, spray application procedures, and evaluating rotary atomisers for spray droplet generation was a priority. A major development was the design and manufacture of a rotary orchard sprayer, a New Zealand first, which was subsequently commercialised and sold by Modern Farm Aids Limited. By the mid-1980s, work had expanded into optimising helicopters and fixed wing aircraft for fungicide and insecticide spray application to horticultural crops, as well as measuring spray droplet size as a key factor for spray efficiency. Extension training courses on pesticide application technology were regularly held around the country by NZAEI staff.

The Institute continued to provide tractor safety frame testing services for the Department of Labour, as well as testing

Clockwise from top left:

The NZAEI stand at National Field Days.

The new NZAEI building, opened in 1985.

Professor James Stewart (Lincoln College) presiding over the opening of the new office block and extension to the still air lab.

The controlled droplet rotary orchard spray applicator.

NZAEI directors, Terry Heiler and Mike Watson.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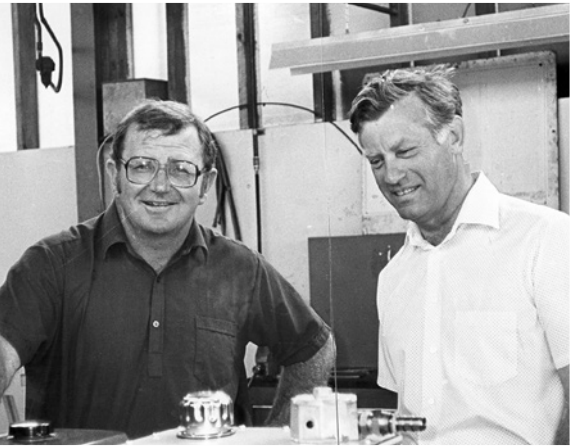
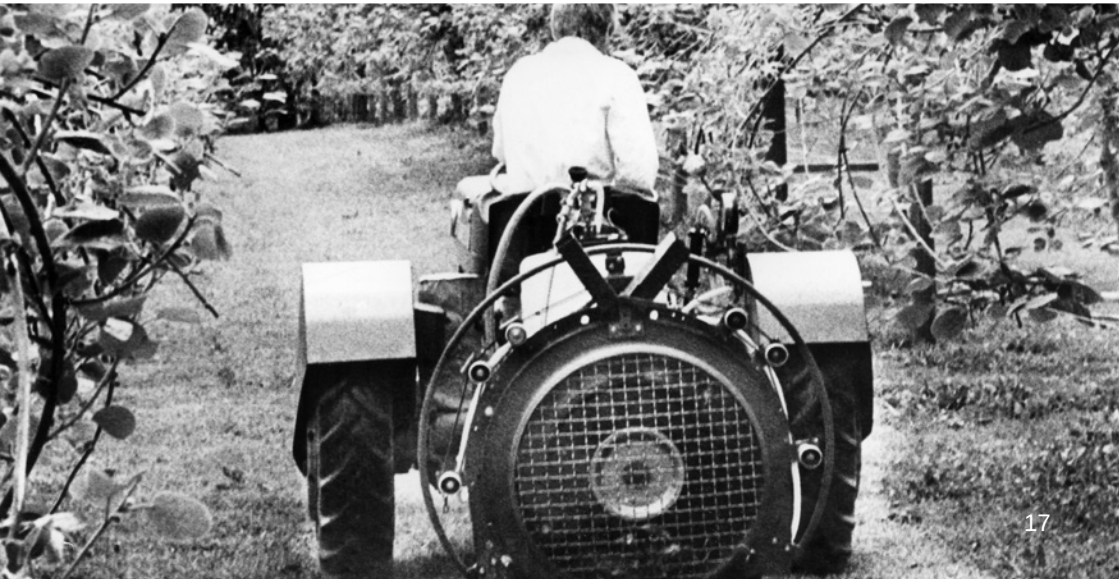




fertiliser spreading equipment. By the mid-1980s, work into frost protection systems expanded rapidly from taking meteorological measurements in the Hawkes Bay to evaluating wind machines, sprinkler frost protection systems, and a fog generating frost protection machine called the Frostrocket. An electric fence earth voltage monitor developed by Institute staff was commercialised by Gallagher and sold internationally.

The oil crisis in the late 1970s saw the start of a substantial new project focusing on ethanol production funded by the Liquid Fuels Trust Board (the equivalent of around $10 million today, over the life of the project). NZAEI and Lincoln College staff worked collaboratively on the project, with the first full year of beet harvesting and handling in 1980, and a total of 1500 tonnes of beet harvested. By 1982, between 12-16 staff (all funded by the Liquid Fuels Trust Board) were working on the project, with much effort directed toward designing and constructing a process plant on site at Lincoln College.

Horticultural mechanisation remained a focus with work progressing on raspberry, grape, blackcurrants, tomato, kiwifruit and apple mechanised management and harvesting. NZAEI was awarded a contract to develop an apple harvester for apples grown on the Lincoln canopy system.

A growth area in latter years of the decade was the development of services for handling, storage and processing horticulture and agriculture commodities. Projects included de-stoning and grading apricots, a patented hygienic inspection window for dairy and brewing vats and tanks, and scallop weighing trials. A survey of kiwifruit packhouses saw a substantial increase in work by the Institute for the kiwifruit industry, including grading, handling, storage and transport. A de-awning machine for grass seed was designed and installed at a Canterbury

AEI's 25-year contribution to irrigation development was recognised by the US Irrigation Association in 1987 with Dr Terry Heiler receiving the prestigious Crawford Reid Memorial Award in recognition of 'significant achievement in promoting proper irrigation techniques and procedures and bringing about major advances outside the USA'.

Clockwise from top left:

The Lincoln canopy system for growing apple trees.

The Rotodrill direct seed driller.

Evaluating chemical spray drift from fixed wing aircraft.

Frost protection studies.

Ross Thompson working with a red clover harvester.

seed-cleaning plant and a royalty-based profit-sharing arrangement negotiated, earning NZAEI/LVL more than $0.5 million by the time the royalty contract was terminated in 2008.

Research and development into a 'Rotodrill' rotary cultivator began in 1978 and continued into the 1980s. The machine was engineered to sow seed and fertiliser into a series of parallel slots in a single pass, and was used to introduce grass species into native and tussock grassland. Two commercial units were in use by 1981, with the manufacturer, Henry Engineering, receiving an award at the Hamilton National Field Days in 1981. A second prototype incorporated a number of features from the original Rotodrill into a modified imported machine and this demonstrated superior performance in field trials.

The greatly increased level of responsibility for regional water resources and slashing of government subsidies led to increased opportunities and demand for Institute expertise in all aspects of water management. Following the successful Glenmark Irrigation Scheme, a major irrigation feasibility study was initiated in the Hakataramea Valley in South Canterbury in 1981 and a water resource study competed for the Rangitata area in 1986. Other work included flood plain management planning for regional councils, a computer model was developed to model the effects of irrigation on water resources on the Canterbury Plains as well as a number of other catchments, and numerous irrigation feasibility studies were completed.

Prophetic

"It would be a real shame if the Institute, MAF and the DSIR were all competing for the same research dollar."

(Dr Terry Heiler, Director, 1985)

With the explosion of new techniques for sprinkler irrigation, including big guns, rotating and fixed booms and centre pivots, problems of poor subsurface uniformity were emerging. This saw the genesis of work investigating the physics of water entry into and infiltration through soil, work that later expanded into important research programmes for the Institute and is still of critical significance today.

NZAEI was developing strong computing capability and a computer-aided design package for horticulture irrigated systems was initiated in the mid-1980s. The software allowed high quality irrigation system designs to be produced and costed,

Clockwise from top left:

Neil Pasco extracting sugar from beets in the ethanol plant.

One of the many NZAEI publications.

Vince Bidwell overseeing operations at the beet ethanol plant.

N.Z. AGRICULTURAL ENGINEERING INSTITUTE

nzaei

The N.Z.A.E.I. carries out research, development and testing projects for the benefit of New Zealand's agricultural and horticultural industries. The professional engineering skills of the Institute are used by other research agencies, local and central government, farmers, growers, and the servicing sector of the industry.

The Institute offers a commercial testing and consulting service, and has been involved in:

- Testing of commercial products.
- Assisting industry with new developments in equipment and componentry.
- Joint venture promotion of its own developments.
- Market survey advice in the agricultural area.
- New Zealand and overseas consultancies related to land development projects.

SOME OF OUR ACTIVITIES AND FACILITIES
(Illustrated on left)

1 Field evaluation of new direct drill.
2 Improved designs for horticultural structures.
3 Chemical analysis—Pilot plant studies.
4 Development of machinery for new horticultural production systems.
5 Materials testing.
6 Sprinkler testing.
7 Laboratory calibration of helicopter borne fertilizer spreader.

including the hardware componentry. IRRICAD was launched in Australia in 1988, where it quickly became a market leader. A popular feature was the regular IRRICAD training courses run by the company – still offered today.

The preparation of farm engineering design manuals was maintained during the decade and included publications for farm waste management, sprinkler irrigation, fencing, and training courses on new spraying equipment and techniques. During the early 1980s, the Institute maintained production of four newsletters per year to a mailing list of greater than 800. Staff regularly contributed to the NZ Farmers Weekly trade magazine and presented at National Field Days in Hamilton and at local demonstrations at Lincoln. Two television programmes were produced in 1980 – one on fruit production and the canopy system for growing fruit, and the other on tractor fuel conservation. However, by 1989 increasing commercialisation initiatives and user-pays research funding caused an abrupt reduction in scientific and extension publications, and an increase in confidential reports to clients.

By the mid-1980s, the Institute staff numbered 53, but the chilly winds of government funding cuts began to bite in the latter half of the decade and by 1988 New Zealand agriculture was facing depressed economic circumstances. In 1985, the Institute's MAF grant was frozen for the next three years, equating to a 40% reduction in real terms from the 1983/84 grant level given these years of rampant inflation. The end of the decade represented the last financial year applicable to the grant funding environment. Consequently, NZAEI put increasing emphasis on contract research and special projects for private industry and government departments. The total income for the company in the 1989/90 financial year was $2.1 million, 32% being derived from commercial contract work. Staff numbers had dropped to 36 by the end of 1989 and some staff were reduced to monthly contracts. In light of the changing nature of the Institute and further funding changes forecast for 1990, the Management Committee reduced its numbers from 11 to five members.

More awards

- Electronic stock scale – Field Days, 1980
- Rotodrill (Direct Drilling Machine) and Henry Engineering – Field Days, 1981
- Inspection window – Prototype Certificate of Merit, Field Days, 1986
- Educational Aids Competition 'Tractor Facts' – Blue Ribbon Award, American Society of Agricultural Engineers, 1987

Clockwise from top left:

An apricot grading table.

Viewing through the NZAEI inspection window.

Cover page from one of the many NZAEI publications.

Field work in tussock high country.

An early kiwifruit harvesting prototype.

1990-99
A more commercial focus

1990 saw Lincoln College become a fully independent university. In 1991, the Lincoln University (LU) Council requested a reorganisation of the University's trading and units and NZAEI became the single largest entity of the LU LINLINK group. NZAEI's Director, Dr Terry Heiler, was appointed Director of LINLINK Services Ltd; other participants included the Agribusiness and Economics Research Unit, Blood Typing Unit, Farm Advisory Service, Kellogg Farm Management Unit, Plant Protection Research Unit, Wool Measurement Service and Lincoln International Shareholdings.

The Institute was renamed the AEI to reflect off-shore expansion – a Melbourne office was opened and staffed by Mr Trevor Pratt in order to explore opportunities and secure Australasian contracts. The office remained open until 1992.

In December 1993, AEI merged with a number of Lincoln University business units (Centre for Resource Management Consulting, Centre for Resolving Environmental Disputes, Kellogg Farm Management Unit) to form Lincoln Ventures Limited (LVL). Dr Peter John was appointed as its establishment chief executive and staff were employed by the company, and not Lincoln University. The limited liability company was (and Lincoln Agritech Limited remains) wholly owned by Lincoln University, governed by a Board of Directors. The inaugural Chair was Lincoln University Council member, Mrs Pansy Wong, and other foundation Board members were LU Vice-Chancellor, Professor Bruce Ross, LU Registrar, Allan Sargison, former Chancellor, Sir Allan Wright, as well as Syd Bradley, Bruce Ash, and Bob Dewar.

With a new commercial focus, LVL aimed to provide a major interface between the University and the commercial and industrial world. Four LVL divisions were formed to deliver research and development, consultancy, project management and IP development services: Lincoln Environmental, Lincoln Technology (including agrichemicals, postharvest, and sensor development), AEI Software (IRRICAD) and Lincoln Software. Staff continued to work collaboratively with LU staff as well as pursuing their own research and consultancy interests. In 1997, there was further restructuring of Lincoln University's trading ventures, with Lincoln University Holdings Limited established to oversee the performance of LVL, Lincoln Hospitality, Lincoln International and the University's commercial farms.

The early 1990s saw a significant restructure of the science system in New Zealand. The Government withdrew non-contestable input funding and introduced competitive funding rounds administered through the Foundation of Research, Science and Technology (FRST). The Department of Science and Industrial Research (DSIR) was disbanded and the Crown Research Institutes (CRIs) created in

Lincoln Ventures Ltd

- new interface with the business and commercial world

THE university as an intellectual resource at the service of society is the philosophical cornerstone of a new campus-based grouping, Lincoln Ventures Ltd.

Incorporated at the end of 1993 as a limited liability company wholly owned by Lincoln University, the new body is headed by Chief Executive Dr Peter John and governed by a Board of Directors chaired by Mrs Pansy Wong, a member of Lincoln University Council.

A publicly-funded university's obligations to society are discharged in many different ways. The most obvious is the production of graduates, as a contribution to society's desired goal of having an educated citizenry. This is largely achieved through teaching.

Equally important as a socially desirable goal is the advancement of knowledge, and universities concern themselves with the fulfilment of this task through their research function.

These obligations - teaching and research - are recognized by Lincoln Ventures as the core business of Lincoln University and the Company sees itself as offering enhancement and complementarity in these areas.

"By focusing on Lincoln University's involvement with the wider community and maintaining a portfolio of enterprises which reflect the University's business and realise commercial returns, Lincoln Ventures is actually able to play a strengthening role in the life of the institution," says Dr John.

"We see ourselves as one of the major interfaces between Lincoln University and the commercial and industrial world populated by client/customers seeking particular categories of knowledge and expertise."

The Chief Executive of Lincoln Ventures Ltd, Dr Peter John.

Lincoln University Outlook article announcing the establishment of Lincoln Ventures Ltd

its place. This represented a major change to the way LVL was funded and ushered in the era of writing regular funding proposals in an increasingly competitive process. In 1992 and 1993, LVL secured FRST funding totalling $1.3 million and $1.5 million, respectively, representing approximately half the company's total annual income.

By 1995, LVL was well-established. In addition to FRST-funded programmes, projects included research activity with the Lincoln Soil Quality Research Centre and collaborative projects between LVL and Lincoln University's Department of Soil Science. A major commission was awarded to co-ordinate research for the Mussel Industry Council, and an Environmental Policy and Code of Practice for the industry was completed in 1997. LVL continued to be a major contributor to water management research and land disposal of waste. Staff also established and helped form standards and code of practices for the use of agri-chemicals and fertilisers in New Zealand, with the national Spreadmark fertiliser application quality assurance scheme being successfully introduced and sought by the Australian industry. In a first for New Zealand, LVL introduced a commercially viable olfactometer for quantifying the intensity of odours in the vicinity of piggeries and meat works, primarily for resource consenting.

Research into developing a simple yet accurate soil moisture measurement device had been initiated in the 1980s and incorporated new techniques in electronics. A joint venture with Streat Instruments was established in 1996 to produce a first prototype of the moisture sensing device, for timber drying. The LVL-patented Aquaflex soil moisture measurement technology was completed in 1997. By 1998, Aquaflex units had been exported to the UK, Australia and the US, and units were installed in high profile sites such as the Millennium Stadium and Leeds United Football Club, in a marketing push for sales in non-agricultural venues.

Two large artificial aquifers were built in 1997 as part of a major FRST-funded programme, allowing LVL scientists to investigate important issues surrounding ground water contamination in New Zealand and to develop models for predicting contaminant transport in soils and aquifers. At the time, there were only two other similar facilities in the world and the LVL facility attracted significant international interest.

A biosensor programme, initiated in the early-1990s with FRST funding, developed an exciting new biosensor technology for rapidly measuring pollutants in water substantially faster than conventional tests. The technology was patented and work progressed to optimise the MICREDOX™ technology for measuring pollutants in waste water treatment plants, for process control, and for detecting toxic substances in waste streams.

Clockwise from top left:

Neil Pasco, Joanne Hay and Judith Webber collecting water samples for testing.

Measuring the forces applied to tomatoes in transit.

The MICREDOX™ prototype.

QPod container demonstration

The IRRICAD display stand at an Australian trade show in 1988.

By the end of the decade, the Hamilton-based Postharvest Group was conducting a substantial research programme into postharvest-handling, including transporting fresh fruit and designing packaging and handling systems. The research aimed to develop a toolkit for the food industry to minimise damage to products through package and handling design. With FRST funding, a palletised mini-container system – QPod – was designed to improve storage and transportation of chilled meat products. Some twenty units were produced and leased to Foodstuffs and Zespri, with a number still being used today. In another project, sensors were applied to measuring the forces fruit, such as apples and tomatoes, were subjected to in transit and these were tested in orchard bins as well as in transportation cartons for ENZA.

A notable success story was the IRRICAD computer software package. Following its release in Australia, IRRICAD was released in San Diego in 1992, with packages subsequently sold in the USA, Canada, Brazil, Guatemala, Mexico and Argentina. By 1995, IRRICAD was being used in 30 different countries, including India and Malaysia. An exclusive marketing and distribution agreement was signed with Nelson Irrigation Corporation of Washington State, and by 1996 there were record sales of the software in North and South Americas. By 1999, the IRRICAD package had earned LVL more than $2 million in foreign exchange.

IRRICAD
IRRIGATION DESIGN SOFTWARE

And more awards:

- Aquaflex – New Zealand Electronics and Software Excellence Awards, The Electronic Product Excellence Award (Highly Commended), awarded to Streat Instruments and LVL, 1999
- In-forest log testing (an LVL technology) – Forest Research 'Technology Innovation Award' awarded to Fletcher Challenge Forests Sonics Team, 1999

TECHNOLOGY

Streat strikes success

Christchurch based Streat Instruments is reporting encouraging export sales of their groundbreaking 'Aquaflex' soil moisture measurement systems, just 18 months after the product's commercial release.

Aquaflex's unique features, promoted through an extensive customer education campaign, have led to sales in five countries. Eighty to 90% of current sales are export bound, says Streat Instrument's product sales manager, Peter Johansson.

Included among Streat Instrument's higher profile customers are a number of English premier league football clubs. Turf culture applications with football pitches, cricket wickets, golf courses and horse-racing tracks currently account for close to a third of Aquaflex sales.

The remainder of orders are split between research institutions and the agricultural sector, where Aquaflex moisture meters, data loggers and associated computer software are being employed to take the guess-work out of watering and irrigation needs for dairy and crop farmers.

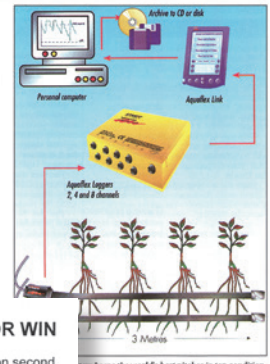
The core Aquaflex technology, which uses a technique known as Time Domain Transmission (TDT), was developed in the early to mid 1990s by Lincoln Ventures Limited (a company wholly owned by Lincoln University). At the request of Lincoln Ventures, Streat being offered the licence to market the technology worldwide in 1997.

An authorised Aquaflex distributor network has been established by Streats in New Zealand, Australia, the United States and Europe.

The market for soil moisture sensors is relatively new, says Johansson, and with new territory comes the responsibility of educating potential customers; typically farmers or groundskeepers used to making subjective judgements of soil moisture levels. Actual field demonstrations are often required to impress upon potential users the increased crop and turf quality that comes through having precise soil moisture data.

Customer education is also necessary to overcome the perception, created by inferior products on the market, that soil moisture sensors are inaccurate, he says.

"Aquaflex was specifically developed by Lincoln Ventures to overcome the problems associated with existing technologies. Namely, that they measured soil moisture content at one point only and that measurements were based on a relatively small volume of soil. Because soil



...tem Keeps the world's best pitches in top condition.

...es. In line with the various Australian authorities ...systems, the Christchurch City Council will be ...the moisture levels of parks throughout the city ...controlled terminal and adjust irrigation patterns

...nents was chosen by Lincoln Ventures to license ...use of the company's proven expertise in mois... ...nt technology, says Johansson. ...novations include the release of meters capable ...o most other data loggers on the world market ...months, meters that will transmit data telemetri... ...ires).

The Lincoln tractor takes a rest after placing second at National Field Days in June.

LINCOLN TRACTOR WIN

John Milne's tractor team won second place this month in the super modified tractor pull at the National Field Days in Hamilton. The shipping company COSCO sponsored this years event, and an all out effort was made by all the competitors to promote the sport to the public. The standard tractor pull event has been a staple at agricultural shows for years, but the super modified --a much faster and noisier version, was created six years ago for promotional purposed. Enthusiastic crowds have since established the event's popularity.

This year, John's team only lost one race, but ended up 4.2 seconds behind the winner for overall time. The Lincoln tractor's best time in the 100 meter dash pulling a one tonne load is 11.51 seconds: standard tractors cover the same ...

Canty biotech venture opens up $1.99b market

Paul Gorman

"Watch out Otago" is the message from new biotechnology start-up company Aotea Bio, which has announced its first major venture, Micredox.

The venture is an environmental measurement system invented by Dr Neil Pasco , a chemist at Lincoln Ventures, the commercial development arm of Lincoln University. Aotea Bio, Griffith University in Queensland, and Lincoln will commercialise the system, which Aotea Bio says can measure the level of organic pollution in water in hours rather than the current industry standard test of five days.

Aotea Bio chairman Stephen Lyttelton said market research had shown the size of the Micredox market could be more than $US1 billion ($NZ1.99b) a year.

The company has issued a prospectus seeking investment in its share issue of 50 million shares at 10c each. Mr Lyttelton said the company was not planning on listing on the Stock Exchange.

The minimum number of shares which can be applied for is 50,000, with the minimum amount to be raised through the issue set at $3 million.

In the prospectus, Mr Lyttelton said $5m had been targeted for the purchase and commercialising of Micredox. Aotea Bio reserved the right to accept a further $5m if the issue was oversubscribed and this would be used for securing and developing other biotechnologies.

Mr Lyttelton said Canterbury had "fallen behind the eight-ball" when it came to biotechnology.

"Otago University has rocketed ahead with these kinds of things. Well, no longer. Now it's time for the Canterbury region to get on with it."

He had known immediately on seeing the system it was technology with "great promise".

Possible markets included food processing plants, pulp and paper mills, breweries, and abattoirs. As well as its uses for waste water quality testing, the system also had applications in pharmaceutical testing for antibiotic susceptibility, he said.

"For Canterbury, this technology will be enormously useful, given the issues with water quality. It has the potential to ensure safe water worldwide."

Dr Pasco, who developed Micredox with a research team of up to five in recent years, came up with the idea of using a cocktail of known bacteria which can metabolise the different components of the effluent in 1997.

Quick results: Lincoln Ventures chief executive Dr Peter John, left, and Aotea Bio chairman Stephen Lyttelton analyse waste water with Micredox inventor Dr Neil Pasco.

PHOTO: DEAN KOZANIC

From top to bottom:

Export News article (17 May 1999) reporting sales of Aquaflex instruments.

The NZAEI team won second place at the tractor pull event at National Field Days in June 1996.

Christchurch Press article (2 December 2002) introducing MICREDOX™ start-up company.

2000-today
Challenging times

In 2000, LVL was restructured to include the Plant Protection Research Group; research continued into supply chain systems, water engineering, data analysis, systems modelling and information technology. By 2001, the company employed 48 staff funded through FRST Public Good Science contracts, as well as commercial contracts with New Zealand clients.

During the decade, FRST funding represented a substantial portion of LVL's revenue with more than $34 million secured for research into electronic sensing, environmental and biosensor development, biomarkers, groundwater allocation and quality, spray and vapour drift management, and tomographic sensors.

LVL remained a key player in many of New Zealand's large water resource and irrigation developments. In 2002, staff prepared a major report, 'Canterbury Strategic Water Study', which quantified the water resources of the Canterbury Region and the likely future demand for water. The report included results of a new technology for assessing groundwater resources, the 'eigenmodel', developed at LVL. This report was the first in a series that formed the technical basis for Environment Canterbury's 'Canterbury Water Management Strategy', the current framework for managing all water resources in the Canterbury Region and which also addresses the quality of natural waters as a result of land use and its ongoing intensification. LVL has been a leading contributor to the development of tools for assessing nutrient losses from agricultural land and managing the impact on receiving waters.

In 2004, a new company called Aqualinc Research Limited was formed, offering water engineering consulting services and headed by former LVL staff from the environmental division. The subsequent departure of most of the consulting staff from the Lincoln office resulted in the remaining environmental staff being largely research-focussed, with the core staff based in Hamilton.

An innovative vadose zone monitoring and experimental facility, called the Spydia, was developed by LVL environmental staff and their partners and established in the Lake Taupo catchment in 2005. The facility was successfully used for six years to study water and contaminant movement between the soil surface and the underlying groundwater.

Clockwise from top left:

Brian Moorhead conducting tracer experiments at the Spydia facility.

Ian Woodhead working at the Spydia facility.

Log strength testing by Fletcher Challenge staff using LVL-developed technology.

Leanne Banks analysing pesticide residues for the Plant Protection Research Group.

Brian Moorhead working inside the Spydia facility.

2000-today

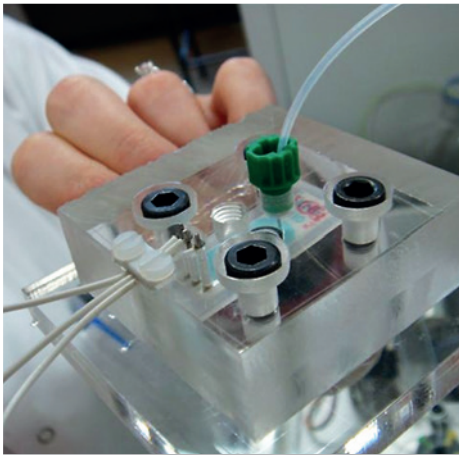
In 2005, Dr Peter John resigned from LVL to take up a position at Lincoln University. He will be remembered for successfully guiding the company through the turbulent transition from input funding to the competitive model administered by FRST, and for the high success rate the company enjoyed in securing long term funding from FRST.

He was replaced in 2006 by Mr Graeme Robertson, previously chief executive at Cawthron Institute in Nelson. Mr Robertson oversaw the negotiations with Netafim for the Australian distribution rights for IRRICAD and negotiated a commercialisation agreement for the MICREDOX™ technology.

LVL successfully secured funding to commercialise the patented MICREDOX™ technology and subsequently took up a shareholding in Scitox Limited, the company formed to commercialise the technology. A further round of capital raising was successfully completed in 2008.

Reduced funding for the Supply Chain Systems Group saw that group closed in 2008, with the loss of staff from the Hamilton office. This, plus fewer commercial contracts, saw overall LVL staff numbers dwindle to 32 FTE by 2008.

Faced with increasingly bad health, Mr Robertson retired in 2009 and was replaced by Mr Peter Barrowclough. 2009 also saw changes to the Board of Directors, with Chair Mr Gary Leech resigning and being



Opposite page top to bottom:

Neil Pasco and Claire Clark taking lactose measurements at a dairy processing plant.

The Menixis prototype for counting faecal parasites.

The ColourStick for measuring kiwifruit ripeness.

Clockwise from top left:

Sean Richards talking to the Livestock Improvement Corporation shareholders council about on-farm automation.

Prototype soil moisture sensor for Smarter Irrigation.

A lactose-sensing flow cell.

GrapeSense measuring canopy porosity.

replaced by Mr Ted Rogers. The number of Directors was reduced to three.

LVL technology staff developed an image analysis platform, IMBADA, based on inexpensive video cameras and processors coupled with smart digital signal processing software. Diverse applications of the platform included data on customer responses to product displays, crop analysis for the wine and kiwifruit industries, football sports tracking and road traffic management.

A number of new technologies with commercial potential emerged by the end of the decade, primarily resulting from FRST-funded research: Fielderview, a technology to track fielder movements on a cricket pitch and featured on TV for cricket matches screened in New Zealand in December 2006; Feedback Football, a player tracking technology trialled in the second division of the UK football league in 2005; Time Domain Reflectometry Imaging (TDRI), a non-invasive moisture detection system with its first application in the roading industry; Kiwicount, image processing technology for estimating New Zealand's annual kiwifruit crop, used by Zespri, Seeka and Ag First; GrapeSense, an image-based research tool for determining the canopy porosity characteristics of grape vines, with units sold in Europe and Australia; and a lactose sensor for detecting lactose concentrations to very low levels in real time, trialled in Fonterra dairy processing factories.

One of LVL's most senior water researchers, Dr Vince Bidwell, received the Hydrological Society's Outstanding Achievement Award in 2009.

2010 and 2011 will forever be remembered for the Christchurch earthquakes. Although no staff members were hurt, some lost friends and associates and many experienced damage to their homes and properties. The Lincoln campus was closed for many days in September 2010, and in February and June 2011. Since that time the company has supported staff, allowing them time to repair their houses and focus on their private lives while providing moral support. The ensuing accommodation crisis created by the earthquakes has continued to make recruitment from outside the region challenging.

Right top to bottom:

The Kiwicount buggy in action.

Country News (July 2005) article describing the Kiwicount image processing tool.

COUNTRY NEWS, JULY 2005 27

HORTICULTURE

Checking kiwifruit quality goes hi-tech

By VAL SHERRIFF

GO-KARTS are not usually considered orchard research tools, but the innovative team at Lincoln Ventures is using one to check kiwifruit.

Not just a go-kart but lights, cameras and a laptop computer are part of the tool kit being used to count fruit, assess fruit quality and check size variability.

The work to test the Imlada system was carried out in Te Puke last month by a team led by Dr Frank Bollen of Lincoln Ventures Ltd's supply chain systems group. Dr Bollen is a research engineer working for Lincoln Ventures — a Ruakura-based stand-alone company owned by Lincoln University in Christchurch.

"Manual fruit counting is a tedious task and is not always accurate," Mr Bollen said. "Fruit density varies throughout orchards making manual estimates accurate only 60 per cent of the time."

To get around the problem Dr Bollen and his team have used real-time image processing and computer power making it possible to video kiwifruit canopy and count the fruit in the images at 4 to 6km/h.

"It's a project that combines several technologies in the field for counting kiwifruit. We thought if more kiwifruit bays could be economically sampled then estimate accuracy could be improved," Dr Bollen said.

The prototype system has worked well, and Dr Bollen said he expected to have an improved Imlada prototype available by this time next year.

He said Zespri needed accurate crop estimates so marketing could be planned and ships ordered as needed.

Packhouses needed the information too, so operations could be planned and the right amount of packaging ordered.

For growers the benefits were that they knew how much fruit they had and also how variable it was across the blocks. This would answer questions such as how well pollination worked and what sort of job the pruners did, as well as being a check for other orchard activities such as pest and disease control.

The go-kart was adopted for the system because it was a small, light but rugged vehicle that would fit under most canopies, and all the necessary technology could be attached and operated by the driver.

With all the lights operating much of the work can be done at night.

Driver Brian Moorhead said there were two teams trialling the system. He and Sam McKoy mostly operated it during the day and there was another team who did the night shift, beginning at 5pm.

LIFE ON THE GO: Sam McKoy (left) and driver Brian Moorhead count a kiwifruit crop.

2000-today

The most significant restructuring of the science system since the introduction of CRIs in 1992 took place in 2010. Funding provider, FRST, merged with the policy arm, Ministry of Research Science and Technology, to form a new ministry called the Ministry of Science and Innovation (MSI). Approximately 48% of the competitive science funding pool was transferred into core funding for CRIs making it unavailable to other research providers, such as LVL, and making it very much harder to gain MSI funding in the future. Further restructuring in 2012 merged MSI with a number of other ministries to become the Ministry of Business, Innovation and Employment (MBIE). In another major shift, ten National Science Challenges (NSC) were introduced in 2013 and some funding moved from the contestable pool into the NSC, further reducing available investment in the competitive pool.

Although the company had seen government funding for the environmental group reduced in 2010, the 'groundwater assimilative capacity' programme (jointly led by LVL and CRI, Environmental Science Research), was the top performer in an external review of water research at MBIE in 2013. New MBIE contracts were awarded in 2012 for smarter irrigation technologies ($848,000 over two years) and research into variable nitrogen application ($5.6 million over five years).

LVL's irrigation design software, IRRICAD, continued to perform strongly through the decade. A new web site for IRRICAD was finalised. Version nine of the software was released in 2007 as a result of irrigation giant Netafim using IRRICAD for its irrigation design services, worldwide. This was followed by Netafim taking over Australian and European distribution of the software. Nelson Irrigation Corporation continued to sell the package strongly in North and South America. Foreign language versions (French, Portuguese and Spanish) were developed, and an AutoCAD version is also under development.

In December 2012, Lincoln Ventures was renamed Lincoln Agritech Limited along with a rebrand of its marketing material and web presence. The new name better reflects the company's unique position as an agritech-focused science and engineering research company, and received positive feedback from the marketplace.

In a nod to the past, the precision agriculture research group was re-established in 2012. As part of a strategy to position the company as a leading provider of precision agriculture research, the Lincoln Agritech chief executive initiated and was founding Chair for the Precision Agriculture Association of New Zealand.

The company has actively sought to pursue professional fee income to mitigate its reliance on the increasingly

Clockwise from top :

Craig Burgess and Greg Barkle installing a monitoring well in the Pukemanga catchment with towers applying artificial rainfall to the hill slope in the background.

Installation of suction tube samplers in a soil pit for investigating nitrate transport and transformations.

Juliet Clague and Aaron Wall retrieving core samples.

competitive government funding. This has been successful with a 28% increase in professional fee income for research services between 2010 and 2013. Significant clients have included Zespri, Silver Fern Farms, TruTest, Dow, CropLife America, Warratah as well as regional councils, and Lincoln Agritech has seen increased repeat business from a number of these organisations.

Lincoln Agritech has continued to transfer its science to international and national audiences through science publications, presentations at conferences and meetings, client reports, attendance at field days and community meetings, and through post-graduate student supervision. Lincoln Agritech's focus on delivering world-class science and engineering has seen increasing international collaboration. In 2014, the company is currently collaborating with 22 scientific institutions and 11 of these are international.

Despite the ongoing difficulties experienced from the earthquakes' aftermath, staff numbers increased again between 2010 and 2014 and currently number 45, reversing the trend experienced in the late 2000s. The company now operates four divisions – Sensing Technologies (electronic and biological), Environmental, Software (including IRRICAD) and Precision Agriculture (including agrichemical spray drift deposition). Financially, the company has continued to deliver profits for its shareholder, Lincoln University, at a time when the University was under financial pressure, primarily due to the earthquakes. The total income for 2013 was $6.2 million, of which 25% came from commercial contracts.

Clockwise from top left:

Chief executive, Graeme Robertson, with Nelson Irrigation executives, Bob Rupar and Reid Nelson, during an IRRICAD marketing trip.

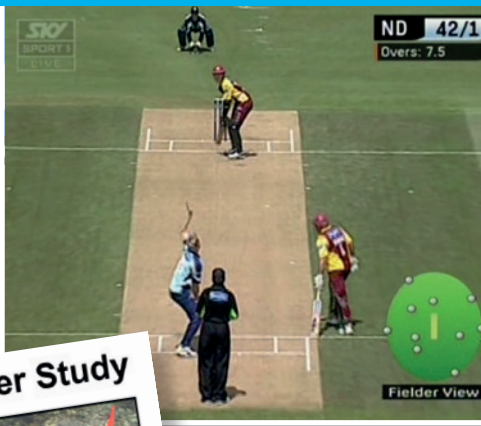
Fielderview technology being used on SKY Television.

Automated pest detection and monitoring device.

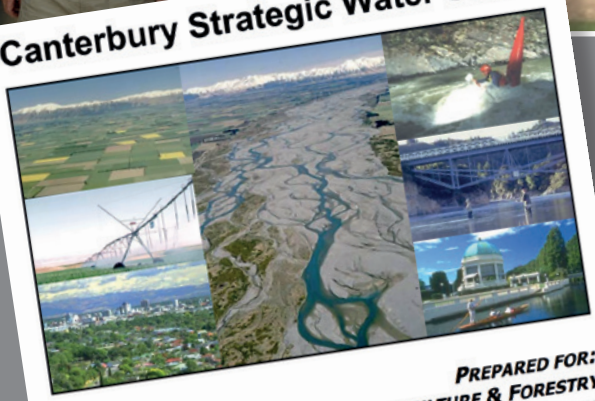
Phase Doppler Interferometer measuring air-borne particles from orchard spraying.

Rory Roten measuring nitrogen levels in pasture.

Cover page of the LVL-authored Canterbury Strategic Water Study.



Canterbury Strategic Water Study



Prepared for:
Ministry of Agriculture & Forestry
Environment Canterbury
Ministry for the Environment

What makes LAL special?

Some collaborative work with MAF scientists on mechanical harvesting of berry fruit was underway. As commonly happens, it became necessary to modify the harvester. NZAEI staff on the job asked where the nearest workshop was; to the astonishment of MAF staff, they set about cutting and welding to make the required changes. The ability to use a welder typified what made the Institute strong – these days it would be a different tool, piece of equipment, or computer technology. The mantra of 'what is the problem, what needs to be done to solve the problem, get on and do it, then check and refine' was integral to the NZAEI staff work ethic and is as strong today as it was then.

(John Maber)

Electrostatic spraying for psyllid in potatoes

The final word

The NZAEI was established as an institutionally-funded organisation that served primarily one industry group, agriculture. Industry representation was strong in the Management Committee, and technology transfer benefited from the established farm advisor network. Economic revolution led to uncertainty in the agricultural industry, disbandment of the advisor network, and a move to centrally managed competitive funding. The consequence was financial uncertainty for the University and the grouping of a number of business units to form LVL.

Although the role of LVL, and subsequently Lincoln Agritech, has become more diffuse, the company has successfully negotiated the changing fortunes of the funding landscape and fluctuations in the New Zealand economy. The skills employed have diversified to include research engineers, software developers, business development staff and specialist scientists with post-graduate qualifications employed to meet funding expectations. The centralised, competitive funding system has led to relationships with a broader client base, including local councils, industry and the manufacturing sector, as well as international collaboration.

The longevity of the company can be attributed primarily to the dedication and high calibre of the many staff that have worked here over the years. They have continued to adapt and deliver applied research with a passion for discovery and invention coupled with a down-to-earth pragmatism. Lincoln Agritech staff maintain a strong belief that what they do is important for the agriculture, environment and industry sectors they represent, and ultimately to the wellbeing of the New Zealand economy and its people.

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MEASURE. MODEL. MANAGE.
Engineering and Science for Agriculture, Industry and the Environment