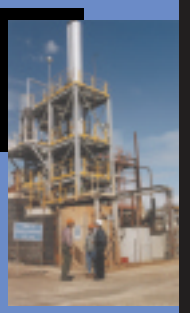
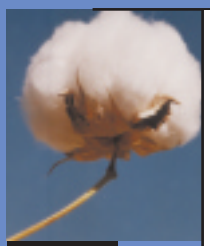
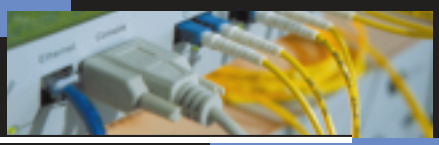


CRC ASSOCIATION

TRIUMPHS OF TECHNOLOGY TRANSFER:

Recent highlights of the Cooperative Research Centres Program





CRC AUSTRALIA

Established and supported under the Australian Government's Cooperative Research Centres Program

Triumphs in Technology Transfer is a snapshot of some of the significant recent achievements of the Government's Cooperative Research Centres Program and it highlights the contribution of CRCs to maximising innovation in Australia.

The CRC Program is a key element of the Federal Government's science and innovation system. It aims to maximise the economic and social benefits of publicly funded research and development for the wider Australian community.

The CRC Program strengthens collaboration between research organisations, government agencies, industry and other users. It overcomes problems that arise from the institutional and geographic spread of Australian research groups, and it facilitates the movement of personnel between government research organisations, academia and industry.

There are 65 CRCs across Australia covering a wide range of industries; those in Triumphs in Technology Transfer include the areas of manufacturing technology, information and communications technology, mining and energy, agriculture and rural-based manufacturing, environmental management, and medical science and technology.

The CRC Program focuses strongly on technology transfer to accelerate the uptake of new and innovative technologies by industry to achieve tangible economic and social benefits in all these industry sectors.

The 17 CRCs highlighted in this booklet have each made a significant contribution to achieving national benefits through new, collaborative approaches to research management, technology transfer and commercialisation.

Triumphs in Technology Transfer demonstrates the wide-ranging success of the CRC Program, and I welcome this opportunity to demonstrate the Government's continuing support for the CRC Program.

Senator Nick Minchin
Minister for Industry, Science and Resources

November 1999

Triumphs in Technology Transfer showcases examples of the fine results that have been achieved by the Cooperative Research Centres (CRCs) in recent years. They comprise many of the entries and the three winners of the CRC Association's inaugural Awards for Excellence in Technology Transfer which were given at the Conference of the Association of Cooperative Research Centres in April 1999.

The criteria for the Awards were that the technology was clearly innovative and had arisen from the CRC Program, and that the research outcome had been applied or commercialised with significant benefits for Australia and Australian industry.

When the CRC Program was initiated by the Australian Government in 1990, its main aim was to instigate a 'change of research culture' by attaining closer links between researchers and industry, following concerns that Australian industry was not readily using the results of research (by universities and CSIRO) or investing in their own research and development to a high degree.

The distinguishing features of a CRC are that it involves multiple participants from industry, the public scientific sector, universities, and other educational institutions, working together to solve technical problems in an innovative way.

Since its inception, the CRC Program has brought about research alliances between technical and scientific researchers and more than 1,100 enterprises, ranging from small businesses to some of Australia's largest companies. At present there are some 65 Centres across the nation. A unique feature of the Program is that it is based on long-term contractual agreements between the providers of research and the research users. Funding for another term or for new Centres is very competitive.

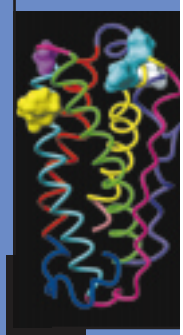
High level communication between participants is intrinsic to the Program as is research training, technology transfer, and outreach and community education. Postgraduate students who have taken part in successful CRC projects are eagerly sought by employers and this, too, helps to transfer technology to other users.

The direct benefits to industry and the nation (not least in export earnings) continue to grow into the millions of dollars, while the side benefits of technology transfer are incalculable.

Through the announcement of a Seventh Selection Round, the Commonwealth Government has pledged to continue its commitment to the CRC Program which has well and truly proven its value by boosting the competitiveness of all the major sectors of Australian industry and ensuring that Australia maintains and extends its science and technology base well into the 21st century.

A listing of the current CRC Association Members and their contact details can be found at the end of this publication.

OF MICE AND MEN: REPAIRING DAMAGED NERVES

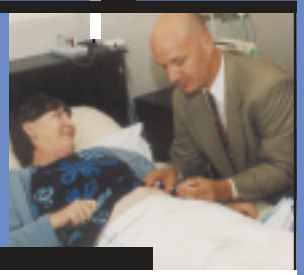


In 1987 the Walter and Eliza Hall Institute of Medical Research discovered a protein which it called the leukaemia inhibitory factor (LIF). LIF was soon commercialised as a laboratory reagent for the production of genetically manipulated mice. It was soon discovered, however, that the technology could also be of great benefit to human health.

The CRC for Cellular Growth Factors is a cooperative venture between five major institutions in the field of medical research and molecular science, and its researchers at the Walter and Eliza Hall Institute—working with colleagues in the CRC and other Melbourne research groups—found that LIF could play a biologically important role in the repair of nerves and muscles after injury.

This discovery was swiftly tested in clinical trials by AMRAD, the CRC's commercial partner, and the next stage of trials will test the efficacy of LIF in preventing the neuronal damage that can arise from chemotherapy for cancer.

But this will not mark the end of the story, for the CRC is discovering other applications and subsequent topics for research. In particular, the knowledge and skills generated by work on LIF enabled the CRC to develop a pilot screen for novel drug candidates. AMRAD Operations Pty Ltd then took up the challenge and developed and modified the technology to the point where it can be readily used in a high-throughput natural product screening program.



The story of LIF is a remarkable tribute to the concept behind the CRC Program. Without the commitment of the staff of all its constituent members to the principles of cooperative research, this CRC could not have achieved the commercial success of the project. It was essential to have multi-disciplinary teams which could plan, execute and evaluate basic biological experiments and then transfer the results rapidly to clinical trial and commercial development. More than 100 staff members of the five institutions have been involved in the development of LIF, while AMRAD invested over $10m in pre-clinical and clinical trials. A similar investment is planned for the new research that the discovery of LIF has suggested.

The exciting possibility of the efficacious use of LIF in the treatment of peripheral neuropathy holds the promise of reaching a worldwide market valued at $1 billion. Where the research will go next only the future can tell, but it is certain that the cooperative approach will continue to produce remarkable results.

CLEANER WATER AT LOWER COST

AWARD FOR EXCELLENCE IN TECHNOLOGY TRANSFER

Poor water quality and an attack by blue-green algae led Melbourne Water in 1991 to stop drawing from the Tarago Reservoir, some 85 km east of Melbourne. The reservoir's catchment area amounts to 11,400 ha, of which around 2,800 ha is in agricultural use. It was thought that pollutants were entering the dam from the agricultural land and that if the reservoir were to be used again, an expensive water treatment plant would have to be built at the site.

Melbourne Water realised that they could not afford to lose the Tarago Reservoir if the city's demand for water in the next century was to be met. In search of alternative ways of cleaning its water, they turned to the CRC for Catchment Hydrology.

The resulting project was innovative in several ways, not least in that it enlisted the cooperation of the landholders of the catchment area and involved them in every stage of the research. Melbourne Water provided funding to purchase materials for rehabilitation works and all but a handful of the owners of the 108 private properties concerned joined in constructing the works. Thus the researchers, the staff of Melbourne Water and the landholders themselves all gained a new understanding of the nature of the water pollution and the means by which pollutants travelled over land and into the dam. A valuable spin-off for the landholders was that they discovered new and better ways of managing their properties.

The prospect of treating such a huge area of land was daunting, but the research eventually showed that 90% of the sediment adjacent to the inlet tower (which most affected the water leaving the dam) came from only 5% of the catchment area. So by concentrating efforts there, much of the problem could be solved.

In the end the desired improvement was largely achieved by the cooperation of researchers, end users and the community in the research and the application of remedial methods. These included land management changes as well as the placement of bufferstrips along the dam's banks to reduce the flow of nutrients into the dam waters.

Melbourne Water has significantly reduced the cost of any future water treatment plant as the quality of the water directly affects the cost of treatment. The other major benefit is the reduction in nutrients entering the reservoir and the resulting reduction in algal blooms in the reservoir. The lessons learned at Tarago are now being applied elsewhere, not only in Victoria but by other water supply authorities. The CRC is currently developing a technology transfer program to enable its research results to be applied across Australia.

HEAD START FOR DAIRY PRODUCTS

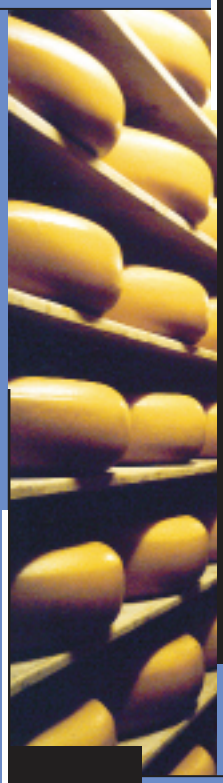
The commercial production of cheese, yoghurt and similar products relies on the use of bacterial 'starter cultures', but these cultures can be attacked and rendered virtually useless by viruses. The continuing cost to the industry of losses from these infections is a serious problem.

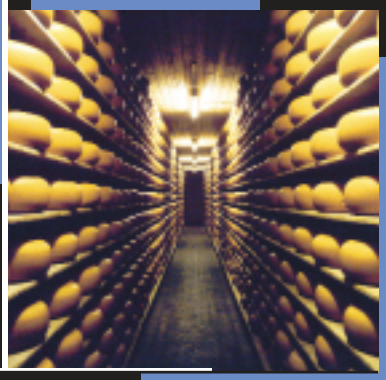
The CRC for Food Industry Innovation has been working closely with the commercial firm Gist-Brocades Australia Pty Ltd (GBA) to develop two ways of producing virus-resistant strains of starter culture. The first depends on improved procedures for selecting and validating virus-resistant cultures, while the second identifies virus resistance systems in starter cultures that can be transferred naturally into commercial strains thus increasing their virus resistance. A third approach which promises to offer good protection relies on gene technology and therefore will have to be processed through genetic manipulation regulatory bodies before it can be used commercially.

The virus-resistant strains are routinely produced in the CRC laboratories at the University of New South Wales (UNSW). They are then passed on to GBA where they are evaluated for their commercial suitability and—if the results are positive—they are put to practical use.

The work on virus-resistant cultures is an excellent example of cooperation between university research scientists and the commercial end user. Throughout the research, the university has had the advantage of the practical and commercial perspective of GBA, whereas the company has benefited greatly from access to the university's research facilities. This has been valuable in trouble-shooting and has also meant that some of the techniques developed and refined at UNSW could be adopted and routinely used by GBA.

The program has involved the training of researchers—some of whom have now gone on to employment with GBA, and has increasingly drawn in GBA's parent company in the Netherlands, with the result that an integrated research effort can be developed internationally. The production of commercially usable virus-resistant strains of starter culture is expected to benefit not merely GBA but the whole dairy industry in the long run.





COMPLEX MOULDING WITHOUT THE COMPLEX COST

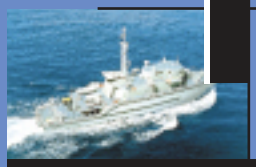
A mixture of high-performance resins with reinforcing fibres produces many familiar, moulded objects such as 'fibre-glass' boats, housings and domestic appliances. Ever more stringent demands are being made upon the manufacturing process to make items that are light, rigid, non-corrosive and fire-resistant. These even include military equipment which can resist or deflect projectiles.

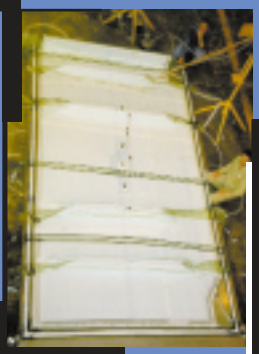
The manufacturing process has for decades looked deceptively simple: make a mould, lay sheets of fibre over it and apply resin. But this will not produce the high-quality materials required by the defence or aerospace industries. In the past, the hand-moulding method has been accompanied by a curing process that called for expensive autoclave and other equipment. Now the CRC for Advanced Composite Structures, in cooperation with ADI Ltd, has developed a method which combines the best features of previous systems without the high costs.

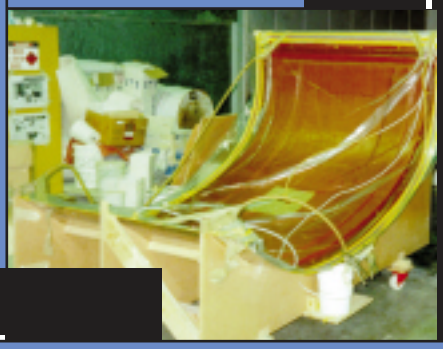
The new system is called the vacuum bag resin infusion (VBRI) technique and involves laying the dry fibre sheets over the mould, covering them with a flexible bag, extracting the air and then allowing the resin to enter under atmospheric pressure. It sounds simple, but a considerable amount of study and research was needed to perfect the technique. After years of effort, however, the result is a moulding method which produces the desired, high-quality mouldings in large and complex shapes and does so more cheaply, cleanly and efficiently than the older methods.

Although the impetus for research came initially from specialised applications, notably marine and large transport applications in the defence industry, the VBRI technique can readily be applied to a wide range of manufactures. This is rapidly occurring as the openness of the CRC arrangement speeds the transfer of technological knowledge throughout the advanced composites industry.

ADI Ltd has been able, through the use of VBRI, to enhance its position in the global defence industry and is now pursuing other markets such as ferries and urban transport. Success will mean a major boost to Australia's export capacity in an important manufacturing sector.







SOMETHING NEW IN BIOPHARMACY

AWARD FOR EXCELLENCE IN TECHNOLOGY TRANSFER

The search for new pharmaceutical drugs is never-ending and one of the most important modern developments is that of biopharmacy. In the process of developing these new drugs, the biopharmaceutical companies need to grow mammalian cells. Insulin is usually added to the culture medium to stimulate growth of these cells. This is a critical ingredient of medium if it is to be serum-free. The previous practice was to use fetal bovine serum, but fear of accidentally transmitting the dreaded 'mad cow disease' to humans has meant that the use of that serum is being avoided wherever possible.

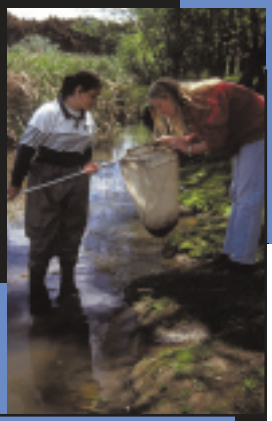
As a result of its research program, the CRC for Tissue Growth and Repair has been able to develop a substitute for insulin in such applications. It has been named LR3IGF-I and has been shown to be vastly more potent than insulin as a growth factor. This means that a biopharmaceutical company could use the new growth factor in a concentration only one five hundredth or one thousandth of that normally required of insulin.

The commercial success of the new growth factor, however, was seen to depend on its widespread acceptance by the biopharmaceutical industry and that in turn meant that it had to be available in much greater quantities than could be produced in a small laboratory. Accordingly, CRC Partner, GroPep constructed a manufacturing plant which can now produce more than 200 g of LR3IGF-I a year, with a market value of $4m.

Since the main markets for industrial cell culture are in Europe and the USA, efforts were made to establish a joint venture with an American firm. Eventually this operation with JRH Biosciences was so successful in marketing the new product that sales grew from less than 10 g in 1996–97 (worth $300,000) to 100 g in the following year (worth $1.7m). As JRH is a Division of the Australian company, CSL Ltd, this commercialisation is providing additional benefits to Australia.

It then became clear that a larger plant would be needed to produce enough LR3IGF-I to meet demand and a new facility is being built which will be able to manufacture amounts worth $30m per year. Since a leading American company now has US Food and Drug Administration (FDA) approval to release a drug which is manufactured with the use of LR3IGF-I, the Centre can now expect to receive increased income from royalties from GroPep's sales of the growth factor. As a result, the CRC expects that it will not be long before it can continue and develop its work without further Government funding.

RESCUING OUR RIVERS



Over the years, there have been sporadic, worrisome media reports about Australia's rivers—increasing pollution, reduced water flows, dying fish and so on—but hard scientific facts have been difficult to come by. For this reason the CRC for Freshwater Ecology decided to conduct a major and rigorous survey of the rivers of New South Wales in conjunction with NSW Fisheries to discover just how serious matters are.

Obviously, the survey had to be representative. The researchers therefore chose 80 sites, each of which represented five examples of river and land use types in four regions. The regions were North Coast, South Coast, Darling and Murray and the types were unregulated lowland, regulated lowland, slopes and montane river reaches. To ensure that the results could justifiably be extrapolated to all NSW rivers, the sites were selected at random. At each site, the fish and their habitats were studied intensively.

The results were startling. In a nutshell, the rivers of NSW were shown to be severely degraded. The fish communities in the rivers are stressed and declining and there is a rapid loss of biodiversity. Diseases and parasites are common in the fish and up to 25% of some fish species show visible abnormalities. In the River Murray system, there is cause for alarm—relatively few native fish now swim in those waters and only 52% of the species that are known to have been there in the past were recorded in the survey.

One of the major causes of the degradation was found to be the regulation of rivers for water supply. This not only affects the fish populations but also reduces the rivers' resistance to alien species.

The survey's results have had a major effect on government policy at all levels and substantial changes in the management of river resources are already taking place. The survey also developed a tool for monitoring the health of rivers. This, the fish-based *Index of Biotic Integrity*, is now routinely used by NSW Fisheries and the technology involved is available for use elsewhere.

In a country as dry as Australia, where every drop of water is precious, the health of our rivers is obviously of concern to everyone. The collaboration in this survey of the CRC and NSW Fisheries has produced a report which cannot be ignored and which, it can be hoped, will lead to effective remedial action before it is too late.

IMPROVED WELDING MEANS CHEAPER GAS

Australia has a lot of natural gas, but it is a long way from the homes, offices and factories of most of the people who use it. That means very long and expensive pipelines are needed.

The most effective ways of keeping costs down are to use thinner walled, high strength steel pipelines, and to build them very rapidly so as to minimise the construction costs. Both of these methods are possible, but they both pose challenges to the welding process used to join the pipes together in the field.

The CRC for Welded Structures (CRC-WS) has carried out research and field trials which have helped the industry to rise to these challenges. By way of an example of what has been achieved, the recent pipeline from Ballera in south-western Queensland to Mt Isa was constructed at up to 8 km per day, which is nearly 500 welds per day. The CRC-WS research made a major contribution to this by establishing safe limits to the parameters which govern welding speed and joint cycle time, and by ensuring that the greater demands upon the weld when welding very high strength steel were also met.

The participants in the CRC include ANSTO, the Australian Pipeline Industry Association, BHP, CIGWELD, CSIRO, DSTO, Pacific Power, TWI, four universities and the Welding Technology Institute of Australia.

As a result of their work, the gas supply industry has been saved—according to an independent estimate—more than $110m in the medium term; and these savings mean lower tariffs and consequent savings for Australian industry.

The savings are also important in allowing otherwise marginal projects to be viable. Projects such as the Eastern Gas Pipeline from Bass Strait to Sydney and the Papua New Guinea to Queensland pipeline have been favourably affected by the economies arising from these new technological approaches.

Many postgraduate students as well as experienced engineers from Australia and overseas have taken part in the CRC's research, including experts from pipeline manufacturers and the welding industry as well as the producers and distributors of natural gas. As a consequence, the expertise being developed through the Centre's work is also becoming widely available and the number of highly skilled engineers in the field is growing.

COTTONING ON TO NEW RESEARCH

The Australian cotton industry contributes $1.1 billion every year to the nation's economy. This comes from the sale of raw cotton, 90% of which is exported, and the production of meal and cotton oil from the seed. An industry of that size needs to be kept up-to-date with the latest technology if it is to remain competitive in world markets and maintain its profitability.

When the Australian Cotton CRC was established in 1993, the problem it faced was how to transfer technological advances to the cotton growers, many of whom were reluctant to adopt innovations either because they did not understand them or because they considered them irrelevant to their farms. In addition, the growers were under pressure from the community to farm in a more environmentally friendly way. In particular, the industry was accused of profligate use of water and insecticides.

This CRC has implemented a team approach to sharing with growers the benefits of research and to assisting in development of best practice management. There are now five focus groups within an extension team, dealing with farming systems, disease and weed management, environment, insect management and water use efficiency. These groups work on a national rather than a State basis and are thus able to deal with regional issues across political boundaries. A Technology Resource Centre has been set up with an education program that makes use of the Internet and traditional paper publications, and 61 students have completed a Cotton Production Course at the University of New England since 1994.

Already, the active promotion of best practice by means of extension programs and education campaigns has born fruit. Cotton growers are much more aware of the practices they can adopt to control pests and insects while reducing the use of pesticides, to use water more efficiently, to control weeds, and in many other ways improve the efficiency and productivity of their farms.

The Cotton CRC has contributed to the steadily increasing yields with greatly reduced use of pesticides that the cotton industry has enjoyed over the past six years and, as a result, the industry can look forward to a stable future.

TAKING OUT TAKE-ALL DISEASE

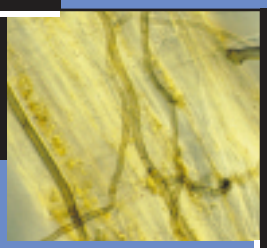
Cereal crops are constantly under threat from a wide range of pests and diseases and one of the most persistent is a fungus commonly known (and with good reason) as the Take-all fungus. Its technical name is *Gaeumannomyces graminis*. The extent of grain losses from this fungus has been enormous. It affects 35,000 grain producers in Western Australia, South Australia, Victoria and New South Wales and threatens some 4.8 million hectares of wheat and 2 million hectares of barley in Australia alone.

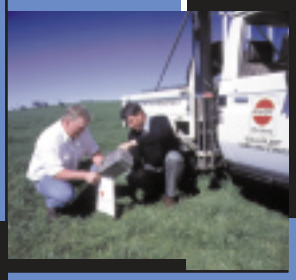
So great is the problem that the CRC for Soil and Land Management has developed an innovative DNA technique for detecting its presence in soils. In collaboration with its joint venture partner, the South Australian Research and Development Institute, it has commercialised the rapid, clean and inexpensive extraction of DNA from soil from which a fast, quantitative measurement of the Take-all fungus is made.

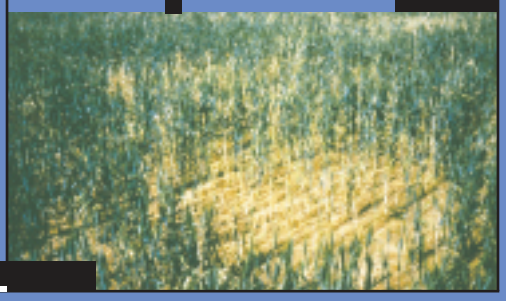
The work of the CRC is a world first. DNA techniques had not previously been used to quantify the level of soil-borne organisms and the information gained from this pioneering research is now being used to develop other forms of DNA soil assays. Moreover, it has proven possible to integrate the testing procedure into the established industry services for analysing soil nutrients.

From the farmers' point of view, it is all good news. Thanks to the new testing technique, they can apply appropriate land management measures and take more timely steps to prevent the disease which threatens their crops. It is estimated that the improved yield of cereal crops will be worth more than $100m a year to the producers. In other terms, the CRC predicts that the end user will gain an additional $150 per hectare from grain production on land where the disease is controlled. So it is not surprising that the number of farmers using the technique to test their soil has grown rapidly from the 2,000 involved in the pilot year. This year the CRC expected this number to rise to 4,000 grain growers with properties covering some 200,000 hectares.

Given Australia's position as a cereal grain exporter, the national benefits to be derived from the breakthrough are obvious.







PASSION FOR PULSES

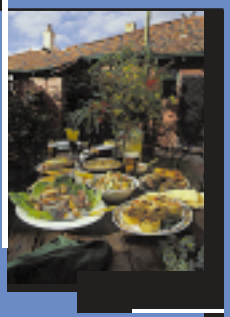
Pulses—notably peas, beans and lentils—have never formed a major part of the average Australian diet, despite their recognised nutritional benefits. Australia has nevertheless become one of the world's top three pulse-exporting nations. The growing of pulses, which took off virtually from scratch in the 1980s, is now worth around $558m per year and is expected to expand to a $1 billion industry by the year 2005.

Of course, this hasn't just happened. Behind the success story lies an intensive research and development effort which has been essential to develop new varieties of pulse adapted to different environmental regions. The CRC for Legumes in Mediterranean Agriculture (CLIMA) has worked closely with plant breeders and other researchers across Australia and with the industry through the Grains Research and Development Corporation (GRDC) to produce and support the new, high-yielding and high-quality pulses which have helped to make the Australian industry a major force.

There remains, however, a gap in the story. Australians themselves are not great consumers of pulses. In fact they have one of the world's lowest per capita consumption rates—less than 3 kg per person per year compared with around 5 kg in the UK and a huge 14 kg in Mexico.

With sponsorship from GRDC, CLIMA has taken unusual steps to remedy this deficiency in the local market. It has produced a cookbook. *Passion for Pulses*, published by The University of Western Australia Press, is already proving so popular that it has already been reprinted once since its March release, and distribution has begun in New Zealand. It has two aims. First, to increase the domestic consumption of pulses and so improve the industry's domestic market for its products. The second aim, important for long-term sustainability, is to let the public know more about the pulse industry and about the scientific research which enables it to keep up its quality and competitiveness.

Although there have been other cookbooks about pulses, this is the first time one has emerged from the industry itself. It is also probably the first time that a cookbook has been seen as a means of communicating scientific progress and development. Snippets of scientific and technological information are woven through the text, but the main message is to the cook: bon appetit!



BETTER WAYS TO PROCESS MINERALS

AWARD FOR EXCELLENCE IN TECHNOLOGY TRANSFER

When it comes to minerals, digging the ore out of the ground is only part of the story. The metals have to be extracted from the minerals embedded in the ore. One way of doing this is by means of hydrometallurgy—using solutions of chemicals to leach the metals out. The work of the A J Parker CRC for Hydrometallurgy is helping to improve this process which in many cases is already cheaper and cleaner than other extraction methods and can be used to produce the metals even in remote locations.

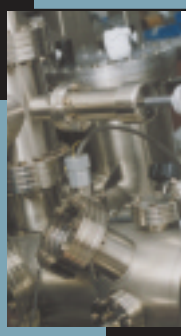
At present new investment in alumina, nickel, zinc, copper and gold is running at about $5 billion, so the cheapness and effectiveness of the extraction methods are a major concern to the producers. The CRC has already saved them very large amounts of money.

The CRC's new understanding of the chemistry involved in winning gold from the ore has led to major savings by producers who have been able to reduce substantially their use of cyanide and lime. A similar breakthrough in understanding another chemical process has meant that the cost of producing alumina has also been reduced.

Advances in thickener technology made by the CRC have greatly enhanced the efficiency of solid/liquid separation in the minerals industry. This has allowed producers to double their capacity and to make substantial savings in capital expenditure and operating costs.

The users of the CRC's innovations estimated that the direct net benefit to them in 1997 alone was between $10m and $20m. That figure will grow steadily as the technology spreads throughout the industry. An indicator of the value of the CRC lies in the employment of many of its professionals and postgraduate students in the minerals industry. The external earnings of the Parker Centre have continued to grow and the income from collaborative industry research reached $2.5m in 1998-99.

The work of the Parker Centre, which has its headquarters in Western Australia, but includes core research partners in Melbourne and Brisbane, is helping to maintain and improve Australia's international position as a producer of minerals.



OCEAN FERRIES WITHOUT SEASICKNESS

Seasickness on ocean-going catamaran ferries is being greatly reduced thanks to new technology developed by the Australian Maritime Engineering CRC in conjunction with Austal Ships Ltd. The technology, called the *Ocean Leveller* Ride Control System, stabilises the vessel by means of underwater fins and flaps. These adopt an appropriate configuration in response to a central computer which assesses the prevailing conditions through sensing equipment, calculates the best stabilising attitude and transmits its instructions to the hydraulic system.

The benefits are felt not only by otherwise queasy passengers but also by the crew who can work without the inconvenience and, sometimes, danger of turbulent motion in heavy waves. The vessels benefit too, since a smoother ride means less wear and tear.

The *Ocean Leveller* reduces the motion of fast ferries by up to 50% and it has already been installed on 22 vessels, earning Australia over $350m in export orders and nearly $20m in direct import replacement.

As a partner in the research, Austal Ships Ltd has gained a competitive edge in the fast ferry shipbuilding market and has used the services of the CRC for other projects, including the computer prediction of the motion of patrol boats when operating in a seaway. The new system has aroused considerable interest internationally and has helped to maintain and boost Australia's reputation for innovative technology, with staff of the CRC and Austral Ships presenting joint technical papers at international conferences. The computer programming developed for the *Ocean Leveller* has also been used to develop controllers for vessels with different hull forms and configurations.

WATER, WATER EVERYWHERE...

We turn on the tap and the water flows and flows. It is cool, clear and refreshing. And at less than a dollar a tonne delivered into our homes, water is the cheapest thing in town.

Water obtained from natural sources is not a pure substance but contains trace quantities of dissolved and suspended material of mineral, plant and even animal origin. So what can the consumer assume about its quality and safety? Here the CRC for Water Quality and Treatment has an important role, undertaking research to measure the relationship between water quality and public health and providing the knowledge and the means to improve the quality of our water supplies.

The key Australian reference on good quality drinking water is a document called the 1996 Australian Drinking Water Guidelines. These guidelines were jointly prepared by the National Health and Medical Research Council (NHMRC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). There are also international guidelines on drinking water quality developed under the World Health Organization (WHO). CRC researchers are contributing to the body of scientific knowledge upon which these are based. However guidelines developed for broad application internationally are not always going to be appropriate for Australian circumstances.

As a result of climate, the pattern of settlement and other local factors, providing quality water supplies to Australian communities can involve considerable and sometimes unique challenges. These can arise from such factors as the natural processes occurring in rivers and storages, the elevated levels of organic material in the water derived from vegetation in the catchment and the need to pipe the water over long distances and sometimes at elevated temperatures. CRC researchers are working to overcome these challenges and to provide the information upon which to base sound decisions about the quality and treatment of our water supplies.

The results of this research into the health and other aspects of water quality are being used to keep the Australian Drinking Water Guidelines up to date and appropriate to Australian circumstances. Thus the efforts of Australian researchers, working within the CRC, impact on every water authority in the country. The ultimate beneficiaries are Australians having access to pleasant, safe and affordable drinking water.

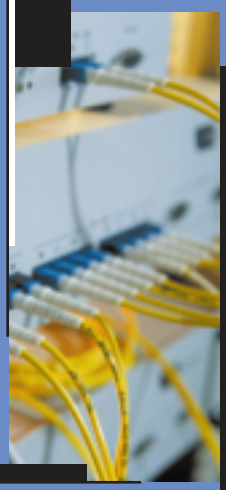
UNCLOGGING THE NET'S ARTERIES

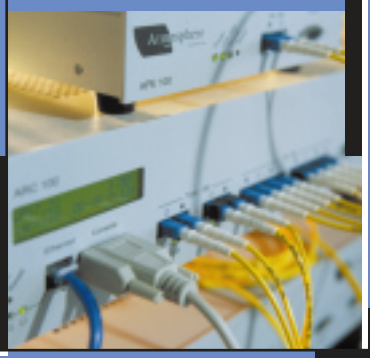
Most people are aware of the ever-increasing numbers of people and businesses around the world who connect to the Internet every day. Huge numbers of both home computer users and businesses gain access to the Net on the same phone line as they use for voice calls. Not surprisingly, the telephone companies are finding their lines clogging up. Many businesses, of course, use a dedicated line for data transmission, but it will not be long before these too show disastrous signs of overload. It has been estimated that in the next century data services will provide 80% of the revenue of public carriers, so it is essential that their networks can carry the data effectively.

Upgrading traditional equipment for existing fibre and copper phone lines will prove a difficult and costly solution to the problem. The Australian Telecommunications CRC (http://www.atcrc.com) believes that a speedier and more cost-efficient solution is to be found in the asynchronous transfer mode (ATM) local area network (LAN) technology that it has developed in response to this rapidly emerging problem.

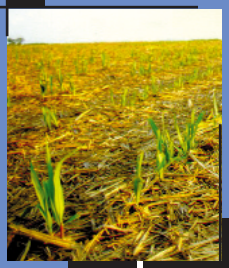
According to the CRC, the demand for networking access in the next century can be met by their product, an 'Outernet' which enables a thin layer of ATM to ride on top of the existing fibre infrastructure, thus preserving the investment that carriers have already made in metropolitan area network (MAN) infrastructure. The product will allow the same system to handle not only the continuous transmission of information, such as video or voice, but also burst transmissions such as Internet data.

The ATM LAN technology developed by the CRC has resulted in the formation of a spin-off company called Atmosphere Networks (http://www.atmospherenet.com) which, in turn, is committed to joining the new CRC as an industry partner. The technology itself is of high value to a global industry and its effect will be to enable carriers to effectively upgrade and expand their networks while providing significantly more reliable and efficient access to the Internet and other bandwidth-intensive applications.





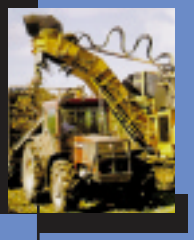
SUGAR GROWERS PROTECT AQUATIC LIFE



Acid sulfate soils contain sulfuric acid which, when it is released and oxidises, can reach concentrations which are toxic to aquatic life, resulting in the death of fish, degradation of streams and corrosion of concrete structures. When these and similar problems occurred on the north coast of New South Wales, many locals, particularly fishers, believed that cane farming was at least partly responsible. The CRC for Sustainable Sugar Production then joined the local industry in an attempt to remedy the problem.

The project began in 1995–96 and involved over 34,000 ha of land and 730 farms in an attempt to reach all 700 cane growers in NSW. Cooperative action between the CRC and the cane growers discovered the extent of the problem and developed effective means of dealing with it.

The first step was to appoint an environmental technician to visit the farms and—together with the land manager—take soil samples which would show whether or not acid sulfate soils were present. Laboratory analysis determined the acuteness of the problem and the quantity of lime that could be applied as a neutraliser. Where acid sulfate soils did exist, drainage management plans were developed, excavator operators were trained in recognising the offending soils, and management plans were worked out with growers. These actions substantially reduced the quantity of acid in waterways.

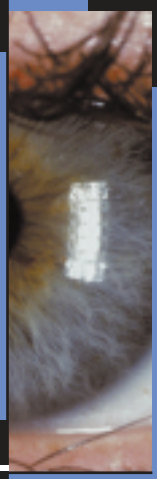


These cooperative actions were backed by constant exchange of views and information between the growers, the community and the media. Finally, the Sugar Milling Cooperative included clauses in its contracts with growers to ensure that best practice standards would apply.

The project started to show results within weeks of its inception and the handling of acid sulfate soils has now ceased to be a point of environmental dispute and become a routine management activity for farms and the industry.

The industry now has, for the first time, an acid sulfate testing laboratory, the technical knowledge of how to deal with the problem has been advanced and is being shared with other industries and landholders, and the cane growers have benefited from the improvement of their land management practices. Best of all, perhaps, the fishers and the cane growers are no longer at loggerheads.

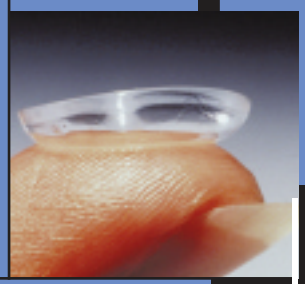
THE LENS THAT 'BREATHES'



How many people do you know who wear glasses or contact lenses? Probably more than you can count, because it has been estimated that nearly two thirds of the world's population (more than four billion people) need some sort of correction to their eyesight.

A great many of those would prefer contact lenses, for practical or aesthetic reasons, but baulk at the prospect of removing them every night and putting them back in again in the morning. Yet this is essential for the health of the eyes.

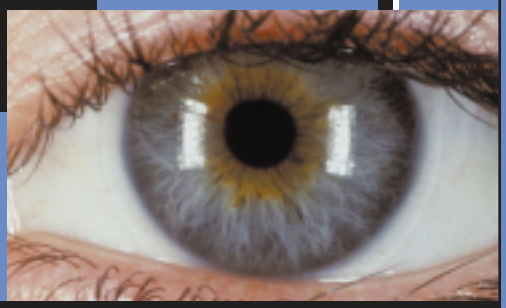
For over thirty years, the contact lens industry throughout the world has been trying to overcome this problem. What is needed is a lens that can be worn day and night continuously for as long as possible without affecting the eyes. Finally, the CRC for Eye Research and Technology (CRCERT), in collaboration with CIBA Vision, has developed a breakthrough in the form of a soft lens which is highly permeable to oxygen.



Because the lens allows the eye to 'breathe' oxygen through the lens from the eyelid during sleep, it can be worn continuously for up to thirty days and nights. The 'breathing' allows the transmission of three times as much oxygen as is available with conventional soft lenses and this, for the first time in the history of contact lenses, eliminates hypoxia and all its unpleasant side-effects.

In developing the new lens, the CRC and CIBA Vision created and evaluated more than forty new polymers and, at the same time, surface treatments have been developed which minimise lens fouling and enhance the 'wettability' of the lens—factors which are essential for the comfort and biocompatibility of contact lenses. In addition, a spin-off company is being set up by CIBA Vision, Novartis, CRCERT and the Institute for Eye Research to exploit the non-ophthalmic applications of the polymer research.

The collaboration has led to other projects that do concern vision, notably seeking to develop an artificial cornea and a 'smart' intra-ocular lens. The royalties expected to flow from sales of the 'breathing' lens will support future research and education in CRCERT.



THE COMPUTER IN THE SERVICE OF THE VINE

Growing grapes, especially for wine, is one of the world's oldest industries. Over recent decades it has also become one of the world's most competitive industries. Grape-growing is also an old-established industry by Australian standards, but until relatively recently was to a large extent small-scale and often family-based. Now the Australian wine industry has become a major exporter, able to hold its own against the stiffest international competition. Annual sales of Australian wine are projected to exceed $4.5 billion by 2025 and exports have already reached $1 billion.

As a means of helping Australia to keep its competitive status, the CRC for Viticulture—in collaboration with the viticultural industries—has produced a unique computer software package which vineyard managers are finding invaluable in the management of their land and their grapes. Known as AusVit, the software package has been eagerly adopted by some 200 industry users and has evoked considerable interest from North and South America, Europe, New Zealand and South Africa. The package is a world first, since previous attempts overseas to produce such a package failed to find a market.

AusVit keeps grape growers up to date with the latest research and best practice. It provides practical advice and usable tools for: managing pests and diseases; recording and scheduling irrigation, along with the monitoring of weather; keeping records of spraying; and recording any events that affect the vineyard, as well as offering invaluable information on agro-chemicals such as pesticides and herbicides. Its use is estimated to be worth more than $14m to the industry and the Australian community generally.

In particular, grape growers who use the integrated pest management (IPM) system are able to reduce costs, as well as produce 'clean and green' grapes and wine. This helps to give Australian exports a major advantage.

The value of AusVit does not stop with vines, however. It has proven a successful means of communicating scientific research discoveries to industry and it is expected that other industries will now proceed to develop software packages on the AusVit model.

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