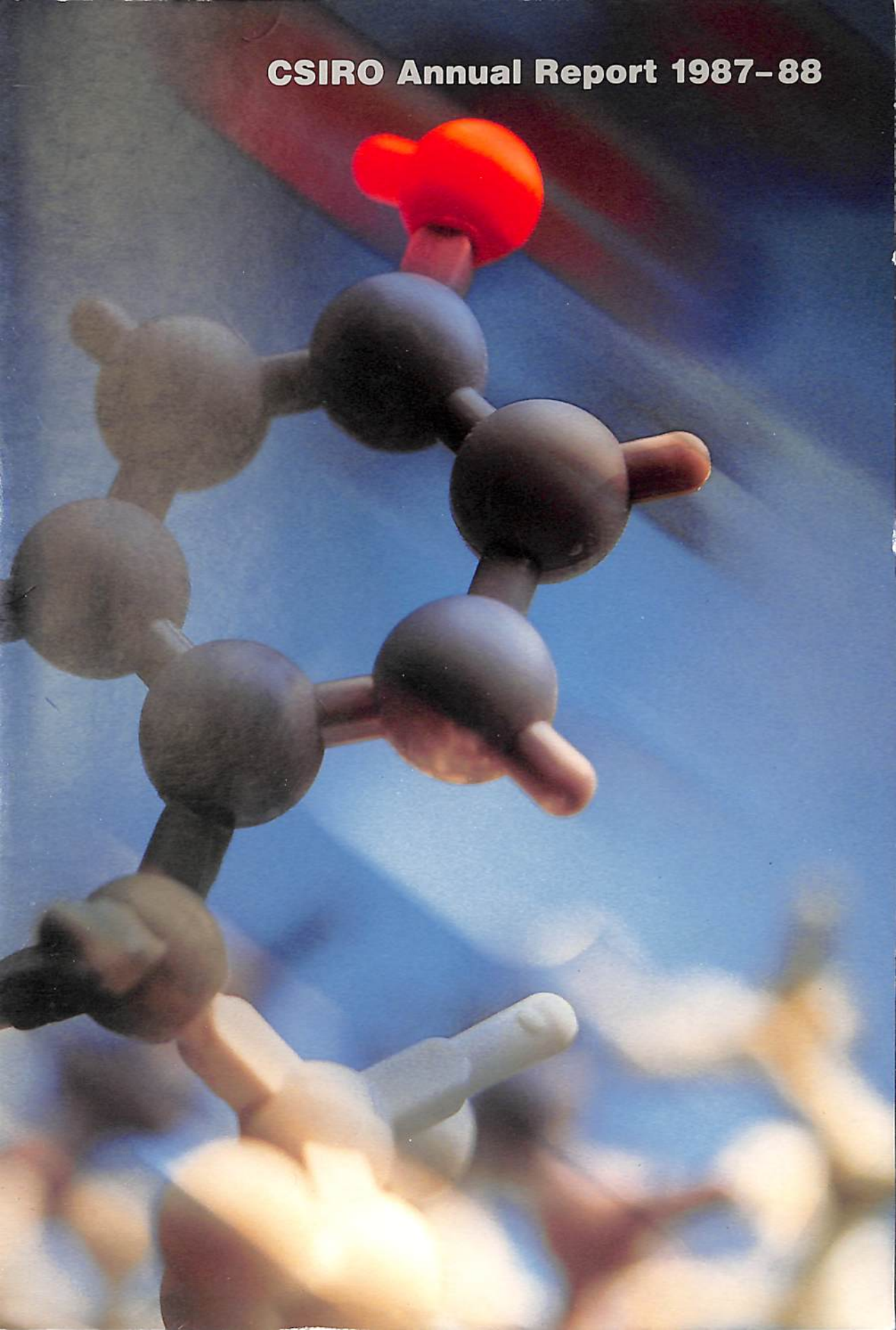
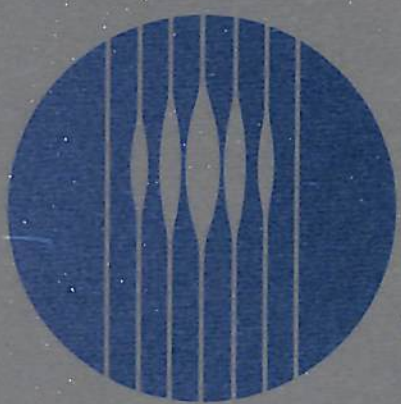
CSIRO Annual Report 1987–88



Front cover:
a model of a newly discovered muscle growth factor occurring throughout much of the body. (See story page 38.)



CSIRO

AUSTRALIA

The Honourable Barry O. Jones, M.P.
Minister for Science, Customs and Small Business
Parliament House
CANBERRA, A.C.T. 2600

We have pleasure in submitting to you, for presentation to Parliament, the fortieth annual report of the Commonwealth Scientific and Industrial Research Organisation.

Neville Wran
(Chairman of the Board)

N. Keith Boardman
(Chief Executive)

December 1988

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The Board is committed to maintaining and enhancing CSIRO's vital role in research for Australian industry and the community, and its tradition of scientific excellence.

Members and Terms of Office of the CSIRO Board

Chairman
The Hon. Neville Wran AC QC
Chairman of Whitlam Turnbull & Co.
Formerly Premier of New South Wales (1976–86)
5 Dec. 86 – 4 Dec. 91

Dr Keith Boardman PhD ScD FTS FAA FRS
Chief Executive of CSIRO
5 Mar. 87 – 4 Mar. 90

Sir Roderick Carnegie BSc MA(Oxon) MBA FTS
Company Director and President, Business Council of Australia.
5 Dec. 86 – 4 Dec. 91

Professor Adrienne Clarke BSc PhD
Director, Plant Cell Biology Research Centre, University of Melbourne.
5 Dec. 86 – 4 Dec. 89

Professor Kevin Foley MCom PhD
Foundation Professor of Economics at Bond University, Managing Director, Kevin Foley and Associates Pty Ltd
5 Dec. 86 – 4 Dec. 89

Dr Tony Gregson PhD DSc FRACI
Primary producer, formerly Associate Professor of Chemistry at the University of New England
5 Dec. 86 – 4 Dec. 90

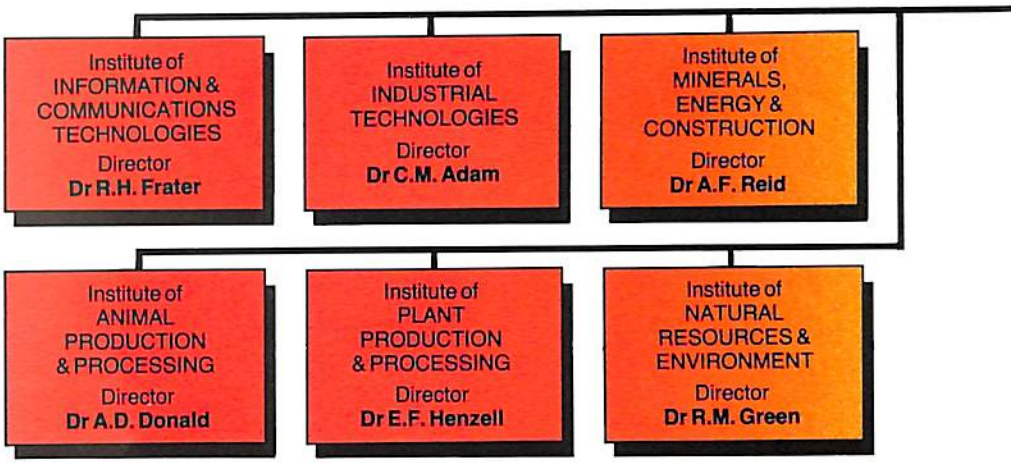
Mr David Hoare BEc AASA ASIA
Chairman, Bankers Trust Australia Ltd and AUSSAT Pty Ltd
5 Dec. 86 – 4 Dec. 90

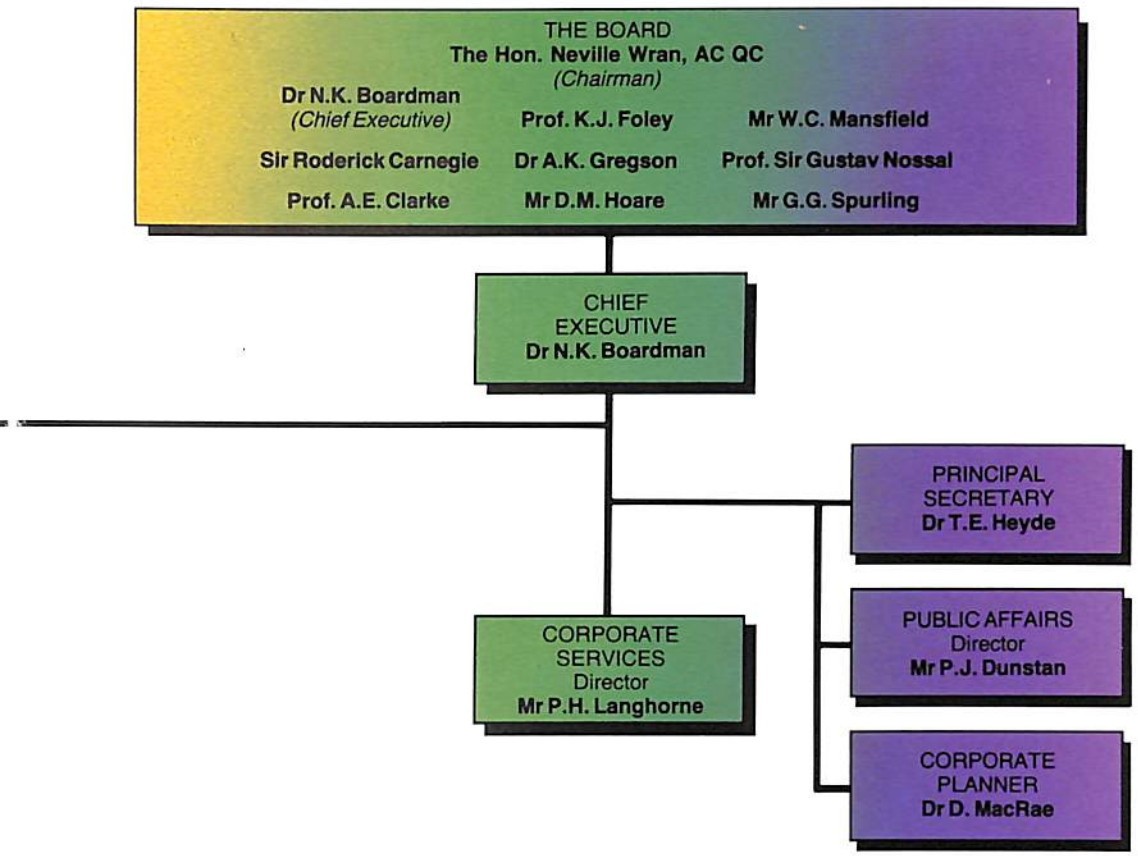
Mr Bill Mansfield LLB
Assistant Secretary of the Australian Council of Trade Unions, Member of the Australian Manufacturing Council
5 Dec. 86 – 4 Dec. 90

Professor Sir Gustav Nossal CBE MB BS BSc PhD FTS FAA FRS
Director of the Walter and Eliza Hall Institute of Medical Research
5 Dec. 86 – 4 Dec. 91

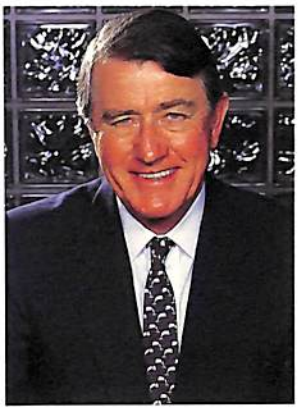
Mr Graham Spurling ED BTech MAE FIEAust
Managing Director, Pacific Dunlop International Battery Group
5 Dec. 86 – 4 Dec. 89

CSIRO Organisation Structure




THE BOARD
The Hon. Neville Wran, AC QC
(Chairman)
Dr N.K. Boardman
(Chief Executive)
Prof. K.J. Foley
Mr W.C. Mansfield
Sir Roderick Carnegie
Dr A.K. Gregson
Prof. Sir Gustav Nossal
Prof. A.E. Clarke
Mr D.M. Hoare
Mr G.G. Spurling
CHIEF EXECUTIVE
Dr N.K. Boardman
PRINCIPAL SECRETARY
Dr T.E. Heyde
PUBLIC AFFAIRS
Director
Mr P.J. Dunstan
CORPORATE SERVICES
Director
Mr P.H. Langhorne
CORPORATE PLANNER
Dr D. MacRae

Chairman's Foreword



In times like these, times of change and upheaval, reorganisation can easily become, not a means to an end, but an end in itself — a demonstration that an organisation is indeed responding to change.

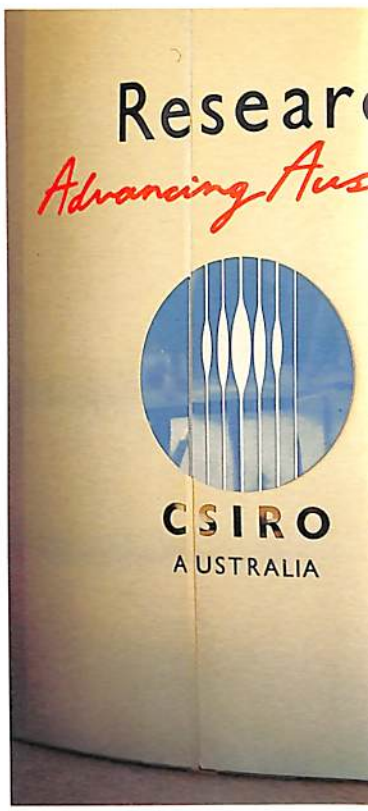
But the objective of any reorganisation must be to enhance performance, and this can only be done by encouraging changes in the attitudes and behaviour of people.

Above all, people must be convinced that change is necessary, and they must be given the incentive to make changes; the bottom line — that the performance of an organisation depends on the performance of every individual member of staff — must be acknowledged.

The CSIRO Board is aware that these things are especially true of institutions like CSIRO, whose work depends critically on the dedication, enthusiasm and creativity of its staff. We are aware that the events of recent years have strained these qualities.

Recent years have been a time of unprecedented change, culminating this year in the implementation of a new organisational structure and major changes to Headquarters functions.

But this is all behind us now and the future is very exciting indeed. The next few years will be a crucial period for CSIRO and we all need to pull together to meet the great challenges ahead; to see that CSIRO has adequate resources (financial and otherwise), and that those resources are marshalled effectively towards the research effort so necessary to address Australia's major economic and social problems and to deliver solutions that will benefit the Australian community.



Central to the ultimate success of our reorganisation is the role to be played by our new Institute Directors. Board members, as well as distinguished people from outside CSIRO, sat on all the selection committees. We were determined to get the best people for the jobs, and I believe we have. There is no doubting that our Directors will build on and broaden our well-earned reputation as a centre of scientific excellence.

But scientific excellence requires more than just good science. It requires science and technology to be integrated. It requires management skills, entrepreneurial flair and public communication skills.

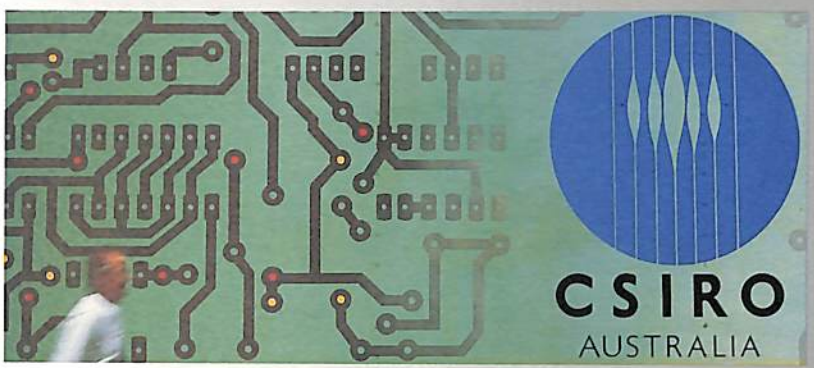
It also requires the very best administrative support. And we have therefore established an employee development strategy to encourage all staff to acquire additional skills — not only so they can contribute more to the Organisation but, equally importantly, so they can enhance their own career prospects and job satisfaction.

We have recommended to the Minister an incentives scheme to reward research teams which make outstanding contributions to Australia's industrial development or community well-being; and I must stress here that the thrust of the new scheme will be to reward

teams, not just the scientific leaders.

We aim to improve child-care facilities throughout the Organisation so that staff, particularly women, do not jeopardise their careers when they also become parents. We believe that the initiatives we are taking are essential to the task of ensuring Australian industry and the Australian community derive the greatest possible benefits from the quite exceptional human and scientific resource that CSIRO represents.

In all of this, the Board remains committed, unequivocally, to the preservation of CSIRO's reputation for scientific excellence.



CSIRO's display in the travelling Australian Bicentennial Exhibition proved to be a hit, especially with young people. At each Exhibition location, CSIRO staff from nearby sites were on hand to talk to the public about CSIRO and answer questions.

Chief Executive's Review

Over the past few years, CSIRO has altered so radically that we have been able, in our annual reports over this period, to talk of each year as one of profound change, transformation, a year heralding a new era.

1987–88 is no different. In fact, it perhaps deserves the epithets more than any of the preceding years: it was the year in which the most thorough reorganisation of CSIRO was actually implemented. The Organisation also received from the Government a revised set of Ministerial guidelines, which will shape the way our strategies and priorities are developed. These are reproduced at the end of this section.

However, in my review of the year, I want to discuss not the changes that have just taken place, but the outcome of those that have occurred in earlier years. While it will take many more years to see the full effects of all the changes to CSIRO, their impact is already clear.

We have improved our system for setting priorities. We have concentrated our resources into those research projects with the greatest potential to benefit Australia. We have significantly improved relations with our customers, the users of research.

The greater emphasis on commercialisation of successful research, and the improved links with industry, are obvious from the figures compiled by Sirotech Ltd, the commercial company we established in 1984. The number of provisional patents taken out by CSIRO has more than quadrupled from 42 in 1984–85 to 172 in 1987–88. The number of commercial opinions given to CSIRO increased from 130 in Sirotech's first year to over 350 in 1987–88. The value of sponsored research undertaken by CSIRO for Australian companies has climbed from $4.3 million in 1983–84 to about $16.5 million in 1987–88.

I am proud of what we have achieved, and I congratulate all staff for responding so well to the challenge facing us. I doubt that we could have done more than we have in the past few years, especially considering our declining appropriation funding, which inevitably makes change more difficult. But, in the long term, the economic benefits that Australia derives from CSIRO's research will depend on industry.

In all industry sectors, we depend on industry's willingness and capacity to implement research findings. In the case of the manufacturing and service sectors, in particular, we depend also on industry's ability to sell the products of our research on the international market.

A classic example of what is required to turn top-rate research into a successful product or process is the story of PSZ, or partially stabilised zirconia, an extremely tough ceramic with a wide range of industrial applications. PSZ was developed using a process discovered by CSIRO scientists, called transformation toughening,

which has been one of the scientific breakthroughs that have revolutionised industrial ceramics.

That research was carried out in the early 1970s. The technology was further developed and a range of PSZ products manufactured by an Australian company, Nilsen Sintered Products, later Nilcra Ceramics. It is only now, some 15 years after the PSZ technology was developed, that a world-class scientific achievement looks like becoming an international commercial winner.

While there is emphasis these days on increasing the level of R&D support for the manufacturing and service industries so as to improve their international competitiveness, it is important that Australia recognise the absolutely vital role research must play in maintaining and enhancing the competitiveness of our traditional export earners, the agricultural and mining industries. Recent advances in molecular biology have enormous potential for boosting Australia's rural productivity.

Among the research highlights of the year are the 'gene shears' discovery, which could make it possible to inactivate specific genes or destroy a particular virus, and the successful development of a vaccine against cattle ticks. These advances, which promise great benefits for Australia's vitally important agricultural industries, represent the opposite ends of the research-to-product pipeline. The gene shears concept is a brilliant breakthrough in basic science, the specific applications of which are a few years away but are likely to be widespread; it offers hope, for example, of new ways of controlling human, animal and plant diseases and creating new varieties of plants. The cattle tick vaccine is now at the end of the research phase, and it is expected to be on the market within three years. The vaccine will be a great boon to the Australian cattle industry, as well as having an export market estimated at tens of millions of dollars a year.

Because of the critical importance of industry attitudes and practices to the successful commercialisation of CSIRO research findings, I have continued during the year to lobby industry on these issues — to stimulate business awareness of the need for a strong industrial R&D capability in Australia and for a more entrepreneurial approach to technological innovation.

There have been some encouraging developments in the business sector in these areas — the continuing climb in its R&D expenditure; signs of a pick-up in business investment in plant and equipment; and substantial increases in both payments and receipts for technical know-how. But I am yet to be conviced that these changes have gone far enough, or deep enough into the corporate culture in Australia.

There remains in Australia, in both the private sector and government, inadequate appreciation of the complementary nature of CSIRO's and industry's roles. The recent survey by the R&D consulting company, Invetech, of senior executives in manufacturing industries reveals that in their attitudes to R&D they show a disappointing tendency to emphasise the short term.

If we look at the leading industrial nations of the world, we find, perhaps not surprisingly, that those countries with the highest R&D

"National recognition of the importance of longer term research, and strong Government support for it, are essential if Australia is to be able to remain at the leading edge of developments in world science and technology"

spending are also those that are doing most to further strengthen their R&D. In these countries there is not only a drive to encourage greater industry R&D activity, but also a new emphasis on building up their longer term basic research.

While Australia has increased its R&D total expenditure from about 1% of GDP to about 1.3% this decade, R&D expenditure in the Netherlands has risen from 2.05% of GDP to an estimated 2.37% since 1984. The Canadian Prime Minister spoke this year of 'decades of neglect' of R&D in pledging an additional C$1.3 billion for science and technology over the next five years; Canada spent 1.36% of GDP on R&D in 1986.

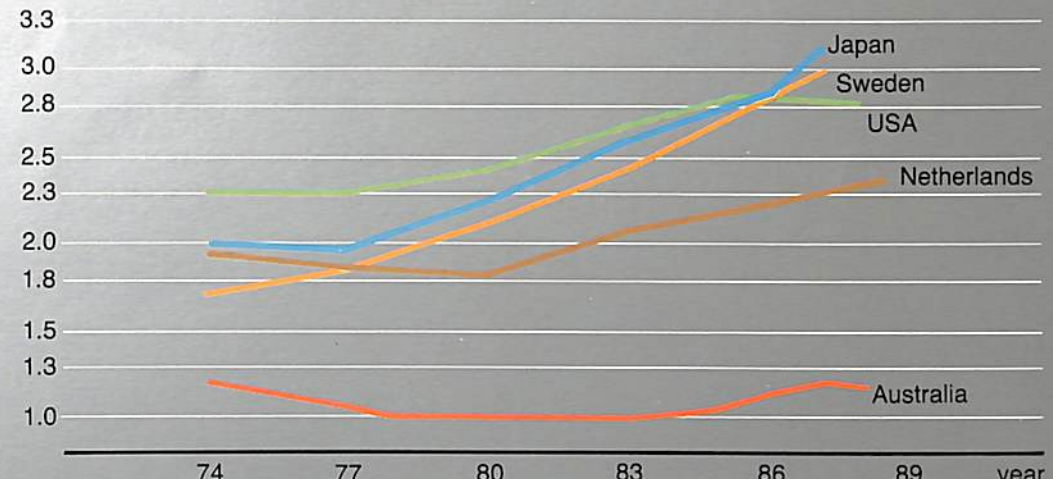
Norway, faced with declining North Sea oil earnings, has made research one of its top priorities in its drive to improve the economy, and it was expected to be the only sector of government spending whose budget would be increased this year; Norway spent 1.67% of GDP on R&D in 1986. The new French Government has moved quickly to strengthen the nation's R&D effort, which stood at 2.31% of GDP in 1985, while in the United States a new analysis of industrial productivity concluded that federal support for both applied R&D and basic research must rise, and that federal tax credits for industrial R&D should continue.

Japan has become the first country in the world to spend more than 3% of GDP on R&D, with expenditure reaching 3.19% in 1987; in 1955, it was 0.84%.

Given these international trends, and considering the structure of R&D activity in this country, Australia will remain for a long time heavily reliant on CSIRO and the universities to provide the scientific infrastructure on which to base industrial development.

International comparisons in R&D

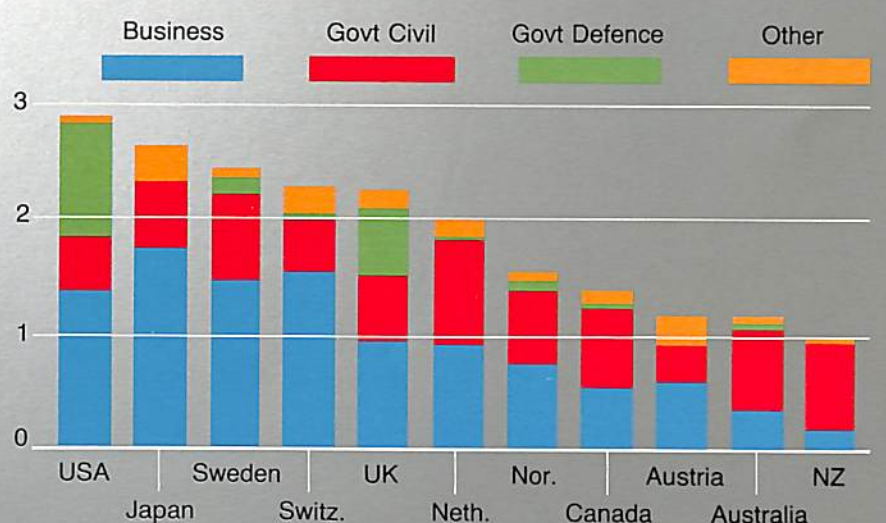
expenditure on R&D as percentage of GDP



I believe the longer term research undertaken by public-sector research institutions such as CSIRO is so important to Australia's economic and social well-being that appropriation funding for this research must be, at the very least, maintained in real terms, and not reduced as industry funding increases, as has happened with CSIRO in recent years.

National recognition of the importance of longer term research, and strong Government support for it, are essential if Australia is to be able to remain at the leading edge of developments in world science and technology — a position Australia must maintain if it is to achieve a sustained economic recovery.

International comparisons of R&D funding by sector as % GDP, latest available year



Ministerial Guidelines

The Minister provided CSIRO with the guidelines below under section 13 of the *Science and Industry Research Act* 1949 on 2 June 1988.

'The following guidelines for CSIRO are to be read in the context of the functions of the Organisation, and the responsibilities of its Board, as set out in the *Science and Industry Research Amendment Act* 1986.

1. CSIRO's main task will be the conduct of strategic and applied research in support of national economic, social and environmental objectives.
2. CSIRO will ensure that research activities in areas of significance to national economic development receive preferential support.
3. CSIRO's research priorities will be planned with due regard to the industry and research policies and priorities of the Government.
4. CSIRO will pay particular attention to strengthening means of ensuring that its research results are exploited to the greatest benefit of the Australian community.
5. CSIRO will maintain procedures to ensure effective communications between the Organisation, other publicly funded research institutions, the users and beneficiaries of its research and the general public.
6. CSIRO will maintain a distribution of effort in accord with the Government's policies and priorities in relation to research in support of existing industries, and research which will contribute to future balanced national development.
7. CSIRO will establish procedures to identify promising areas of research as part of its strategic planning process.
8. CSIRO will give greater attention to assessing the potential value of research before it is performed, and will strengthen procedures to evaluate research programs during their performance and after their completion.
9. CSIRO will maximise the proportion of its overall expenditure funded from non-Budgetary sources, subject to the need for continual Commonwealth support for its main task described in guideline one.
10. The Organisation shall, as far as possible, cooperate with other organisations and authorities in the coordination of scientific research, with a view to —
    a) the prevention of unnecessary overlapping; and
    b) the most effective use of available facilities and staffs.
11. CSIRO will ensure that its financial, administrative and personnel management practices are consistent with relevant Government policies for the operations of statutory authorities and business enterprises.'

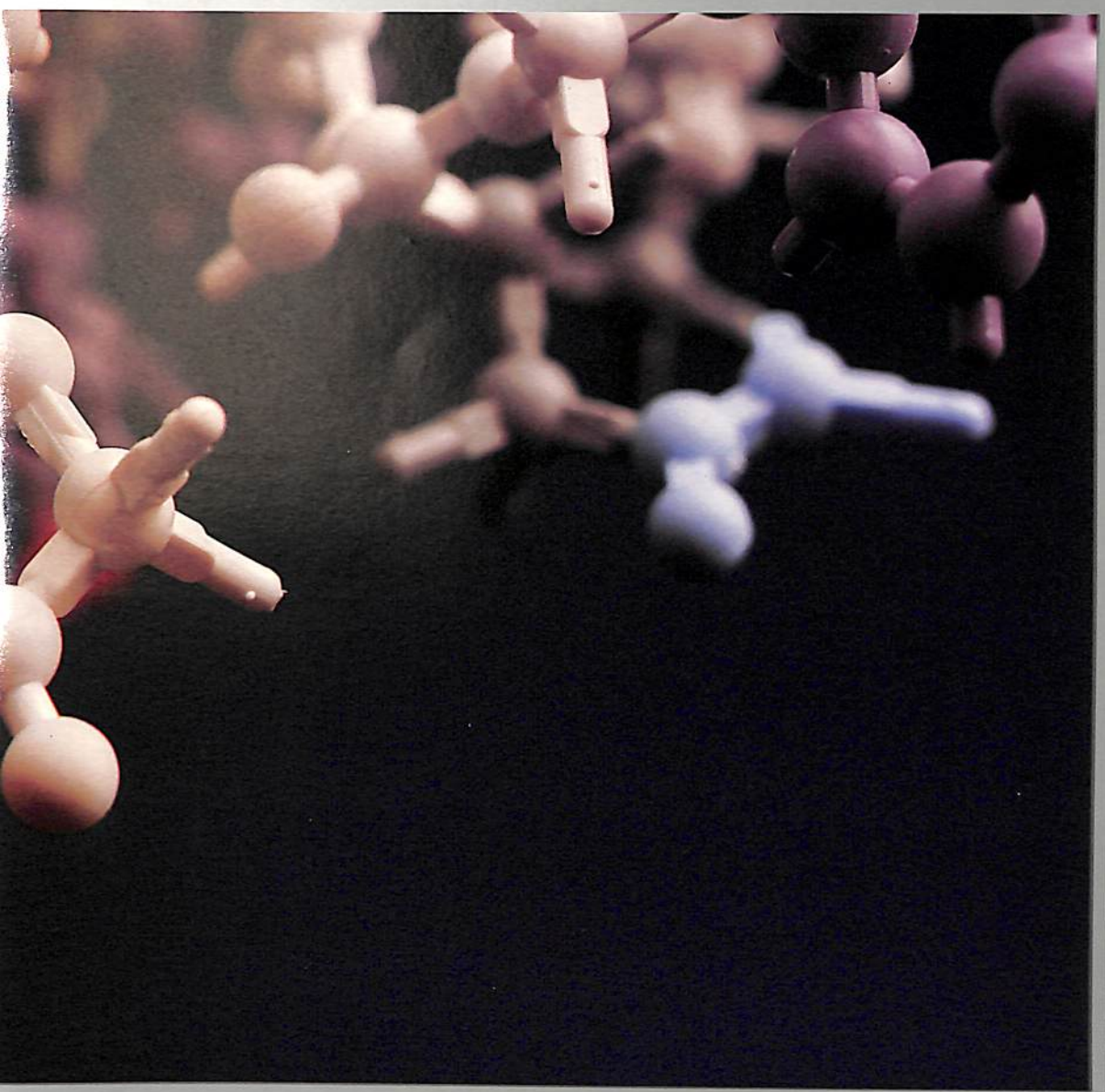
The Minister for Science, Customs and Small Business, the Honourable Barry O. Jones


CSIRO
AUSTRALIA

Highlights of the Year

CSIRO's research has produced many major advances in the past year. The examples described in this section illustrate the Organisation's commitment to advancing Australian industry and community well-being.

A model of a newly discovered muscle growth factor occurring throughout much of the body. (See story page 38.)



Research breakthroughs help cattle industry

Major CSIRO advances in the field of cattle health will enable the cattle industry to avoid more than $230 million in current production losses.

Vaccine against cattle tick

About one-third of Australia's cattle are affected by the cattle tick (*Boophilus microplus*). The tick is responsible for production losses estimated at more than $150 million each year.

Chemicals are currently used for tick control, but resistance has developed to most 'tickicides', and recent concern about pesticide residues has heightened awareness of problems associated with the use of chemicals in animal production.

In a remarkable biochemical feat a group of CSIRO scientists has succeeded in isolating and purifying a protein (from ticks) with the capacity to make cattle resistant to this parasite.

CSIRO is collaborating with Biotechnology Australia Pty Ltd in this venture, which involves genetic engineering, to manufacture large quantities of the tick protein for use in a vaccine.

An inexpensive, genetically engineered vaccine will allow researchers to investigate ways to optimise the vaccination regime. It is already showing considerable promise and is the first time that a vaccine has been effective against an external parasite.

In addition to the Australian market, there is a large international market for such a vaccine, as annual losses caused by the tick in Latin America are estimated to be more than $1 billion.

The research by CSIRO and Biotechnology Australia was supported by the Industry Research and Development Board and the Australian Meat Research Committee.

The cattle tick (*Boophilus microplus*) causes production losses of more than $150 million each year in the cattle industry.

Eradication of disease in cattle

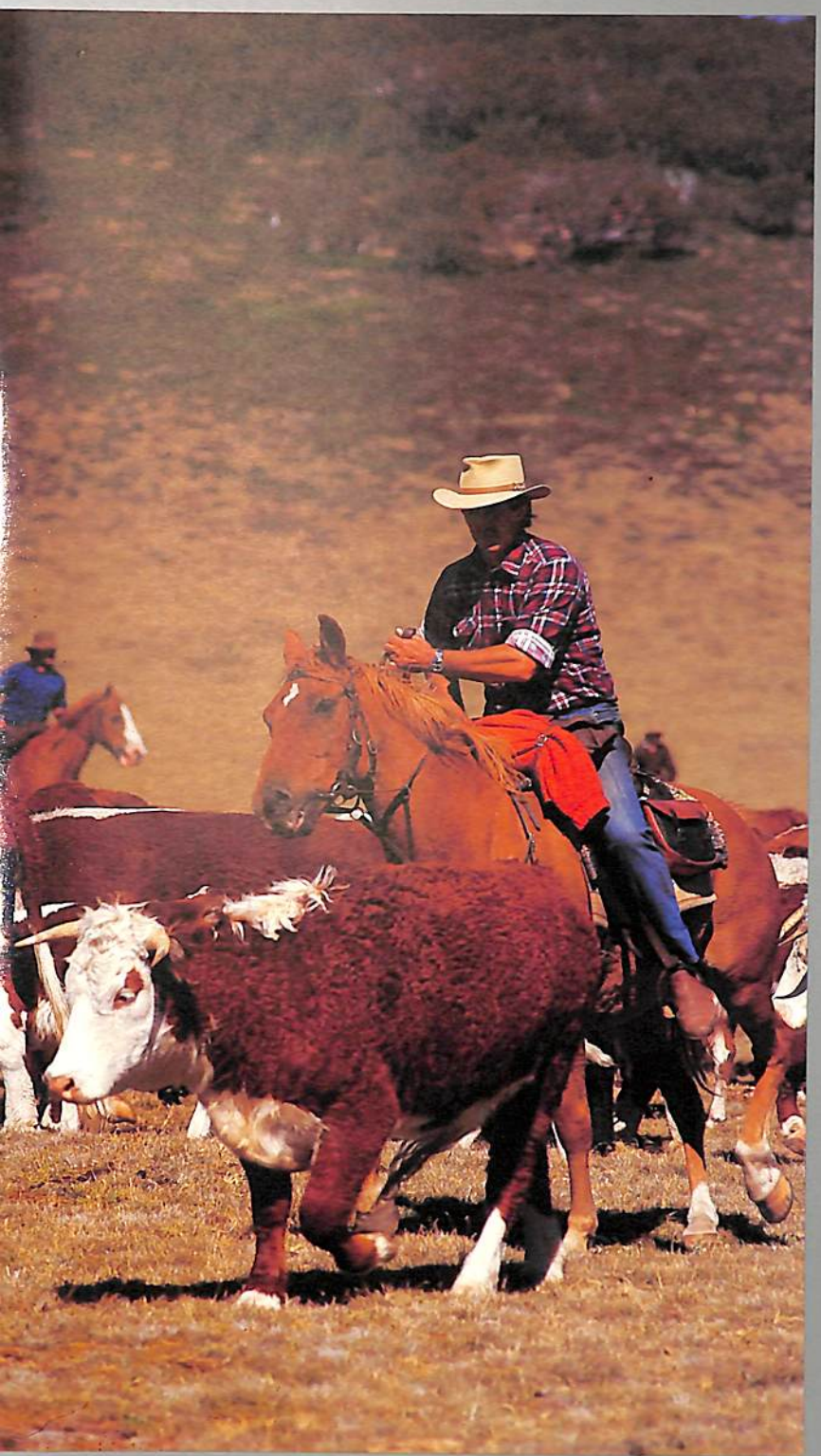
The Australian cattle industry can expect to save about $80 million from two new CSIRO-developed diagnostic tests for bovine tuberculosis.

This large saving (calculated by the Australian Bureau of Agricultural and Resource Economics) is the likely result of widespread use of blood-based tests developed by CSIRO and currently being evaluated by CSIRO in conjunction with several State Departments of Agriculture and a commercial partner.

CSIRO development of the tests is in support of the National Brucellosis and Tuberculosis Eradication Campaign, which aims to rid Australian cattle herds of both these diseases by 1992, to maintain Australia's access to beef export markets.

One of the tests devised by the researchers also has potential as a diagnostic test for many other diseases. It is currently being adapted for the detection of Johne's disease in cattle and mycobacterial infections in humans.

Another development from this work is the potential for engineering the human tuberculosis vaccine organism as a low-cost, safe and effective bacterial vaccine vector. This project is being supported with research funds from the Australian Meat and Livestock Research and Development Corporation.



The cattle industry will benefit from CSIRO research breakthroughs in the field of cattle health.

A cattle tick taken from a cow treated with the genetically engineered vaccine developed by CSIRO

Airborne radar helping the fishing industry

Productivity in the Australian fishing industry will benefit as a result of a CSIRO study on the use of low-cost high-performance radar to spot schools of fish.

CSIRO is using Side Looking Airborne Radar (SLAR) as part of a study on the distribution and biology of the open sea resources in the Australian Fishing Zone.

The radar is being leased from Ericsson's Defence Systems and mounted aboard CSIRO's F27 research aircraft to detect surface fish schools at ranges up to 25 km — three times the range of the usual technique of visual spotting from light aircraft.

Hardware and software for the recording and processing of SLAR digital data have also been developed by CSIRO to produce a clear display of the image in colour. This enhanced display allows better detection of faint targets.

CSIRO is working in close collaboration with the fishing industry and tuna and jack mackerel fishing companies are showing keen interest in the technique.

The SLAR is being marketed to other customers in Australia and strong commercial interest could lead to a domestic radar manufacturing industry.

Revolutionary plant test kit

A plant test kit launched in September 1987 could boost farmers' earnings by millions of dollars through improved returns on their investment in fertilisers.

The kit, marketed as the GREENLEAF FARMLAB, was developed by CSIRO and Australian Fertilizers Ltd.

It enables farmers and advisers to carry out their own quick and simple checks for nutrient shortages in growing crops and pastures, and helps them select a fertiliser program to correct any such shortages before serious yield losses occur.

Instead of checking the nutrient status of the soil — the most common check carried out with conventional laboratory testing — the new kit analyses plant tissue. Farmers simply collect crop or pasture leaf samples from one or more paddocks, take them back to the farm office and run them through the testing procedure. They have the results in about an hour.

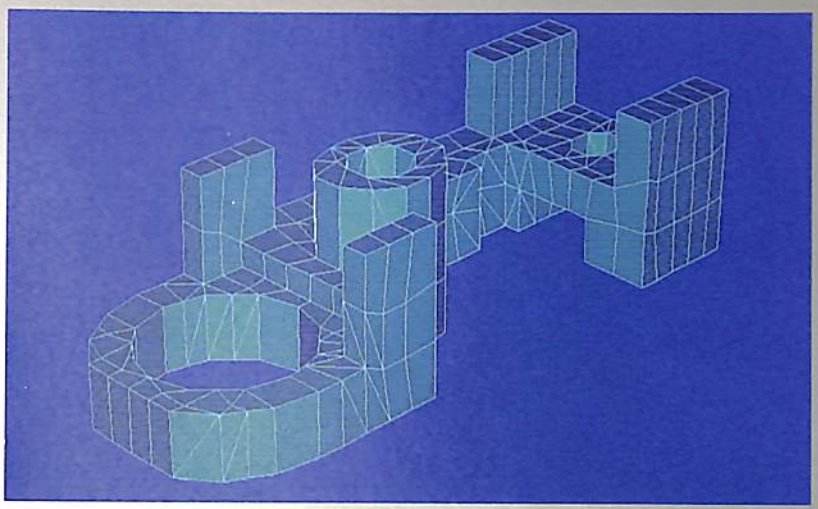
Australian soils are generally deficient in both phosphate and nitrogen. With the squeeze on farm incomes and with costs increasing, it is important that optimum levels of both nutrients are applied to ensure maximum benefit from fertilisers and other soil additives.

Faster data preparation for design analysis

Engineers must ensure that all the products they design perform in real use without failure. A modern computer analysis technique called the 'finite element method' allows engineers to analyse stresses, temperatures and other aspects of their designs without having to build expensive prototypes.

With this method, an object is represented by thousands of small, simple blocks, or finite elements, 'glued' together. The collection of

The GREENLEAF FARMLAB kit analyses plant tissue quickly and simply, helping farmers check for nutrient shortages in growing crops and pastures.



A software program called a mesh generator significantly reduces the time required for stress analysis and design of products through the splitting of a mechanical part into 'finite elements'.

The use of Side Looking Airborne Radar to detect schools of fish promises to increase productivity in the fishing industry.

elements is called a mesh. The preparation of a mesh for computer analysis is the most time-consuming step in finite element analysis, taking days or even weeks.

Research conducted by CSIRO in collaboration with Monash University has resulted in a computer program that markedly reduces the mesh preparation time to minutes or hours. This means that considerable savings in time and money can be made in many industrial operations.

Known as a mesh generator, the program automatically splits the engineering description of an object into finite elements, the sizes of which are controlled by the design engineer. The engineer need only put in the boundary of the object.

The CSIRO/Monash generator can be used in all situations where the finite element is applicable. These include stress analysis in automotive engineering, thermal analysis of casting dies in the metals industry, fracture analysis of pressure vessels such as those used in the chemicals industry and in power generation, and electromagnetic analysis of electric motors.

Big savings for offshore platforms

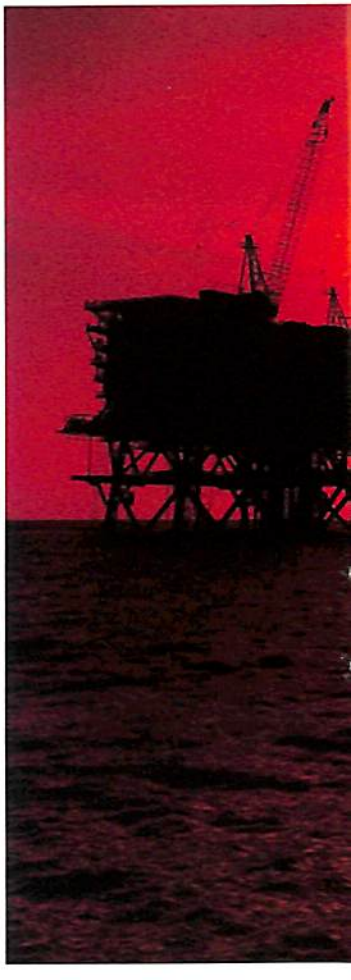
CSIRO research input into Australia's offshore oil and gas industry is contributing to the potential saving of tens of millions of dollars on the construction costs of each offshore oil and gas platform.

CSIRO scientists and engineers have worked with companies in this industry, often as part of teams that have included the Universities of Western Australia and Sydney and Monash University, to provide urgently needed insights into the behaviour of the foundations of offshore platforms. Their work has increased the level of understanding of, and confidence in, the foundations of offshore platforms and their capacity to carry loads.

The behaviour of sands that form the sea floor sediments in Bass Strait and on the North West Shelf have proved to be an important and unique problem for the construction of offshore oil and gas platforms. CSIRO researchers have examined the nature of these sediments and developed models to explain how they behave when subjected to loads from a platform. This has led to the design of better models of foundation design.

In addition, through participation in large and small pile-testing projects, CSIRO has developed a proposal to improve the performance of piles by the injection of grout into the foundations.

Part of the CSIRO input has been in conjunction with the Norwegian Geotechnical Institute through a joint venture consultancy arrangement. As a result, CSIRO staff are working on North Sea platforms while Norwegian researchers are participating in projects in Australia. This valuable exchange of knowledge is expected to increase further the contribution CSIRO can make to the national oil and gas industry.



The foundations of the North Rankin 'A' gas platform on the North West Shelf in the Indian Ocean required extensive modifications because of unusual properties of the sediments under the platform.

Healthier crops offer increased grain sales

Production in Australia's grain industry is severely reduced each year by crop diseases. CSIRO is developing new and efficient biological methods of preventing these diseases and enhancing productivity of our crops in order to raise the income earned by our grain exports.

Engineering a disease resistance gene

A novel method of making plants resistant to viruses is an exciting first step in a revolution in plant hygiene that will increase productivity by reducing harvest losses.

CSIRO researchers have synthesised a gene that gives tobacco plants resistance to the virulent ringspot virus.

Tobacco is used for this type of research because it lends itself readily to genetic manipulation.

The synthetic gene is passed from one generation of genetically engineered tobacco plants to the next, giving them a large degree of resistance.

When the ringspot virus enters the plant, it meets molecules produced by the gene and multiplies them instead of itself. The molecules thus act as decoys.

The next step is to build resistance genes for the Barley Yellow Dwarf virus disease in cereals.

This virus is more destructive to grain crops than any other known throughout the world, and is estimated to cost at least $20 million a year on average in the Australian wheat crop alone.

Tobacco plants with (left) and without (right) disease resistance gene

Biological control of root diseases

Root diseases reduce the value of Australia's cereal harvest by several hundred million dollars annually. CSIRO researchers are developing non-chemical methods, using crop rotation, tillage practices and biological treatments, to reduce these losses.

In particular, biological control measures are being sought for three major root diseases of cereals — Take-all, Rhizoctonia and Cereal Cyst Nematode. In a world conscious of the side effects of large-scale chemical use, this approach has exciting prospects for Australia's export-oriented grain industries.

Thousands of soil bacteria and fungi are being screened in the laboratory for their ability to protect plants from disease. The most promising are subsequently tested in the greenhouse and the field.

As a result of this work a provisional patent has been issued covering a specimen of the Trichoderma fungus from Western Australia, which has the potential to control several root diseases. Other organisms are being tested for controlling root knot nematode, which attacks more than 2000 plant species world-wide, including many fruits and vegetables. Bacteria and fungi for the biological control of nursery seedling diseases are also being tested.

SIROFLO — a grain storage innovation

The Australian grain industry contributes about $3 billion a year to the nation's export income. In a period of increasing competition, it is more important than ever for Australia to maintain and indeed

A wheat root affected by the fungal disease Take-all

Biological control measures lead to healthier crops and increased harvest for export.

increase its share of the world's grain trade.

CSIRO scientists in Canberra have invented a new and safe way of storing grain free of insect contamination and virtually free of chemical residues. This technique is giving Australia a marketing edge over its competitors.

Called SIROFLO, the method is the outcome of several years of research into the biology of grain insects and the toxicology of phosphine gas. Allowing controlled dilution of the fumigant into a metered air flow passing through stored grain, it offers protection without leaving harmful residues in processed food.

Holding grain insect-free for long periods using SIROFLO can reduce present storage protection costs by as much as $1.85 a tonne. The wheat crop in Australia for the coming season is expected to be around 13.5 million tonnes. With a 50 per cent implementation level, SIROFLO represents a saving, to the wheat industry alone, in excess of $12 million a year.

SIROFLO is now being introduced in a range of grain stores throughout Australia.

The Marroo seedless grape developed by CSIRO

A new approach to table grape breeding

Australian table grape exports tripled in value from 1985 to 1987 (when they were worth about $33 million), but remain small compared to those from other countries, leaving considerable scope for expansion.

World market preference is for seedless varieties, so high priority is given to these. However, a problem facing breeders is that the number of seedless selections arising from seeded/seedless crosses is very small. Also, using conventional technology, direct hybridisation of two seedless varieties is not possible as there is no mature seed to produce a hybrid. Seedless/seedless crosses do produce embryos, but these abort long before the fruit reaches maturity.

CSIRO researchers have used a biotechnological approach to overcome this obstacle to breeding. By excising the hybrid embryo from the mature seed before it has time to abort and culturing this in the test tube in an appropriate nutrient medium, they can directly hybridise selected seedless varieties.

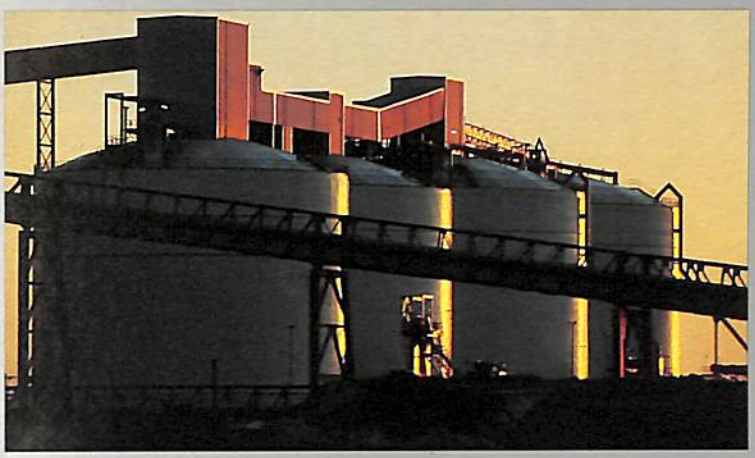
This approach seems to have removed the genetic barrier to increasing production of seedless hybrids from which new specialised varieties can be selected to boost Australia's share of overseas markets.

Improved methods for finding gold

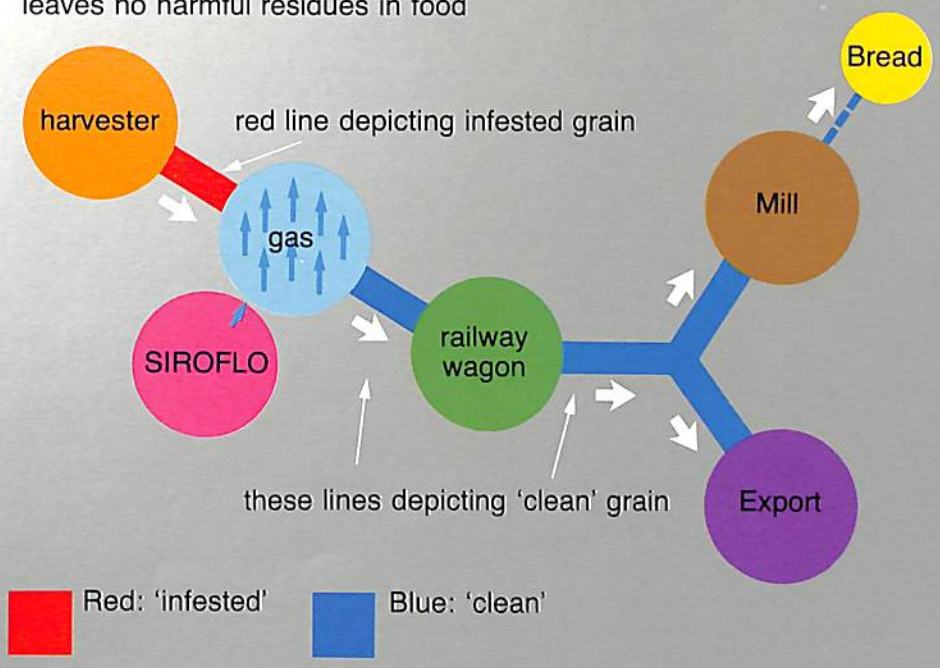
The contribution of gold to Australia's earnings has grown significantly in recent years and it has become a major export commodity. The search for new gold deposits to boost exports relies heavily on modern exploration techniques to detect well-hidden deposits.

By combining expertise in geochemistry with expertise in remote sensing, geophysics and geology, CSIRO has made a major commitment to improving the exploration industry's ability to locate economic gold deposits in Australia's deeply weathered terrain.

The expected implementation of SIROFLO in half of Australia's grain stores promises to save the wheat industry $12 million a year.



SIROFLO — a method that enables the grain industry to supply Australia's national and international markets with insect-free grain that leaves no harmful residues in food



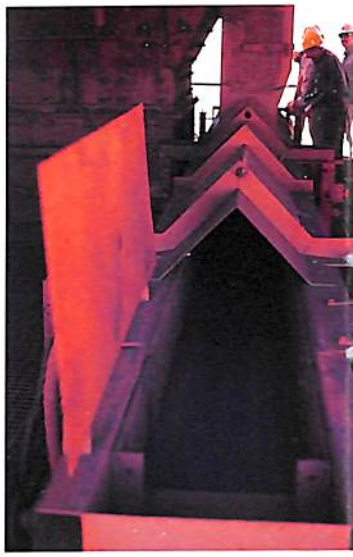
CSIRO's multi-discipline research team, working in Western Australia and New South Wales, has received substantial industry support. By June 1988, 40 exploration companies were sponsoring one or more of the modules of the four-part research project, thereby contributing about $3 million towards the project over a three-year period.

Each research module investigates a different aspect of gold mining: the nature and origin of gold mineralisation; the consequences of deep weathering for gold deposits; the composition of laterites; and the interpretation of remotely sensed data from the land surface.

High priority is being given to industry collaboration, which is being coordinated by the Australian Mineral Industries Research Association, to ensure that relevant areas of the terrain are studied and that there is an effective transfer and implementation of research results.

Increasing the competitiveness of our mineral ore exports

Two new CSIRO techniques for making Australia's mineral ore exports more competitive on the world market are already proving successful. One technique improves the quality control of iron ore, while the other results in a new and more efficient sampling scheme for estimating the grade of ore.



IRONSCAN monitors the quality of the iron ore as it moves along the conveyor belt.

Improved quality control

A sophisticated on-stream iron ore analyser, known as IRONSCAN, has been developed by CSIRO in collaboration with Hamersley Iron Pty Ltd and Mineral Control Instrumentation Pty Ltd.

The analyser can determine with considerable accuracy the iron content of ore on moving conveyor belts, providing immediate information on grade during shiploading or stockpiling. In this way IRONSCAN can detect any departure from desired ore quality in time for corrective action to be taken.

Tests are under way to assess the instrument on the lump ore issuing from the main crushers at the mine site, so that the grade can be controlled during the mining operations.

The use of IRONSCAN will raise the quality of Australia's iron ore exports, improve the consistency of stockpiles and enable optimum use to be made of ore grades throughout a deposit, thus extending the effective life of the resource.

CSIRO is currently working on suitable methods for on-stream analysis of the impurities in iron ore in an effort to improve the quality control of Australia's iron ore even further.

The development of IRONSCAN also provides Australia with a valuable opportunity in the world-wide export market for mineral ore analysers.

Better sampling schemes

Sampling from a moving conveyor belt carrying thousands of tonnes of ore per hour is an expensive business. Each sample may weigh up to a tonne and many samples may be required for estimating the grade of a trainload or shipload of ore. Oversampling is wasteful,

CSIRO is making a major commitment to improving the exploration industry's ability to locate economic gold deposits.

but undersampling or biased sampling will give inaccurate results, leading to poor quality control. Correct design of sampling schemes is therefore of great economic importance.

A CSIRO team of scientists has designed a new sampling scheme that will be applicable to process monitoring and quality assessment in the minerals industry and other industries where continuous processing is used.

These researchers have converted an accurate but complex approach called the 'variogram method' into a form simple enough to be used routinely in the minerals industry. Previous statistical techniques for designing sampling schemes were either inaccurate or too complicated for routine use.

The research, which was sponsored by several Australian mining companies through the Australian Mineral Industries Research Association, is being incorporated in new sampling standards being produced by the Standards Association of Australia. To promote the use of the new standards, CSIRO scientists have developed a software program called VARPACK, for IBM-compatible personal computers, thus making the new sampling techniques readily accessible.

New plant for zirconia production

The world's largest producer of high-quality zirconia powders, located at Rockingham, Western Australia, began commercial production in July 1988. The $13 million plant, built by ICI Australia Ltd, is the end result of five years joint research between that company and CSIRO.

This collaborative project will give a major impetus to the national strategy of enhancing the value of Australia's raw mineral production and is one of CSIRO's most significant achievements in the manufacturing sector.

Like many other minerals, zircon had long been exported from Australia in unprocessed form.

CSIRO researchers saw the market opportunity for the chemical processing of zircon in Australia and a research program in collaboration with ICI Australia rapidly developed.

The main target was high purity zirconia (zirconium oxide) powder for the rapidly expanding engineering ceramics industry. However, the joint CSIRO–ICI marketing company, Z-tech Pty Ltd, soon identified a range of other important markets for zircon products including electronic ceramics, ceramic colours and pigment additives.

The research and development program then led to a range of processes and products covering pure and blended zirconia powders and various other zirconium chemicals. These processes were successfully tested on a large scale at a pilot plant constructed at the CSIRO laboratories in Port Melbourne, and the trial batches of products brought favourable customer responses.

Z-Tech has developed an international marketing network and has announced plans for a $4 million customer service centre, which will consolidate the company's leading position in the world market for high-tech ceramics.

Ceramic components made from partially stabilised zirconia, a new substance based on high purity zirconia

The patented technology developed through the collaborative CSIRO–ICI Australia research and development program has brought to Australia a valuable, new, and fast-growing export industry.

SIROSCOUR successfully commercialised

A wool-scouring system based on technologies developed by CSIRO is being manufactured and marketed world-wide by an Australian engineering company.

Called SIROSCOUR, the system is licensed to the Melbourne chemical engineering contractors, Process Design and Fabrication Pty Ltd. The first SIROSCOUR plant was sold to the Australian subsidiary of the Danish company, Bloch & Behrens, and started operations in Melbourne in July 1988.

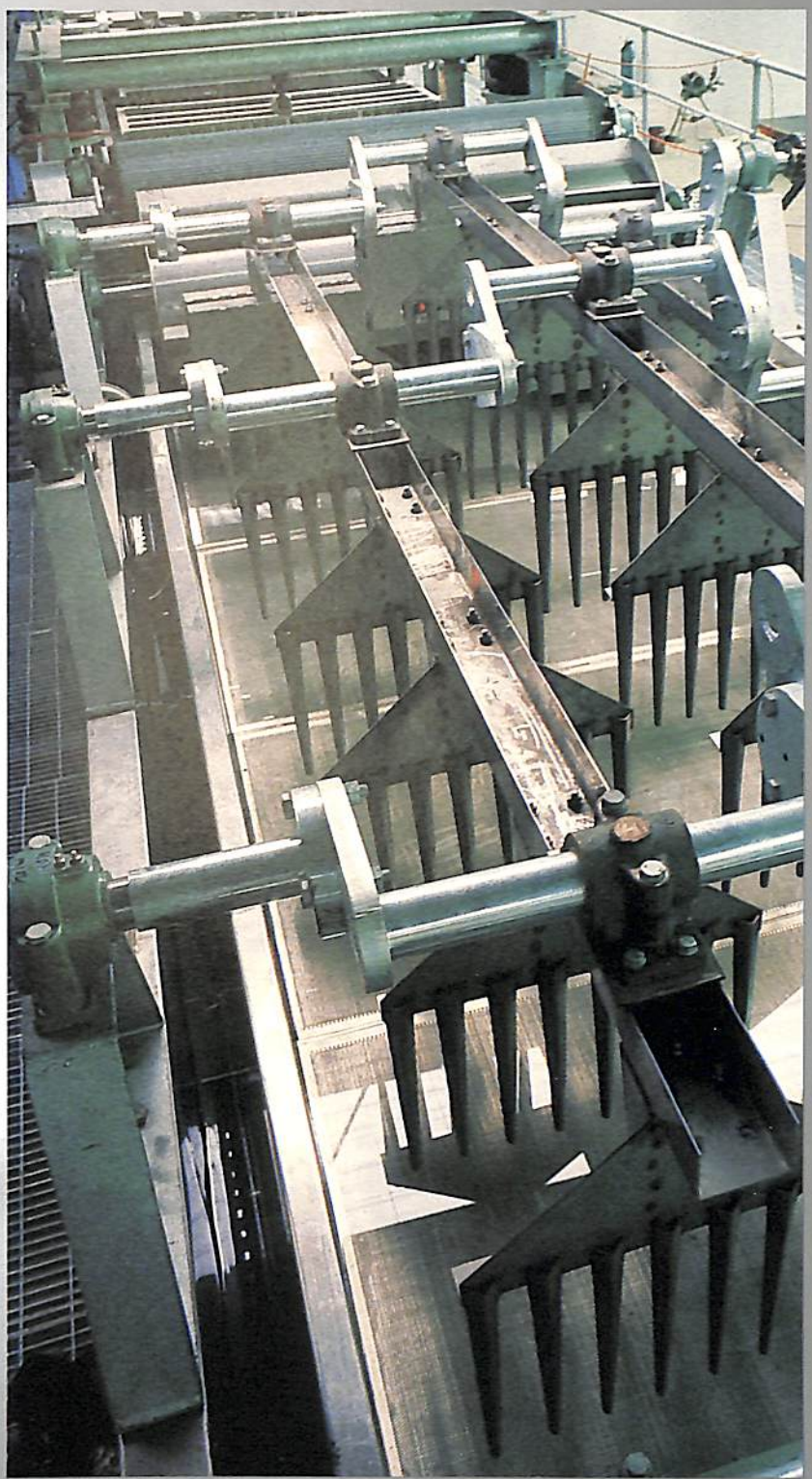
The widespread use of SIROSCOUR would effectively raise Australia's scouring capacity, which at present is only 20 to 25 per cent of its 900 000 tonne annual wool clip. The Australian Wool Corporation estimates that Australia could scour around 40 per cent, adding as much as $50 million per year to the value of its wool exports.

Designed specifically for Australian wools, SIROSCOUR offers scourers optimised cleaning of their wool with reduced effluent disposal costs.

The system is based on research showing that raw wool contaminants — which include grease, dirt, sweat salts and protein contaminants from skin flakes — have a much more complex removal pattern than was previously thought. In simple terms, contaminants can be classified into easy-to-remove and hard-to-remove fractions.

The easy-to-remove contaminants can be readily taken out by conventional scouring systems that use hot detergent solutions followed by rinsing. The hard-to-remove contaminants require different liquors, temperatures and detergents to ensure their optimum removal. Removal of this fraction results in a higher quality scoured wool, which is important for many woollen products.

Widespread use of SIROSCOUR in Australia could add $50 million a year to the value of our wool exports.



SIROSCOUR, a CSIRO-developed wool-scouring system offers scourers optimised cleaning of wool with reduced effluent disposal costs.

Promoting our expertise in the space industry

CSIRO maintains a coordinated space research program which emphasises satellite-based communications and remote sensing applications to help Australia's new aerospace industry become internationally recognised. The Organisation's highly regarded expertise has resulted in many important projects, two of which are: the supply of preliminary designs for antennas to AUSSAT for its next generation of satellites, and the design of a low noise amplifier for the Soviet Radioastron orbiting radio telescope.

Designing antennas for space

Satellite antennas receive and transmit signals to and from the earth's surface. Each antenna produces one or more beams and each beam covers a specific region. There are basically two kinds of beams: spot beams, which cover areas such as a major city; and shaped beams, which are contoured to fit the boundary of a state or country.

CSIRO scientists specialise in the design of satellite antennas that produce shaped beams. One advantage of shaped beams is that optimum use is made of the available electrical power, which is relatively scarce in space. Another is that shaped beams allow the same frequencies to be used in neighbouring regions — for instance, Australia and New Zealand — because the beam does not 'spill over' appreciably from one region to the next.

In recent years, CSIRO has carried out several satellite antenna contracts. Under a consultancy, CSIRO helped AUSSAT develop the specifications for all seven AUSSAT-B shaped beams. In a later contract, CSIRO evaluated Hughes Aircraft Company's proposed design for the National Transmit Beam during the development of the successful Hughes' tender for AUSSAT-B. The National Transmit Beam covers Australia's major population centres and is probably the most commonly used AUSSAT beam, being involved, for instance, in television networking and telephone services.

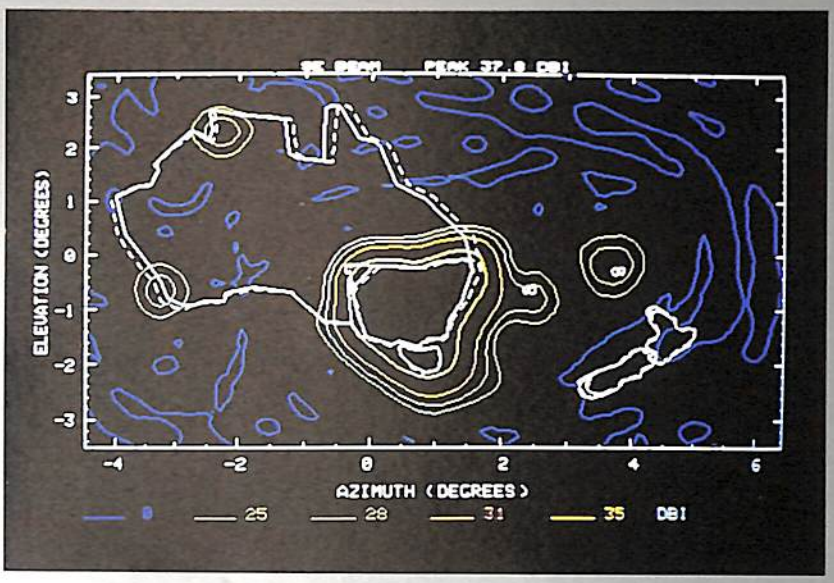
Radioastron

CSIRO has been invited to participate in both the space and the ground sectors of the international Radioastron space project initiated by the USSR. The participation was made possible by a Memorandum of Understanding signed in early 1988 between the CSIRO Office of Space Science and Applications (COSSA) and the USSR Academy of Sciences.

A team of engineers is responsible for the Australian contribution to the project through design of the 1.6 Gigahertz (L-Band) low noise receivers. CSIRO also plays a vital role as host institution of the Australia Telescope. British Aerospace Australia has been granted the early contracts to build the 1.6 GHz receivers and amplifiers for the Radioastron spacecraft.

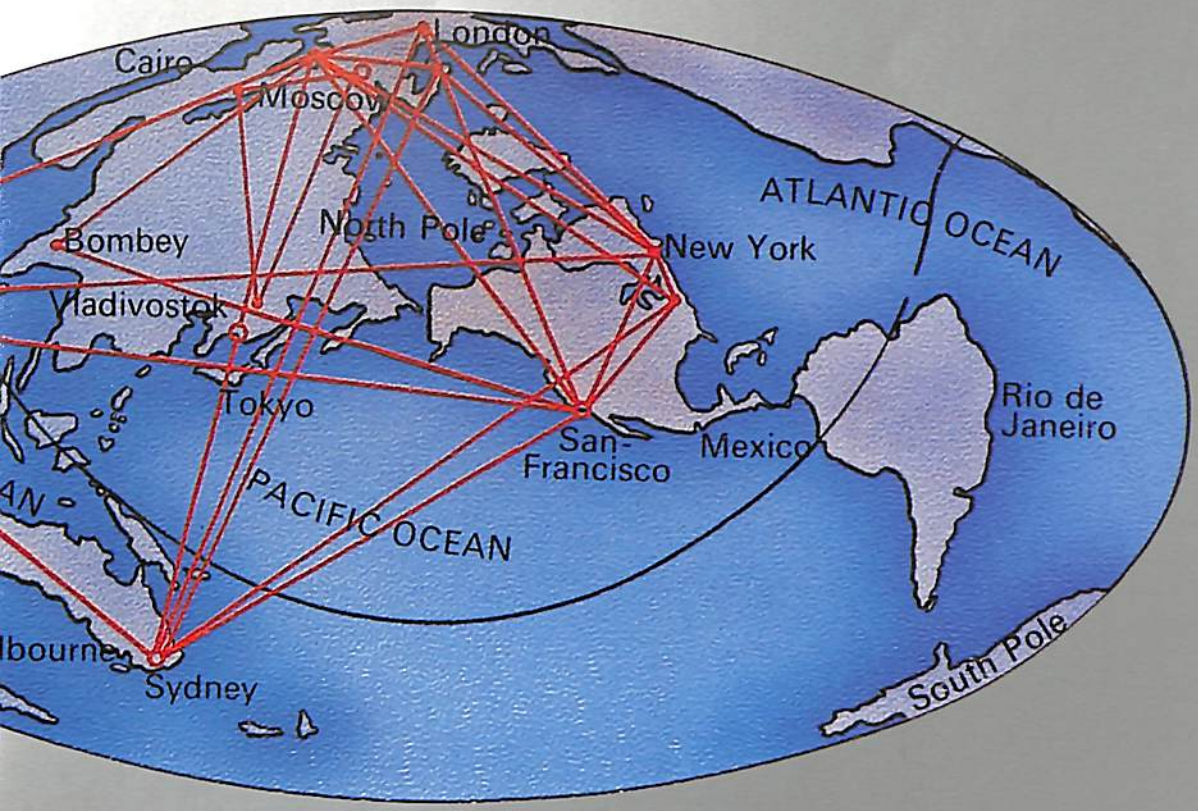
Radioastron will be an orbiting radio telescope linked to earth-based radio telescopes around the world, including the Australia Telescope, to simulate a very large diameter telescope. This will permit very high-resolution observations of distant astronomical radio sources.

Modern communications satellites, such as AUSSAT, use highly efficient antennas to produce shaped coverage regions, or 'footprints', on the earth's surface.



The 'footprint' of the CSIRO-designed AUSSAT south-east beam. The highest signal level (in yellow) occurs over New South Wales, Victoria and Tasmania, with 'spots' over Perth, Darwin and Lord Howe and Norfolk Islands. The areas marked in blue receive negligible signal.

CSIRO has been invited to participate in the international Radioastron space project which will consist of an orbiting radio telescope linked to earth-based radio telescopes around the world.



The Radioastron project will enable Australian industry to gain expertise in building a low noise amplifier sub-assembly for space use. At 1.6GHz it will operate at the frequency that AUSSAT has selected for its mobile communication system on the next generation of satellites. This was an important factor in stimulating CSIRO's participation in the project.

The Radioastron spacecraft is to be launched in 1992 — proposed as International Space Year — when CSIRO's contribution to Radioastron will highlight Australia's interest and increasing capabilities in space science and technology.

Major advances in ceramics technology

Australia is well placed to develop new industries based on ceramics technology, as it has both the research and development potential to devise specialised materials and the raw minerals from which many ceramics are made.

Modern engineering ceramics, which are extremely tough and heat-resistant, have a huge range of possible applications including their use in engines, as machine components and as metal extrusion dies. Two CSIRO teams of scientists have been successful in advancing ceramics technology.

Stronger and tougher ceramics

With the discovery in the 1970s of 'transformation toughening' in zirconia-based ceramics, CSIRO opened the eyes of researchers and engineers around the world to the potential of advanced ceramics as structural materials.

Transformation toughening is the process of crystal phase transformation in zirconium dioxide (the ceramic, zirconia), which produces strong ceramics of high toughness and reliability.

Current work within CSIRO has built on that foundation to create new ceramics for a host of engineering applications.

CSIRO scientists have produced transformation-toughened materials that can be spark-machined to intricate shapes for use in manufacturing.

Substituting a specific type of crystalline zirconia for the pores in refractory bodies — which are materials especially resistant to heat and corrosion — yields dense, thermal shock resistant materials. Compared with conventional refractory bodies they show higher strength, better corrosion resistance and less wear. Components are being evaluated in critical applications in fibreglass production and steel casting and forming processes.

Some zirconia alloys are known to possess exceptional strength. Current CSIRO research has shown these materials to be candidates for advanced ceramic devices such as high temperature fuel cells, oxygen pumps and electrochemical reactors.

One of the new 'transformation toughened' ceramics is used for the 'bushing block' in the production of glass fibres.

Rapid metal–ceramic bonding

The special properties shown by ceramics make them suitable for demanding engineering applications where harsh conditions such as heavy wear, corrosion and heat occur. The innate brittleness of ceramics, however, frequently necessitates their bonding to tougher

materials such as metals before they can be used as components in real engineering systems.

Current bonding processes for metals and ceramics tend to use expensive materials, and generally involve elaborate treatments before or after bonding and long processing times.

CSIRO research workers have invented a process that produces strong bonds in a range of metal/ceramic combinations. The process is much faster and cheaper than existing processes and involves minimal damage to components. Thus it is well suited to the high-volume production of engineering components that incorporate advanced ceramics.

The integrity of the CSIRO bond is currently being evaluated for the use of ceramic tines (prongs) in agricultural tools. Indications are that the bond will withstand this demanding use without failure, enabling the ceramic tines to be assessed for wear and compared with their metal counterparts.

Superconducting devices

A recent technological development in superconductivity, whereby new materials have been produced which superconduct at relatively 'warm' temperatures, has been described as a 'startling breakthrough that could change our world'. And Australia is well placed to take advantage of this emerging technology to form the basis for new industries.

CSIRO scientists have been successful in pursuing innovative applications of superconductivity and have made major contributions in the field of precise electrical measurement.

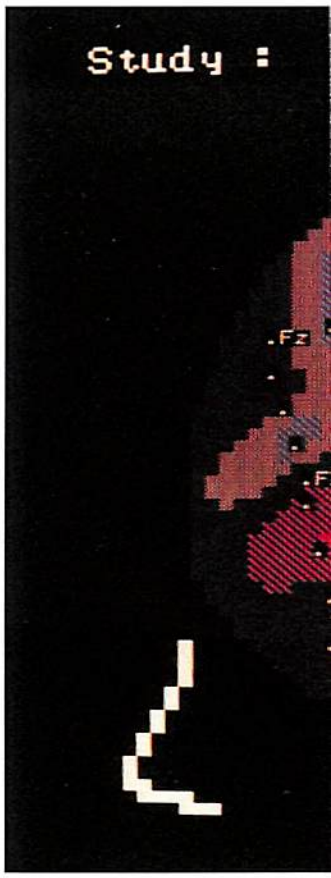
The new materials superconduct (that is, they lose all electrical resistance and thus waste no energy) when conducting a current at the relatively warm temperatures (above −196 degrees Celsius), created by the coolant liquid nitrogen. Previously existing materials exhibited superconductivity only at the much lower temperatures created by liquid helium, which has a boiling point of −269 degrees Celsius and is much more expensive than liquid nitrogen.

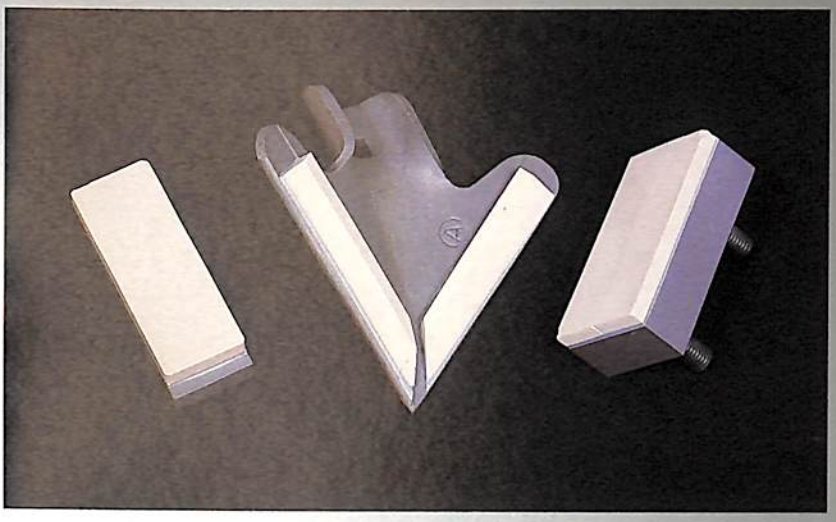
CSIRO researchers are investigating superconducting devices made from various metals, alloys and ceramics with a view to using them as very sensitive detectors of magnetic field changes.

The work is part of a well established research program on SQUIDS (Superconducting Quantum Interference Devices), which are the most sensitive magnetic field sensors available. SQUIDS are based on the unique properties of the junction between pairs of superconducting wires or films that are separated by a thin insulating layer.

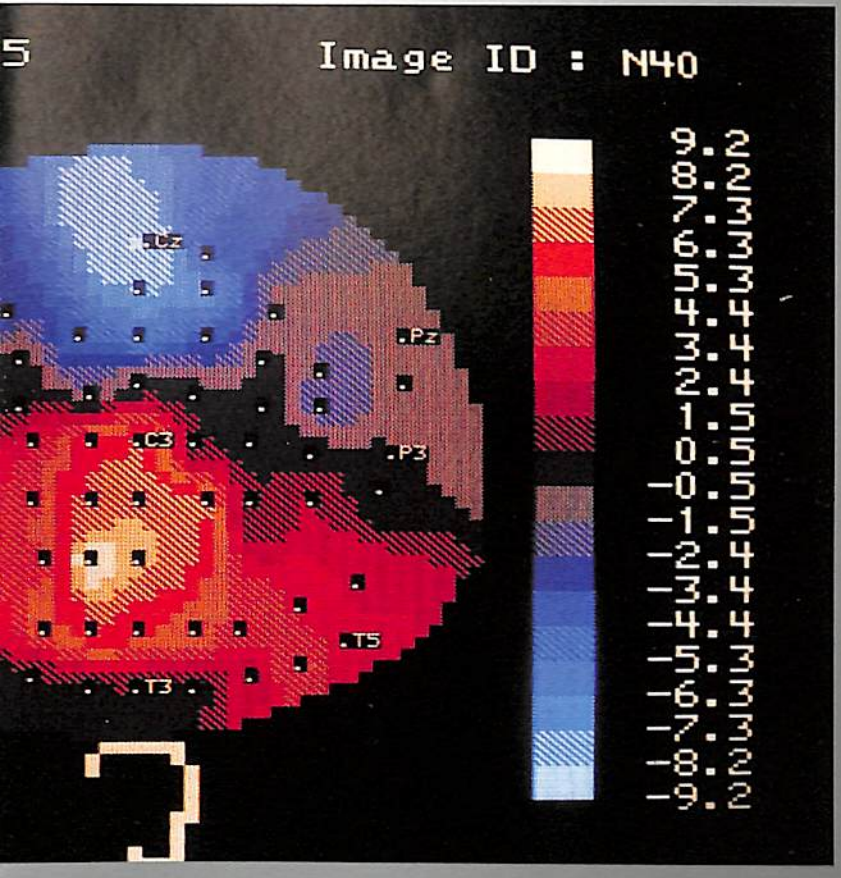
SQUIDS have found application in biomagnetometry, which is the measurement of the minute magnetic fields produced by the human body and in particular the human brain. In 1984 a CSIRO collaborative group was formed with medical researchers at Westmead Hospital, Sydney, to explore the use of SQUIDS for the detection of brain magnetic phenomena and as a diagnostic tool. An Australian manufacturer with established expertise in medical instrumentation is now involved as well.

This image of the magnetic fields produced by the brain can aid in medical diagnosis.





Strong metal–ceramic bonds can now be produced faster and cheaper using a CSIRO-invented bonding process.



Recent research is aimed at producing SQUIDS for use in situations requiring high sensitivity and multichannel capabilities. Another avenue is exploring characteristics of warm or high temperature superconducting ceramics that are likely to find wide practical applications, such as in mineral prospecting, flaw detection, mass screening for heart disease and precise electrical measurements.

New banknote

Unique CSIRO technology for the manufacture of a high security $10 banknote has been sold to the Reserve Bank of Australia. The Bank released the new commemorative $10 note in 1988 for sale over the counter as a collector's item. All the notes have been overprinted with the date of Australia's Bicentenary, 26 January, 1988.

The note's critical security elements include an optically variable device and a novel plastic laminate. This revolutionary approach to banknote technology was developed in a major collaborative research effort extending over 20 years, between CSIRO and the Bank's Note Printing Branch. The potential now exists for Australia to develop a new industry producing banknotes and other high-security products.

The project was conducted in secret at CSIRO, and involved a team from a wide range of activities, including physical optics, polymer chemistry, machine design and creative metal-working.

As the research succeeded it was incorporated into a pilot scale production line at one of CSIRO's Victorian laboratories. This line was transferred to the Bank's Note Printing Branch where it was developed, with CSIRO expertise, into the current production line.

CSIRO technology was used to produce Australia's high-security commemorative $10 banknote.


10


AB 10 000 000

Growth factors for the treatment of muscle wasting

CSIRO and University of Adelaide scientists have isolated a high-potency muscle growth protein with great potential for treating victims of burns, infection and severe injury ('polytrauma'). These patients normally need treatment in hospital intensive care units and suffer major loss of body protein, seen most clearly as muscle wasting. Enormous research effort world-wide has been directed towards finding a successful treatment for 'polytrauma'.

Australian scientists discovered the highly potent protein in milk. It is very similar to a muscle growth factor occurring throughout much of the body — Insulin-like Growth Factor-1 (IGF-1). The new growth factor, known as des-(-1-3)-IGF-1, is ten times more active than IGF-1. It also has potential agricultural applications as it could promote muscle growth in preference to fat deposition in livestock.

The scientists have patented the discovery as well as other closely related growth factors which have been synthesised chemically.

A joint development company, GroPep Pty Ltd, has been formed to commercialise the new growth factor for human, agricultural and industrial uses. GroPep has negotiatied a collaborative agreement with a major international biotechnology company to produce the proteins and test them prior to clinical trials.

Improving our soil

CSIRO is attacking Australia's soil problems by studying soil erosion and by improving soil quality.

Soil erosion and water sediment

Australia's loss of soil has emerged as a major environmental problem, and urgent action is needed to find better ways of monitoring and stopping land and water degradation.

Many water storages — ranging from farm dams to major reservoirs — have large amounts of sediment reducing their capacities. The sediment also causes problems in river channels, where it impedes flow and disturbs the habitat of fish and animals.

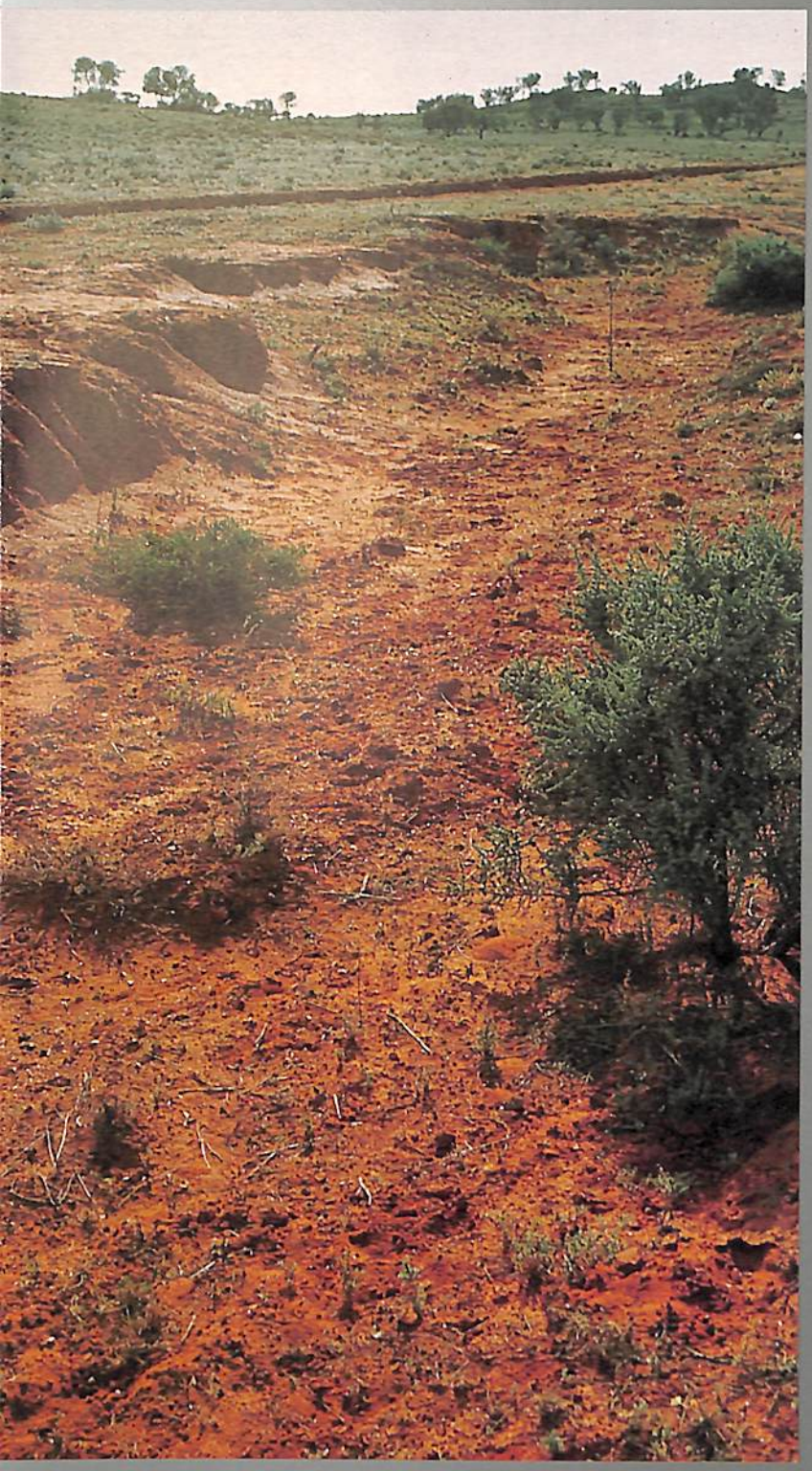
Farmers, planners and developers would benefit greatly if they knew the sources of the sediment and could take steps to reduce it.

CSIRO scientists have developed a new technique to find the source of eroded soil causing sediment problems in dams, thus giving a basis for monitoring soil loss and correcting harmful land management practices.

The technique uses radioactive particles already in the soil to trace the movement of soil particles. It relies on detecting a characteristic radioactive 'fingerprint' in dam sediment and comparing it with the fingerprints of soil at different locations within the water catchment area.

If the technique can be developed as a routine management tool, it will give land managers reliable feedback on the effects of their practices on water storages downstream.

CSIRO and its project collaborator, the Australian Nuclear Science and Technology Organisation, have already used the technique successfully to investigate the source of sediment in the Burrinjuck Reservoir on the Murrumbidgee River.



Soil erosion is one of Australia's major environmental problems and causes large-scale losses in farm productivity.

Gypsum slotting improves soil quality

Soils with poor aeration and water infiltration characteristics, which have low productivity when cultivated and irrigated, can now be economically treated with gypsum by using a CSIRO-designed slotting machine.

The problem was first defined by CSIRO researchers who identified a 'throttle' effect at a depth of about 25–55 cm in clay soils in the New South Wales Riverina plains, which prevented adequate aeration and water infiltration.

The slotting technique applies gypsum to the soil in narrow slots about one metre apart. The machine digs discrete, stable slots and mixes gypsum with the topsoil and subsoil in the slots, which are up to 80 cm deep.

The slots act as pathways for air and water to enter the soil, increasing wheat yields by up to 50 per cent.

A Port Macquarie-based company in New South Wales, Gerrard Cassegrain & Company, has helped develop the machine further for slotting acidic vineyard soils with lime and gypsum, and is negotiating the commercial development of the technique and machinery.

Alerting Australia to the greenhouse effect

Over the past 15 years, CSIRO has been at the forefront of a world-wide research effort to establish the nature of changes currently taking place in the world's atmosphere.

One likely effect of these changes is the greenhouse effect — whereby increasing levels of carbon dioxide and various trace gases in the earth's atmosphere contribute to global warming and sea-level changes.

Scientists working in CSIRO decided there was a need to alert planners, engineers and the community to the implications of the greenhouse effect.

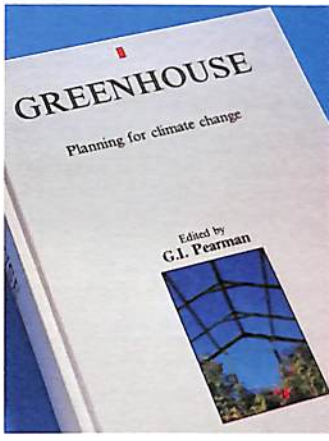
So CSIRO joined with the Commission for the Future in sponsoring the Greenhouse Project, an ongoing program to inform policy makers and the general public of the social and environmental effects that climatic changes may bring about.

The program included a national conference, attended by more than 300 scientists, engineers and planners, on the impact of climate and sea-level changes on Australia.

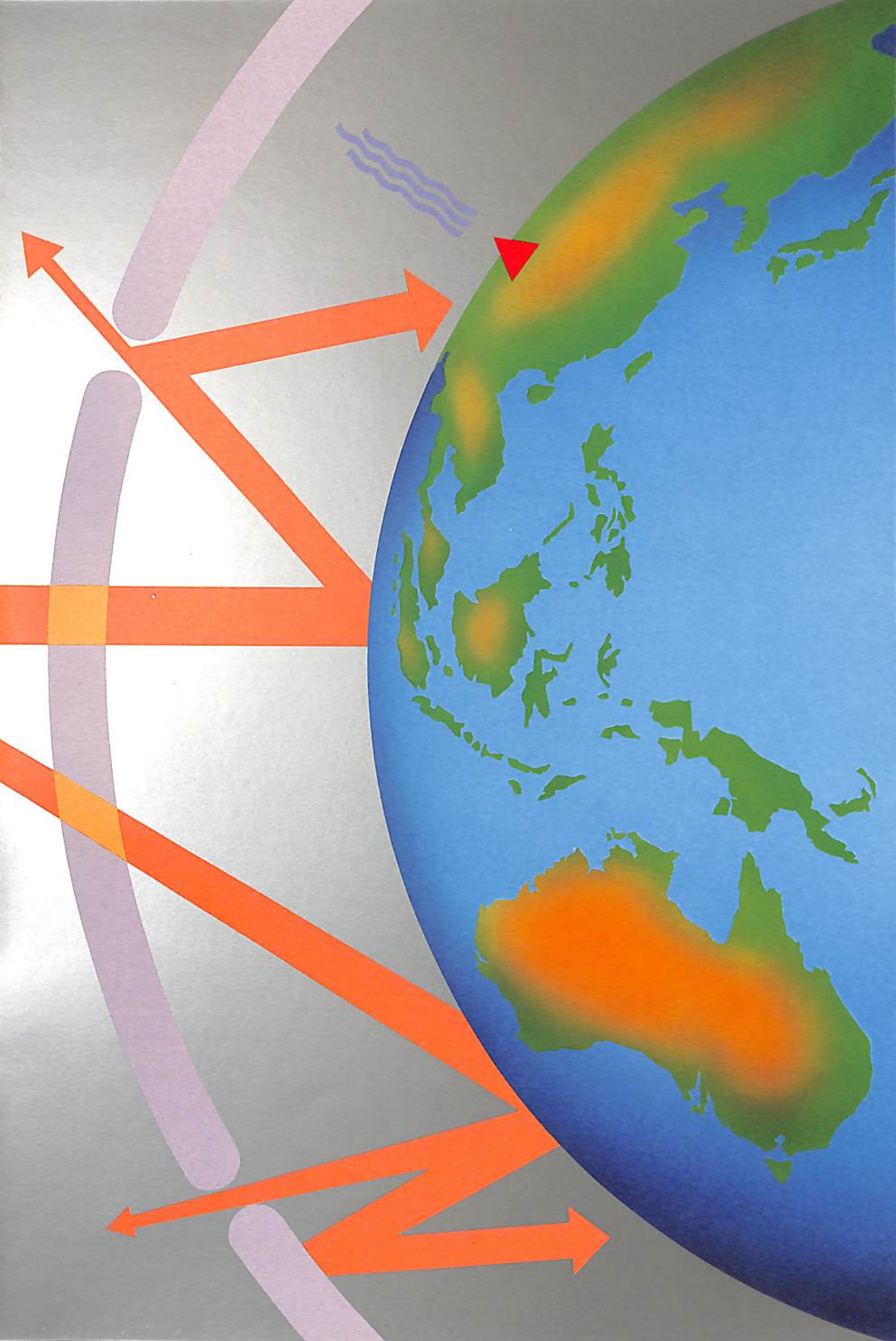
Named 'Greenhouse '87', this major conference aimed to encourage research into the impact of climate and sea-level changes on the Australian environment, community and economy; to establish a basis for a rational approach to the changes in order to minimise undesirable effects and maximise the potential benefits; and to communicate scientific developments concerning the greenhouse effect to policy makers, engineers and planners.

The conference papers will be published in a book to be called "Greenhouse Planning for Climate Change".

While planning for climate change is very important, CSIRO scientists are not losing sight of the need for more detailed descriptions of the climatic changes to be expected and are continuing their research program to meet this need.



CSIRO research into the greenhouse effect is at the forefront of world-wide activity in this area. The greenhouse effect is a phenomenon caused by the warming of the atmosphere through excessive concentrations of carbon dioxide and various trace gases trapping infrared radiation coming from the earth's surface.



A fire management expert system for Kakadu

Fires can burn up to three quarters of Kakadu National Park in a single year. Anticipating their behaviour and effects is a major problem for Park managers.

To assist them, CSIRO has an 'expert system' called FIRES. Expert systems are computer programs that aid decision-making by simulating the approach to problem-solving adopted by human experts. They offer many advantages — such as the use of fire for conserving plant and animal communities — in the management of complex environmental situations.

FIRES consists of two parts. The first is a 'knowledge base', or set of rules and various data bases reflecting accumulated knowledge of fire behaviour and effects on different vegetation types. The second is an 'inference engine', specially designed to handle spatial information, mathematical models and descriptive information about fire behaviour and the characteristics of the vegetation.

The system can be operated on a standard IBM-compatible microcomputer with 640K of memory and a hard disc, or a mainframe computer. Numerous help commands are provided to facilitate operation.

The system forecasts the behaviour of fires burning under different conditions and relates this to the level of damage sustained by different plant species, their mechanisms of recovery, and the time it takes plants to return to their original size.

Preventing costly damage to Australian homes

Each year at least a thousand Australian homes are damaged as a result of foundation movement, at a cost to owners and builders of over $5 million.

CSIRO research has shown that this damage is rarely the result of foundation settlement but is due to the swelling and shrinkage of clays upon which the homes are built. The reactive clays causing these problems are largely peculiar to Australia's dry climate and its soil types.

The identification of such clays, and the design of suitable footings must be carried out as part of normal building practice, and it is important that the methods selected should be both economical and practical.

CSIRO research workers have studied this problem extensively and have developed a method of site classification and design of footings that provides adequate stability and minimises the potential for damage.

The results of their work have been incorporated by the Standards Association of Australia in new standards for residential slabs and footings that help home builders to ensure that their houses are constructed on a firm footing system. They also give advice to owners of existing homes on precautions to minimise the risk of damage from soil movement.

Substantial savings for the housing industry as well as for Australian home owners will result from this study on foundation movement.

FIRES, a CSIRO 'expert system', offers Kakadu National Park managers an effective tool in the management of fire.

Terrain modelling

The commercialisation of a computer software package to model and analyse terrain data will result from research collaboration between two CSIRO Divisions.

Named GAIA, the package will be useful in a wide range of applications where the water properties of the landscape as well as the overall topography are of interest.

Mapping agencies, forestry commissions, defence services, mineral exploration companies, and water and soil conservation agencies all need accurate digital models that take account of drainage patterns and indicate waterlogged areas. GAIA is also applicable in the more traditional markets involving terrain modelling, such as transportation, civil engineering, landscape planning, communication and navigation planning.

The package uses a new procedure for generating a digital elevation model (a grid representation of elevation) that takes account of natural drainage patterns. The procedure is a marked improvement on previous methods of terrain modelling, which can introduce spurious peaks and troughs into the surface.

CSIRO scientists designed GAIA to run on modern graphics computer work stations for easy evaluation of results and user interaction.

The Commonwealth Department of Administrative Services is using the procedures incorporated in GAIA in the production of a 500 metre grid digital elevation model of Australia.

CSIRO, in conjunction with its technology-transfer company, Sirotech Ltd, is developing a marketing strategy prior to the selection of an industry partner to further develop and market GAIA.

A plan view of a section of terrain near Bullock Creek, North Queensland. CSIRO's new software program, GAIA, has computed the derived drainage characteristics and displayed the area so that the gradation from dark to light represents the amount of catchment area draining into it.

New Western Pacific current

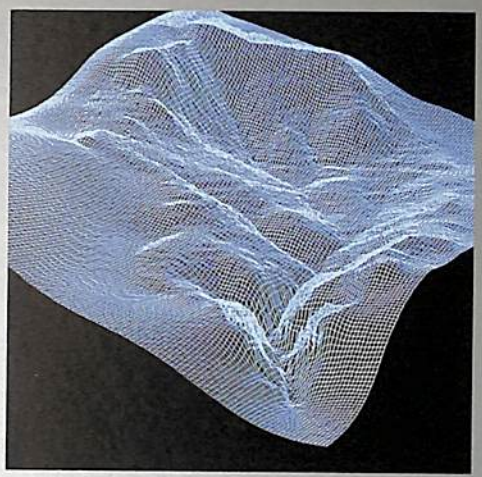
CSIRO is taking part in an international oceanographic research program to improve our understanding of the western Pacific area — the Western Equatorial Pacific Circulation Study (WEPOCS).

General circulation of the ocean in this area is poorly understood and yet there is little doubt that it has a profound influence on Australia's climate, particularly via the El Nino Southern Oscillation.

Over the past two and a half years, CSIRO's oceanographic research vessel *Franklin* has taken part in two joint Australian–American cruises involving intensive observation programs in the region.

The Study has resulted in the discovery and naming of two currents in the tropical western Pacific — the New Guinea Coastal Current, which flows towards the equator at 200 to 700 metres depth through Vitiaz Strait between Papua New Guinea and New Britain, and the Pacific Equatorial Monsoon Jet, an easterly surface current which develops soon after the onset of the north-west monsoon in the region.

Knowledge of the regional ocean currents and structure gained during WEPOCS will make a valuable contribution to the international Tropical Oceans Global Atmosphere (TOGA) program, a major 10-year study of tropical ocean–atmosphere interaction aimed at helping us predict devastating global extremes of climate.



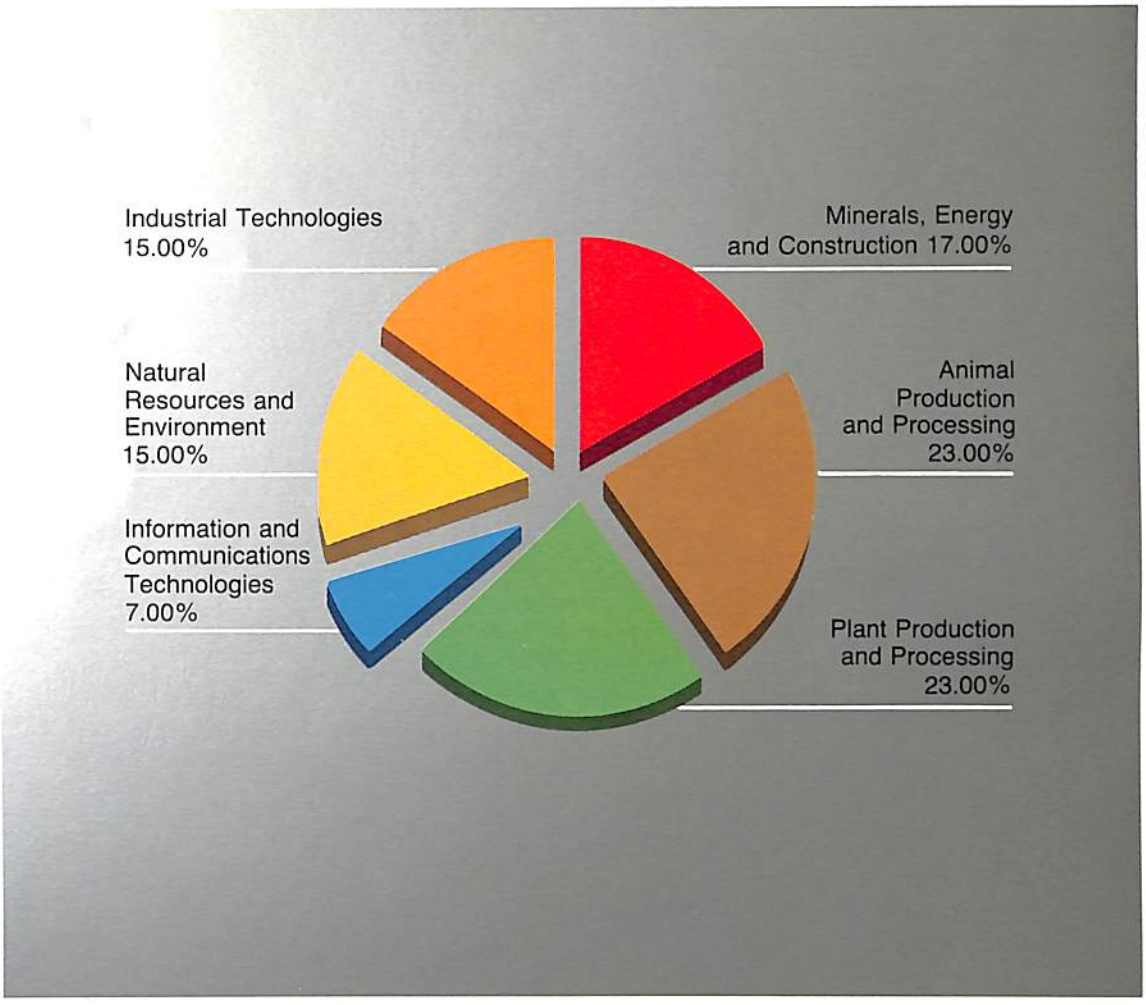
A view produced by GAIA of a visual grid elevation model of terrain near Eden, New South Wales

CSIRO's oceanographic research vessel, the *Franklin*

Distribution of Research Effort

The restructuring of CSIRO's research Divisions and Institutes, which came into effect on 1 January 1988, aimed to align its structural elements with Australia's major economic and social activities. In addition it recognised the vertical links that exist within those industries which are the principal beneficiaries of the Organisation's research. Consequently the distribution of resources between Institutes and between component Divisions reflects the allocation of CSIRO resources to industry and community sectors.

The pie diagram depicts the distribution of CSIRO's research effort according to Institute; the figures refer to professional scientists directly engaged in research. CSIRO has a total staff of 7110, of which 2454 are professional scientists directly engaged in research. Total research expenditure is $362.6M: the Institutes of Animal Production and Processing and Plant Production and Processing account for 46%, and a further 17% goes to the Institute of Minerals, Energy and Construction, indicating the extent of resources devoted to research for primary industries.



At June 1988 about 82% of the professional research staff were funded from appropriation funds. Figures for 1987–1988 reveal an increase in the proportion of externally funded staff (from 14% to 18%) and a decrease in professional research staff levels overall (from 2488 to 2454).

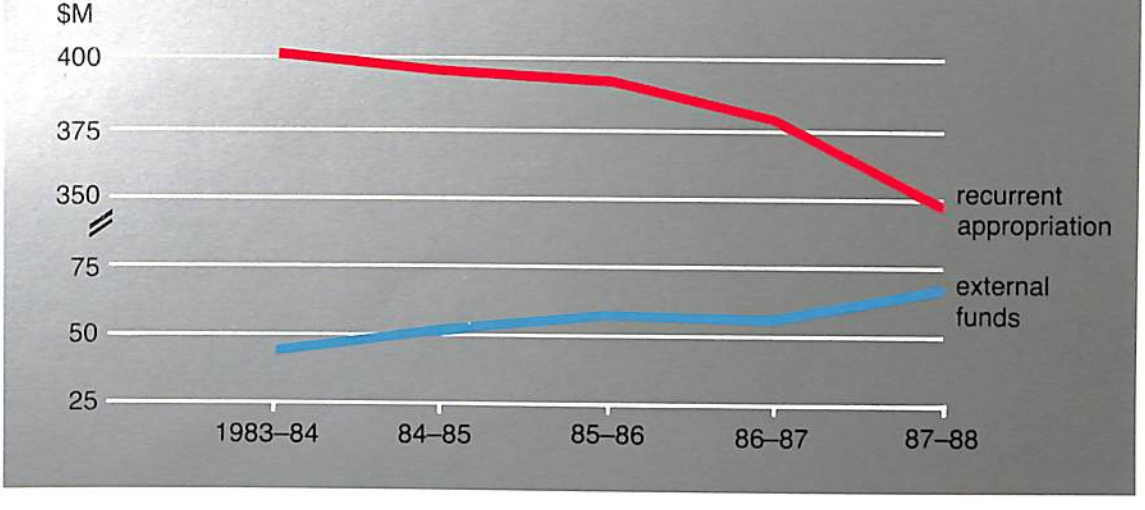
In real terms, CSIRO's appropriation funding has fallen by 17% over the past five years; external funding has increased by about 40% in that period.

The Government has set an objective for the Organisation to increase the level of external funding to 30% over the next 3 years.

Some key features of professional staff distribution and trends over the past four years are:

- Total professional staffing in rural production and processing has been maintained. Within this sector there have been increases in inputs to production and manufacture, arising in part from the significant increases in resources devoted to biotechnology research for the rural sector.
- Resources from both appropriation and industry sources for the minerals and energy sector have declined, reflecting the continuation of reallocations from energy-related research, which had been rapidly increased from 1982–83 in response to the energy crisis.
- For the manufacturing sector funding from both appropriation and industry sources has increased. The major increases in effort have occurred in technology-based manufacturing financed by both industry and appropriation funds.
- There has been a small but significant increase in appropriation-funded staffing for research related to the service industries sector, due to increases in research related to information, communication and space technologies and applications.
- Funding for research related to the environment and water resources sector is particularly dependent on appropriation allocations.
- There has been a decline of about 1.4% in total professional staff, as the increase in industry-funded professional staff has not balanced the decrease in appropriation-funded staff.

CSIRO expenditure 1984–1988 (in 1987/88 dollars)



Corporate Services

CSIRO's Executive Committee, comprising the Chief Executive, the Directors of all six CSIRO Institutes, and the Director of Corporate Services carried out major structural changes to CSIRO's corporate centre during the year.

The controlling and processing tasks previously undertaken by the centre were devolved to a strengthened line of management through Institutes to Divisions. More responsibility for line managers together with more efficient administrative procedures will mean that resources previously used for corporate centre activities can now be redirected to research.

The changes have re-focused the resources of a much smaller centre onto the essential tasks required to support the Chief Executive and to provide key corporate services.

Central to implementing the changes has been the need to reduce staffing levels. During the latter half of the year, 118 staff (about 18 %) separated from the corporate centre by resigning, retiring or choosing retrenchment. A further 156 staff reductions are scheduled to occur by the end of 1989–90 by which time the total savings will be over $10.5M.

As part of the devolution of accountability and responsibility, new management systems using an increased level of computer sophistication were developed and introduced to Divisions.

The major corporate service functions have been grouped into a new department — Corporate Services — which coordinates CSIRO's financial operations and international scientific relations. It also develops and implements policies for the best management of CSIRO's human resources; provides a computer-based management information service; gives legal advice on corporate activities; and provides library and other information services both to the public and to support research within CSIRO.

CSIRO's Executive Committee: clockwise from top left, Dr Roy Green, Dr Alan Reid, Dr Alan Donald, Dr Colin Adam, Dr Robert Frater, Dr Keith Boardman and Mr Peter Langhorne. (Dr Ted Henzell was not present.)

Human Resources

Employee Relations

Negotiation with unions and staff associations over the effects of the restructuring and managing the subsequent retrenchments were the major industrial relations activities for 1987–88. The Executive Committee established a Redundancy and Outplacement Task Force which was given specific responsibility for managing retrenchments. Affected staff were given personal counselling and offered financial planning advice, help in their search for new employment and, where applicable, retraining.

Two other major industrial relations issues required extensive negotiation with unions during the year. The first was the introduction of a Performance Review and Development Program for all staff. The Program aims to enhance performance, productivity, job satisfaction and morale through clear work objectives developed by officers and their supervisors.

The introduction of a second tier wage agreement for all clerical and non-clerical administrative staff was the year's other major industrial relations event.

CSIRO's central forum for consultation between management and staff, the Consultative Council, held two meetings during the year. The Council, composed of eight senior management representatives and an equal number of representatives from staff associations, considered a number of issues including the restructuring of CSIRO and the review of the corporate centre.

In addition to meetings of the full Council, numerous sub-committees met to work on the specific issues of equal employment opportunity, staff development and training, personnel policy and conditions, remote localities and industrial democracy.

Pilot Divisional consultative committees have been established in a number of Divisions to enable management and staff to consult and openly discuss matters affecting staff so as to improve mutual understanding.

Occupational Health and Safety

CSIRO is committed to creating and maintaining a healthy working environment for its staff. During the year, full-time safety officers were appointed to the Black Mountain (Australian Capital Territory) and Clayton (Victoria) sites, and a further six occupational health and safety officers will be appointed in 1988–89.

A smoke-free work environment was introduced at CSIRO from 1 March 1988. As part of the phasing in of a smoke-free workplace, all indoor areas and vehicles have been designated 'non-smoking' and in an attempt to encourage staff to stop smoking, CSIRO is offering up to 8 hours of paid leave to attend 'quit smoking' courses.

Other major policies were formulated following studies on the topics: 'Working in Remote Areas', 'Working Alone' and 'Hearing Conservation'. A fourth study, 'Survey of the Use and Control of Radioactive Substances in CSIRO' is being considered by the Executive Committee.

As part of its broader concern for staff health, CSIRO employs eight part-time personal counsellors who are located at CSIRO's major sites. The counsellors provide confidential counselling in work-related and personal matters. In 1987–88, the counsellors offered over 40 seminars and training courses and played a key role in helping to train supervisory staff to implement the Performance Review and Development Program.

Equal Employment Opportunity

Throughout 1987–88, CSIRO continued to implement the objectives of the Organisation's Equal Employment Opportunity (EEO) Management Plan, which was formally endorsed by the CSIRO Executive in March 1986 and which has been in operation since then.

The objective of the EEO policy is to promote the principle of appointment and promotion by merit, and to ensure the right of all candidates to be considered for positions for which they are qualified and skilled.

Underlying this objective are two major principles. One is that the best possible candidates should be attracted to and recruited by the Organisation. The other is that once appointed, equally qualified employees should have equal opportunities to develop and progress in the Organisation.

Many internal training courses were held to help staff acquire additional skills.

Following this year's corporate centre review, EEO activities are managed by an EEO officer who coordinates a network of on-site contact officers. These officers deal with local EEO issues and provide a source of expertise at each CSIRO location.

CSIRO's EEO program addresses the concerns of all the groups mentioned in the legislation: women, Aboriginals, people with disabilities and people with non–English speaking backgrounds.

The role of women in science, and their opportunities for employment, are of specific concern to CSIRO, and the EEO program is monitoring personnel practices on this issue and their effects on recruitment.

The EEO sub-committee of the Consultative Council has developed a proposal to establish work-based childcare and is examining a number of alternative ways of introducing the scheme. This initiative has been endorsed by the Board.

Courses designed to help managers select the best applicants for vacant positions have been conducted in every major location. The EEO officer participated in the courses for first-level supervisors. Next year, the primary training focus will be on middle and top-level managers.

This year's most important EEO activity was the conduct of an EEO census, the results of which were presented to the CSIRO Board in April 1988.

The census received the exceptionally high response rate of 92 per cent. The census report, together with the annual CSIRO Personnel Statistics Yearbook, will be used to evaluate the effectiveness of the EEO program and to develop appropriate policies. The next EEO census is scheduled for 1992.

Employee Development

In the current era of tight fiscal policy, there is strong pressure to improve efficiency. Declining resources make this goal particularly challenging, and success depends more than ever on the skills of individual officers.

To help staff meet this challenge and gain the skills they need, a three-year Corporate Training Strategy is being prepared in consultation with employees.

As part of the new Organisational philosophy, employee development activities have been expanded and programs are being developed for senior scientists and managers; receptionists and information officers at the front line of public communication; craftsmen and women; technical staff; and librarians and other service personnel.

Management Information Systems

A major element of CSIRO's restructuring has been the introduction of new administrative systems. These have been designed to provide information and give control to the decision-making management level. There has been significant devolution of responsibility to operational units in the areas of finance, budgeting, personnel recruitment, information systems and communication.

During the year, the financial systems that provide the information required for CSIRO's statements within the accrual accounting format were implemented. The systems include sophisticated on-line enquiry facilities.

Following the piloting of a number of new systems in individual Divisions, a full range of systems was developed and implemented across the Organisation, using both mainframe and micro computers. More than 25 corporate centre staff helped train Divisional officers in the use of the new systems.

Corporate Resources

Financial Systems and Services

The corporate budgeting and accounting functions were rationalised and located in one area, together with a restructured resource statistics group. The resource statistics group, which embraces both financial and personnel statistics, provides statistical information in support of corporate decision making.

Administration of grant funds, an important area in times of diminishing appropriation budgets, has been devolved to Institutes and Divisions, as is consistent with strengthening line management.

The corporate centre administration has been rationalised.

Property

Efficient management of CSIRO assets is a major objective of the Corporate Services Department. Continuing rationalisation of property holdings saw the disposal of properties at Jimboomba, Queensland, ($1.5M), Mulgrave, Victoria, ($4.8M), Sungarrin, Victoria, ($1.1M) and three houses throughout Australia. Acquisitions include two houses, the Longpocket site in Brisbane (housing the Division of Tropical Animal Production), and the National Materials Handling Bureau site at North Ryde in Sydney.

During the year the Organisation has overseen two major building projects at Floreat Park, Western Australia, ($11.2M), and at the Division of Chemicals and Polymers, Clayton, Victoria, ($14.4M). Stage II Floreat Park has been completed and is within budget. Stage III will begin next year. Building works at the Black Mountain site in the Australian Capital Territory were valued at $5.2M, and include the completion of a $2.2M Division of Entomology laboratory. March 1988 saw the start of a housing project at Darwin to accommodate visiting scientists.

As part of the improved efficiency measures, CSIRO's assets register was computerised and the implementation of accrual accounting related to real property assets was completed. A major review of repairs and maintenance functions has culminated in the devolution of responsibilities to Divisions.

Information and Library Services

Effective communication, both within the Organisation and with its stakeholders, continues to be given high priority. In conjunction with the devolution of many communication functions to Institutes and Divisions, a corporate Information Services Unit has been formed to provide information products and services on behalf of the corporate centre and to provide communication support to the Institutes.

CSIRO helps Australia's Overseas Aid Program by offering specialised training to overseas scientists and technicians.

Products range from books and scientific journals to videos and semi-technical magazines. Sales of books and journals grossed $1.3M during 1987–88. Subscription sales of the quarterly research magazines increased, generating revenue of more than $100 000. Video footage was supplied for several high-rating TV programs and income from film and video products and licences exceeded $70 000.

Information services include the on-line AUSTRALIS service, which provides access to CSIRO and other databases; the database production group; and the Search Party document retrieval and delivery services.

In 1988–89 action will be taken to reduce costs and optimise effectiveness while consolidating those services which make a significant contribution to CSIRO's strategic goals.

Central library units will be restructured in 1988–89 and all site libraries will be reviewed. Wherever practicable, 'user-pays' arrangements are being introduced to help Institutes rationalise their use of central services.

Legislative and Legal Services

Following the corporate centre review, a corporate legal service was formed by drawing together resources from the Office of the Chief Executive and the former Finance and Administration Branch. The service is located within the office of the Director, Corporate Services, and provides policy advice and legal services to the Organisation.

Since 1980, CSIRO has been subject to an injunction restraining it from proceeding with a program to control the declared noxious weed, Paterson's curse. The injunction was obtained by a coalition of bee-keeping and dryland grazing interests. The program has been authorised under new biological control legislation throughout Australia, and in March 1988 CSIRO attempted to use this legislation to have the injunction lifted, but failed. As of 30 June 1988, an appeal against this decision is under consideration by the Supreme Court of South Australia.

International Relations

CSIRO's Centre for International Research Cooperation (CIRC), the focus for the Organisation's international activities, continued to identify opportunities for CSIRO input into the Australian Aid Program. Last year, CSIRO managed more than thirty research projects on behalf of the Australian Centre for International Agricultural Research (ACIAR) and undertook numerous short-term assignments for the Australian International Development Assistance Bureau (AIDAB). Two major AIDAB projects in the People's Republic of China are being managed by the Division of Animal Health.

Another significant part of CIRC's work was the management and development of training programs for overseas scientists and technicians.

Other CSIRO Divisions also establish and manage research programs with overseas scientists.

Sirotech

Sirotech Limited was established in 1984 on the initiative of CSIRO to assist in transferring CSIRO technology to Australian manufacturing industry. Since that time the company has established a strong expertise in the field of technology transfer as well as in managing CSIRO's patent portfolio.

The past year has seen CSIRO take another leap forward in not only the value, but also the type of commercial agreements being entered into. Combinations of research sponsorship arrangements, licensing agreements, collaborative research agreements and equity investments through joint ventures and other commercial arrangements are used, depending on the circumstances. CSIRO research sponsored by Australian companies is valued at about $16 and a half million per annum, while licensing CSIRO technology attracts about $1 million per annum in royalties.

For the first time a long-term collaborative research agreement has been signed which sees CSIRO become a major shareholder in a public company — Queensland Metals Corporation.

Major agreements were negotiated by Sirotech, on behalf of CSIRO, in numerous areas, including power station technology, wool technology, software programs, cement, forest products, environmental monitors and agricultural equipment.

Provisional patent filings, to provide patent protection for CSIRO developments with commercial potential, totalled 172 in 1987–88, up from 123 in the previous financial year and 71 the year before.

Sirotech has continued to play a role in the promotion of links between CSIRO and industry by participating in a number of business forums, exhibitions and conferences. Sirotech worked with Austrade in the organisation of an Australian exhibition at the Hanover Technology Fair, in West Germany, and specifically represented SCRIMBER, a product of the Division of Forestry and Forest Products.

During the early part of 1988 Sirotech was reviewed by an external consultant and the changes flowing from his recommendations should see the company even better able to serve CSIRO in the years ahead.

The links between CSIRO and industry are promoted by Sirotech, which participates in numerous exhibitions, business forums and conferences.

Taking Science into the Community

CSIRO at the Australian Bicentennial Exhibition

As its main contribution to Bicentennial celebrations, CSIRO has been taking part in the Australian Bicentennial Exhibition with a major display.

The Bicentennial Exhibition is touring Australia during 1988, stopping at 34 towns and cities on the way. It is the largest single continuous activity undertaken by the Australian Bicentennial Authority and in its first six months has attracted more than 430 000 visitors; by the time it completes its tour in Sydney in December 1988, it will have been seen by about 1.4 million people.

The CSIRO display is transported in a specially designed semi-trailer which unfolds to create a covered display area. Within this, a circular structure houses a 4-screen audio-visual show which depicts the range of CSIRO's research activities and their contribution to the welfare of Australia and its primary and secondary industries.

Various products resulting from CSIRO's research are displayed in a series of wall-mounted cabinets, and a large kaleidoscope set into the floor uses optical and electron microscope images to illustrate further aspects of the Organisation's work.

At each location, CSIRO staff from nearby laboratories have been on hand to talk to the public about CSIRO and answer questions and this has contributed to the widespread popularity which the CSIRO display has enjoyed among visitors to the Australian Bicentennial Exhibition.

CSIRO at the Royal Melbourne Show

CSIRO was guest exhibitor at the 1987 Royal Melbourne Show which had as its theme 'Show the Tomorrow'. The Show, which ran from 17 to 26 September, attracted some 780 000 visitors; an independent market survey showed that 49 per cent of these visited the CSIRO exhibition and that 77 per cent of those who did visit regarded it 'very favourably' or 'favourably'.

The CSIRO exhibition occupied some one and a half floors of the P.B. Ronald Pavilion, an area of 1200 square metres, and was aimed particularly at young people and their parents.

Entitled 'Adventures with Science', it comprised the following elements:

The CSIRO display in the travelling Australian Bicentennial Exhibition featured a kaleidoscope illustrating aspects of CSIRO's research work.

- 'The CSIRO Science Spectacular' — a series of half-hour science demonstrations presented 8 times a day by Deane Hutton of the widely-acclaimed children's television program, 'The Curiosity Show';
- 'CSIRO — Research Advancing Australia' — an 8-minute audio-visual showing the relevance of CSIRO to all Australians;
- 'Fun with Science' — a series of interactive, hands-on displays, a number of which were provided by the Museum of Victoria from its 'Experilearn' section;
- 'Worlds of Science' — a series of walk-through audio-visual environments designed to capture something of the beauty and wonder of science as revealed by telescope, microscope and satellite imagery, supplemented by a laser light show;
- a CSIRO bookshop and information counter.

The various displays were staffed by members of local CSIRO Divisions who explained the exhibits, answered questions and talked to the public about CSIRO. Their presence was an important element in the overall success of the exhibition.

CSIRO's Chief Executive, Dr Keith Boardman, escorting Her Majesty Queen Elizabeth II on a tour of the CSIRO display in the Australian Bicentennial Exhibition when it visited Perth, Western Australia

The Prime Minister, Mr Bob Hawke, and host of a popular children's television science show, Dr Deane Hutton, presenting a demonstration at the CSIRO exhibition at the 1987 Royal Melbourne Show

The Chairman, Mr Neville Wran, officially opened the Sydney CSIRO Science Education Centre in February, 1988. The Centre is operated in conjunction with the NSW Department of Technical and Further Education and offers school students a stimulating, hands-on environment to help them discover science.

CSIRO Education Programs

CSIRO is creating a national network of CSIRO Science Education Centres, where teachers provided by State education authorities are helping students experience the excitement of performing scientific experiments, using equipment not normally available in schools. The experiments show scientific principles at work in the real world and illustrate the benefits of CSIRO research.

The centres are so popular that they can cater for only a small percentage of the requests to visit. The Sydney centre, which was opened in February 1988, is the fourth centre to be established following the successful operation of centres in Melbourne, Adelaide and Hobart. Two further centres are due to be opened in Brisbane and Darwin in mid-1989. Also, plans are in the offing for another CSIRO Science Education Centre at the Scitech Discovery Centre in Perth.

CSIRO's Astronomy Education Centre at the Parkes radio telescope is continuing to attract in excess of 60 000 visitors each year. The Centre provides information about CSIRO and astronomy and offers an audiovisual presentation and exhibits.

CSIRO's Double Helix Science Club reaches out to over 2000 members, aged between 10 and 18 years, and their families across Australia. The club encourages students to take their interest in school science further by reading about current developments in science in the quarterly newsletter, entering competitions, taking part in national science experiments and attending excursions to CSIRO Science Education Centres and other CSIRO sites around Australia.

The CSIRO Women In Science Project encourages girls to continue their study of science and maths at senior secondary level. Under the auspices of this project, women volunteers from CSIRO and elsewhere visit schools to talk to the girls about life as a working scientist, thus providing the students with role models showing science as a rewarding and interesting occupation open to all. The video program, 'Women In Science', produced by CSIRO in 1986, is shown to classes prior to these visits.

Other activities include the production of Scifile magazine, which is sent to every secondary school in Australia and to 5000 members of the Australian Science Teachers Association. Scifile alerts teachers and students to current developments in CSIRO research.

The CSIRO Student Research Scheme this year allowed 44 Canberra students to take part in a scientific research project under the supervision of a practising scientist.

CSIRO also arranges the judging for the BHP Science Prize, a highly regarded national competition which CSIRO initiated.

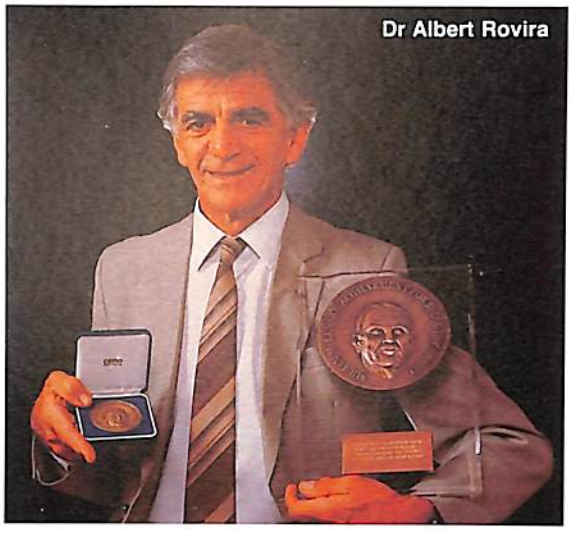
Sir Ian McLennan Achievement for Industry Award

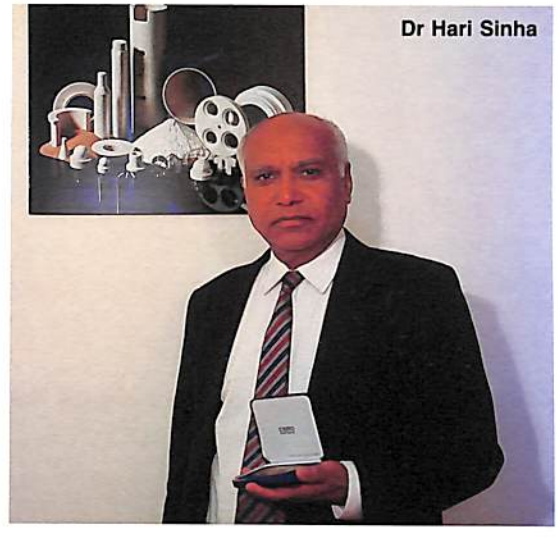
Nominations received for this Award, established by the former Advisory Council, were again of a very high standard. In November 1987 the medal and prizes were presented by eminent former CSIRO scientist Sir David Zeidler, to Dr Albert Rovira from the Division of Soils, and Dr Hari Sinha from the Division of Mineral Products.

Dr Rovira has been recognised for the work he and his research team have done on cereal cyst nematode (CCN) — a pest which costs wheat growers in southern Australia $80 million a year. The research, in conjunction with chemical companies and the Victorian and South Australian Departments of Agriculture, has led to a soil test for estimating CCN infestation and to subsequent chemical and soil management strategies to control the pest.

Dr Sinha's work has resulted in the construction of the world's largest zircon processing plant.

He led the CSIRO research team that, with an ICI team and the joint CSIRO–ICI marketing company, Z-Tech Pty Ltd, invented and developed a new process for the production of high-purity ceramic grade zirconia powders and zirconium chemicals from zircon, derived from Australian beach sand.


Dr Albert Rovira


Dr Hari Sinha

CSIRO Medals

The CSIRO Medals represent peer recognition of individual researchers' contribution to the nation's industrial development or to the Australian community through outstanding achievements in either basic or applied science.

This is the third year the awards have been made. Three medals were awarded to CSIRO staff and one to scientific workers elsewhere in Australia. The recipients of the medals were:

- Mr John Coleman, from the Division of Forestry and Forest Products in Melbourne, for his invention of SCRIMBER — a reconstituted wood product designed to overcome both the shortage of quality timber for structural purposes and the high cost inherent in producing manufactured structural beams;
- Dr David Solomon and his team, from the Division of Chemicals and Polymers, and Mr Don Addison, from the Reserve Bank of Australia, for their joint invention of highly secure banknotes;
- Dr Hugh Tyndale-Biscoe, from the Division of Wildlife and Ecology, for his world-famous studies on the reproductive physiology of marsupials, which have led to greater understanding of the

relationships between the hypothalamus, pituitary, ovary and mammary glands, as well as development of the pouch young;

- Mr Kim Ryrie and Mr Peter Vogel, from Fairlight Instruments Pty Ltd, and Mr Tony Furse, from Creative Strategies Pty Ltd, for their joint invention of a sophisticated computer music instrument which is unmatched in its ability to sample and manipulate natural sounds, as well as create entirely new sounds.

The Medals were presented in December 1987 by the Chairman of CSIRO, the Hon. Neville Wran, at a CSIRO Board meeting in Melbourne.

BHP Award for the Pursuit of Excellence

Dr Jim Peacock

In February 1988 the Prime Minister, Mr Bob Hawke, presented CSIRO's Dr Jim Peacock with a Bicentennial BHP Award for the Pursuit of Excellence. Dr Peacock, Chief of the Division of Plant Industry, won the science and technology section of these awards for his contributions to genetics and molecular biology research.

Dr Peacock's research has led to significant new fundamental knowledge of plant gene function which, when applied, could lead to greater productivity and value for Australia's agricultural industry. Under his leadership, the Division of Plant Industry has achieved international recognition as a leader of research in molecular biology.

His research team was the first in the world to isolate "jumping genes" in maize. Other work has included the application of gene probes for accurate diagnoses of virus diseases in plants and the engineering of a synthetic gene that provides resistance to disease in tobacco plants (reported in the Highlights section of this Report).

CSIRO's Statutory Reporting Requirements

The *Science and Industry Research Act* 1949 (referred to below as 'the *Act*') and the *Audit Act* 1901 require the CSIRO Annual Report to include a general account of the operations of the Organisation and:

- a statement of the policies of the Organisation in relation to the carrying out of the scientific research of the Organisation that were current at the beginning of the year, together with a description of any developments in those policies that occurred during the year (see pages 4–10 and 46–56);
- any determinations made by the Minister under sub-paragraph 9(1)(a)(iv) of the *Act* during the year;
- any directions or guidelines given by the Minister under section 13 of the *Act* during the year;
- any policies notified by the Minister under section 14 of the *Act* during the year;
- financial statements for the reporting year in a form approved by the Minister for Finance (see pages 66–81);
- the Auditor-General's report on these statements (see page 65).

The Minister made no determinations, gave no directions and notified no policies under the *Act* during the year. CSIRO was provided with Ministerial Guidelines which appear on page 10.

Science and Industry Endowment Fund

In 1987–88, 21 grants totalling $42 224 were provided for this fund, which was established under the *Science and Industry Endowment Act* of 1926. Recipients of the 1987 grants ranged from retired professional scientists through amateur naturalists to school science associations. This was in keeping with the intention of the *Act* to promote interest in scientific and industrial research and to provide support to worthy individuals who have no institutional support.

The Science Grants come from the annual return on the 100 000 pounds Australian originally allocated to the Fund by the *Act*.

The Chief Executive of CSIRO is Trustee of the Science and Industry Endowment Fund.

Freedom of Information

The following information is presented in accordance with the requirements of section 8 of the *Freedom of Information Act*.

The *Freedom of Information Act* gives a right of access to the general public to documents held in CSIRO.

In the year to 30 June 1988, CSIRO received 15 requests under the *Act*. Of these, 4 requests were granted in full, 5 were granted in part and 6 were withdrawn or treated outside the provisions of the *Act*.

Categories of Documents

CSIRO holds documents under the following headings:

financial management and administration
buildings and property
personnel and industrial relations
scientific and industrial research.

The following CSIRO documents are customarily made available to the public free of charge: policy circulars; information circulars; staff circulars; CoResearch (house journal); film catalogue; list of saleable publications; information service leaflets issued by Divisions on a wide range of technical subjects which attract frequent enquiries from the general public; conditions of CSIRO postdoctoral awards; press releases, information on careers in CSIRO and school project material; and Industrial Research News.

Archives and Disposal Arrangements for Documents

CSIRO maintains an extensive archives collection dating from the establishment in 1916 of the Advisory Council for Science and Industry, the original predecessor of CSIRO. Apart from official files, documents held include personal and scientific material, large quantities of scientific data (including much on magnetic tape) and many maps and photographs. CSIRO archives are managed by professional archivists and the main collection is housed in Canberra. Limited use has been made of the Australian Archives for the storage of records of a routine administrative nature. CSIRO encourages the use of its archives and provides access in accordance with the provisions of the *Archives Act* 1983.

Facilities for Access

Arrangements can be made for documents that are the subject of FOI requests to be made available for inspection at the CSIRO office nearest to the address of the applicant. Help will be given to people with disabilities in entering and leaving CSIRO premises if prior arrangements are made.

FOI Procedures and Initial Contact Points

A central Freedom of Information Co-ordination Unit is responsible for the receipt of requests, referring these to senior officers for decision and granting access to the documents. Initial enquiries should be made to:

The FOI Co-ordination Unit
CSIRO
Limestone Avenue
Campbell ACT 2601
or PO Box 225
Dickson ACT 2602
Tel: (062) 48 4123

In accordance with the *Freedom of Information Act*, formal requests to CSIRO should be posted to:

The Chief Executive
CSIRO
PO Box 225
Dickson ACT 2602


IICT
CSIRO
Research Advancing Australia
CSIRO
PERSPECTIVES
R.V. FRANKLIN
CoResearch
No. 315 August 1988
CSIRO's staff newspaper
The Australia Telescope
INFORMATION SHEET
SATELLITE ANTENNAS
natcom

About CSIRO

The primary functions of CSIRO are:

- to perform scientific research aimed at assisting Australian industry, benefiting the Australian community, and contributing to the achievement of national goals; and
- to encourage and facilitate use of the results of its research.

An independent statutory authority, CSIRO operates under the provisions of the *Science and Industry Research Act* 1949. Throughout the reporting year Mr Barry Jones, Minister for Science, Customs and Small Business, was the responsible Minister.

A 10-member Board is responsible for determining policy and ensuring the efficient functioning of CSIRO. The Chief Executive, who is a member of the Board, is responsible for the Organisation's management.

Staff are employed under Section 32 of the *Science and Industry Research Act* 1949. At 30 June 1988 CSIRO had a total staff of 7110. Names of senior staff are shown opposite.

CSIRO's research is performed in 35 Divisions and research units, grouped into six Institutes.

The Organisation produces a wide range of publications related to this research. Information on these can be obtained from the CSIRO Bookshop, PO Box 89, East Melbourne, Vic. 3002 (Tel. (03) 418 7333).

Scientific and technical enquiries may be directed to CSIRO's National Information Network (see page 82).

Media enquiries may be directed to Public Affairs at CSIRO's Canberra headquarters: Tel. (062) 48 4484.

Freedom of Information enquiries: Tel.(062) 48 4123.

CSIRO
AUSTRALIA

SENIOR STAFF AS AT JULY 1 1988

CORPORATE CENTRE

Director, Corporate Services
Mr P.H. Langhorne

Principal Secretary
Dr T.E. Heyde

Director, Public Affairs
Mr P.J. Dunstan

Corporate Planner
Dr D. MacRae

INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES

Director
Dr R.H. Frater

Divisions and Chiefs

Information Technology
Dr J.F. O'Callaghan

Mathematics and Statistics
Dr R.L. Sandland (Acting)

Radiophysics
Dr D.N. Cooper

CSIRO Office of Space Science and Applications (COSSA)
Dr K.G. McCracken (Director)

INSTITUTE OF INDUSTRIAL TECHNOLOGIES

Director
Dr C.M. Adam

Divisions and Chiefs

Applied Physics
Dr W.R. Blevin

Biotechnology
Dr G.W. Grigg

Chemicals and Polymers
Dr D.H. Solomon

Manufacturing Technology
Dr R.H. Brown

Materials Science and Technology
Dr M.J. Murray (Acting)

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION

Director
Dr A.F. Reid

Divisions and Chiefs

Building, Construction and Engineering
Dr D.C. Gibson (Acting)

Fuel Technology
Dr P.G. Alfredson

Exploration Geoscience
Dr B.J.J. Embleton

Coal Technology
Prof. L.S. Leung

Geomechanics
Dr B.E. Hobbs

Mineral and Process Engineering
Mr W.J. Trahar (Acting)

Mineral Products
Chief: Dr T. Biegler

INSTITUTE OF ANIMAL PRODUCTION AND PROCESSING

Director
Dr A.D. Donald

Divisions and Chiefs

Animal Health
Dr T.J. Bagust

Animal Production
Dr T.W. Scott

Food Processing
Dr D.J. Walker

Human Nutrition
Dr P.J. Nestel

Tropical Animal Production
Dr D.F. Mahoney

Wool Technology
Dr K.J. Whiteley

Australian Animal Health Laboratory
Mr W.A. Snowdon

INSTITUTE OF PLANT PRODUCTION AND PROCESSING

Director
Dr E.F. Henzell

Divisions and Chiefs

Entomology
Dr M.J. Whitten

Forestry and Forest Products
Dr W. Hewertson

Horticulture
Dr J.V. Possingham

Plant Industry
Dr W.J. Peacock

Soils
Dr D.E. Smiles

Tropical Crops and Pastures
Dr R.J. Jones (Acting)

INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT

Director
Dr R.M. Green

Divisions and Chiefs

Atmospheric Research
Dr G.B. Tucker

Fisheries
Dr F.R. Harden Jones

Oceanography
Dr A.D. McEwan

Water Resources
Dr G.B. Allison

Wildlife and Ecology
Dr B.H. Walker

Centre for Environmental Mechanics
Dr J.R. Philip

SIROTECH Ltd

Chairman and Acting Managing Director
Mr L.G. Cuming

Finance

Expenditure by CSIRO of funds under its control totalled about $451 million in 1988.

Of this amount, $348m (77%) came from funds appropriated directly to CSIRO by Parliament. Another $71m (16%) came from funds provided by industry and other contributors. The remaining $32m (7%) came from revenue earned by the Organisation, unspent funds from 1987 and receipts from the Department of Primary Industry for its half-share of the operation of the Australian Animal Health Laboratory.

The year's expenditure from appropriation and revenue funds for salaries and general running expenses was $403m.

CSIRO's audited financial statements for the year are presented on pages 66 to 81.

Executive Office of the
Auditor-General

Australian Audit Office
G.P.O. Box 707
Canberra, A.C.T. 2601

29 November 1988

The Honourable the Minister for
Science, Customs and Small Business
Parliament House
CANBERRA ACT 2600

Dear Minister

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION
AUDIT REPORT ON FINANCIAL STATEMENTS

Section 51 of the *Science and Industry Research Act* 1949 declares the Commonwealth Scientific and Industrial Research Organisation to be a public authority to which Division 3 of Part XI of the *Audit Act* 1901 applies. Pursuant to sub-section 63M(2) of the *Audit Act*, the Commonwealth Scientific and Industrial Research Organisation has submitted for my report its financial statements for the year ended 30 June 1988. These comprise:

- Statement of Activity
- Statement of Capital Accumulation
- Statement of Assets and Liabilities
- Statement of Sources and Applications of Funds
- Notes to and Forming Part of the Statements, and
- Certificate of Chief Executive and Manager, Corporate Resources.

The statements have been prepared in accordance with the policies outlined in Note 1 to the accounts and are in accordance with the Guidelines for the Form and Standard of Financial Statements of Commonwealth Undertakings approved by the Minister for Finance. The statements are in the form approved by the Minister for Finance pursuant to sub-section 63M(1) of the *Audit Act*. A copy of the financial statements is enclosed for your information.

These statements have been audited in conformance with the Australian Audit Office Auditing Standards.

In accordance with sub-section 63M(2) of the *Audit Act*, I now report that the statements are in agreement with the accounts and records of the Organisation and, in my opinion:

(a) the statements are based on proper accounts and records, and
(b) the receipt, expenditure and investment of moneys and the acquisition and disposal of assets by the Organisation during the year have been in accordance with the *Science and Industry Research Act* 1949, except in relation to the matters referred to in Note 15 to the statements.

Yours sincerely

(Sgd) J.C. Taylor

J.C. Taylor
Auditor-General

Commonwealth Scientific and Industrial Research Organisation
Statement of Activity for the Year ended 30 June 1988

	Notes	1988 $'000	1987 $'000
Revenue			
Parliamentary Appropriations		347 641	367 757
Transfers to Capital Accumulation		40 929	48 011
		306 712	319 746
Other Revenue	2	31 569	26 593
Grants and Contributions		71 507	46 619
Transfers to Capital Accumulation		5 024	2 574
		66 483	44 045
Total Revenue		**404 764**	**390 384**
Expenses	3		
Research Programs			
Animal Production & Processing		80 092	80 080
Industrial Technologies		53 322	53 742
Information & Communications Technologies		20 788	18 934
Minerals, Energy & Construction		59 155	57 554
Natural Resources & Environment		49 394	46 510
Plant Production & Processing		82 447	85 772
Research Support		28 715	30 675
Corporate Centre		24 560	34 993
National Facilities		4 934	4 654
Total Expenses		**403 407**	**412 914**
Surplus (Deficiency) of revenue over expenses before provisions and unfunded charges		**1 357**	**(22 530)**
Provisions and unfunded charges	4	**30 684**	**31 367**
		(29 327)	**(53 897)**
Abnormal item	5	**3 698**	**–**
Deficiency— transferred to Statement of Capital Accumulation		**(25 629)**	**(53 897)**

The accompanying notes form part of these statements.

Commonwealth Scientific and Industrial Research Organisation
Statement of Capital Accumulation for the Year ended 30 June 1988

	Notes	1988 $'000	1987 $'000
Balance as at 1 July		**609 786**	**613 098**
Transfer from Statement of Activity for capital appropriation		40 929	48 011
Capital receipts from Grants and Contributions		5 024	2 574
		655 739	**663 683**
Deficiency transferred from Statement of Activity		**(25 629)**	**(53 897)**
Balance as at 30 June 1988 transferred to Statement of Assets and Liabilities		**630 110**	**609 786**

The accompanying notes form part of these statements.

Commonwealth Scientific and Industrial Research Organisation
Statement of Assets and Liabilities as at 30 June 1988

	Notes	1988 $'000	1987 $'000
Capital accumulation from Statement of Capital Accumulation		**630 110**	**609 786**
represented by			
Current assets			
Cash at bank and on hand		38 122	9 075
Short-term deposits		—	21 350
Debtors	6	16 629	6 453
Prepayments		3 546	3 430
Consumable stores	1.5	—	4 669
		58 297	**44 977**
Non-current assets			
Land, buildings and leasehold improvements	7	554 034	549 989
Other non-current assets	8	166 970	147 848
Investments	9	3 596	931
Leased assets	1.12	—	120
		724 600	**698 888**
Total assets		**782 897**	**743 865**
Current liabilities			
Accrued expenses		5 496	4 440
Creditors		19 325	14 816
Grants and revenue received in advance	11	35 535	21 253
Provision for recreation leave	1.6	28 801	28 545
Provision for long-service leave	1.6	51 910	54 622
Provision for workers' compensation	1.7	1 000	1 000
Lease liability	1.12	—	48
		142 067	**124 724**
Non-current liabilities			
Provision for long-service leave	1.6	9 291	9 298
Lease liability	1.12	—	57
Provision for superannuation benefit	1.8	1 429	—
		10 720	9 355
Total liabilities		**152 787**	**134 079**
Net assets		**630 110**	**609 786**

The accompanying notes form part of these statements.

Commonwealth Scientific and Industrial Research Organisation
Statement of Sources and Applications of Funds
for the Year ended 30 June 1988

	1988	
	$'000	$'000
Sources of Funds		
Funds from Operations (See note)		
Inflow of funds from operations		
Sales revenue	15 329	
Other revenue		
Proceeds from sale of fixed assets and CSIRONET operations	16 381	
Grants and contributions	71 507	
Miscellaneous revenues	12 681	
Funds from Government		
Parliamentary appropriations — Recurrent	317 856	433 754
Outflow of funds from operations — expended in the provision of goods and services		417 140
		16 614
Funds from Government		
Parliamentary appropriations — Capital works		29 785
Reduction in assets		
Current assets		
Short term deposits	21 350	
Consumable stores	57	21 407
Non-current assets		
Land, buildings and leasehold improvements	3 136	
Other non-current assets	6 387	9 523
Increase in liabilities		
Current liabilities		
Accrued expenses	1 056	
Creditors	4 509	
Grants and revenue received in advance	14 282	19 847
TOTAL SOURCES OF FUNDS		**97 176**
Applications of funds		
Increase in assets		
Current assets		
Cash at bank and on hand	29 047	
Debtors	9 966	
Prepayments	116	39 129
Non-current assets		
Land, buildings and leasehold improvements	23 198	
Other non-current assets	32 184	
Investments	2 665	58 047
TOTAL APPLICATION OF FUNDS		**97 176**

		1988	
		$'000	$'000
Note			
Reconciliation of operating result with funds from operations:			
Surplus of revenue over expenses before provisions and unfunded charges			1 357
plus:			
Transfers to capital accumulation		45 953	
Proceeds from sale of fixed assets and CSIRONET operations		16 381	
Loss on disposal of non-current assets		729	63 063
less:			
Parliamentary appropriation for capital works		29 785	
Profit from sale of fixed assets and CSIRONET operations		3 559	
Disposal of fixed assets and CSIRONET operations		14 462	47 806
Funds from operations			16 614

Commonwealth Scientific and Industrial Research Organisation
Notes to and Forming Part of the Financial Statements

Note 1 Summary of Significant Accounting Policies

1.1 General

Except where stated, the financial statements have been prepared in accordance with the historical cost convention, the Guidelines for the Form and Standard of Financial Statements of Commonwealth Undertakings, issued by the Minister for Finance and the Australian Accounting Standards. The form of the financial statements has been approved by the Minister.

As this is the first year CSIRO has prepared a Sources and Applications of Funds Statement it was not possible to provide comparative figures.

1.2 Statement of Activity

As a result of the restructuring of CSIRO during 1988, the 1987 expenditure figures were recalculated to reflect the new Institute and Divisional structures and to provide meaningful comparative information.

1.3 Fixed Assets

Except where stated, all fixed assets are valued at historical cost. Assets costing less than the threshold limit of $1000 are expensed during the year of purchase.

The valuation of buildings and leasehold improvements was performed by the Department of Housing and Construction and CSIRO officers as at 30 June 1986. Building valuation includes plant, fixtures and fittings which form an integral part of the building.

Land has been valued by CSIRO's registered valuer as at 30 June 1986.

Computer software, scientific glassware, experimental prototype equipment, and library monographs and serials are not capitalised as fixed assets owing to either their uncertain useful lives or the uncertainty of benefits to be derived from their development.

Assets totalling $4 811 474 (1987, $3 274 150) which are purchased from Specific Research Funds and where the sale proceeds are refunded to the grantor under the terms of the grant agreement, have been expensed during the year of purchase. Separate records for these assets have been maintained and are disclosed in Note 13.

1.4 Depreciation and Amortisation

Depreciation on fixed assets, except land and leasehold improvements, is calculated on a straight-line basis, so as to write off their cost or valuation less estimated residual value progressively over their estimated useful lives.

The valuation or cost of leasehold improvements is amortised over the unexpired period of the leases or their estimated useful lives, whichever is the shorter.

1.5 Consumable Stores

Stocks of consumable stores mainly consist of fuel and lubricants, chemical supplies, maintenance materials and stationery. They are not trading stocks and not considered material in terms of total expenditure or total assets. As a result, in accordance with the Australian Accounting Standard AAS 9 "Expenditure Carried Forward to Subsequent Accounting Periods" (para. 9) and AAS 5 "Materiality in Financial Statements" (paras 16 and 17), CSIRO has this year elected to write off expenditure on consumable stores as it is incurred. This change in accounting policy has had the effect of increasing this year's deficiency by approximately $4 million (Note 5).

1.6 Employee Benefits

Provisions for recreation and long-service leave are calculated by multiplying the leave entitlements of employees by their current pay rates. Probability factors are applied to employees with less than ten years service to calculate provision for long-service leave.

1.7 Workers' Compensation

CSIRO carries its own risk for workers' compensation. During the year an independent actuarial assessment of CSIRO's liability for compensation was made. This assessment determined CSIRO's workers' compensation liability, based on known and expected cases, to be in the order of $27.8 million, excluding common law claims assessed at $3.2 million. The above estimates do not take account of new Government benefits and arrangements which come into effect on 1 December 1988 on the introduction of a revised compensation scheme COMCARE. The effects of the introduction of the new scheme have not been calculated because of uncertainty attaching to its implementation arrangements.

It is expected that COMCARE will assume responsibility for CSIRO's compensation liability from 1 December 1988. In view of this and of the above CSIRO has retained its provision at the previous level of $1 million.

1.8 Superannuation

CSIRO is an approved authority for the purposes of the *Superannuation Act* 1976 and is required to meet the employer's share of the cost of benefits payable pursuant to that *Act* to eligible employees. CSIRO discharges this liability by periodic payments to the Commonwealth of amounts, expressed as a percentage of the salaries of eligible employees, estimated by the Commonwealth to be sufficient to meet CSIRO's share of the full accruing cost both of pensions granted on the retirement or death of such employees and any subsequent pension increases.

An actuarial review was performed as at 30 June 1986 and the rate of 15·4% was recommended by the actuary as sufficient to meet the cost of benefits accruing in respect of future service, allowing for new entrants. This rate became effective as from 1 July 1987. The previous rate was 20·5%.

The amount of employer contributions paid in respect of 1988 was $27 879 514 (1987, $38 285 900) and this represents 15·4% of superannuable salaries.

The Australian Government agreed to a 3% additional superannuation benefit for eligible employees with 1·5% commencing on 1 January 1988 and the balance no later than 1 January 1989. This arrangement is separate from the Commonwealth Superannuation Scheme. CSIRO is required to finance benefit payments as they fall due. An amount of $1 428 958 has been provided for the period 1 January 1988 to 30 June 1988 as a provision.

1.9 Investments

Interests in companies (including associated companies) other than SIROTECH Ltd (Note 10) are shown as investments at cost or Board Members' valuation (Note 9). Associated companies are companies in which CSIRO exercises significant influence by holding shares and participating in financial and operating policies.

1.10 Research and Development

Research and development costs are expensed as incurred, except where benefits are expected, beyond any reasonable doubt, to equal or exceed those costs.

1.11 Reporting by Segments

CSIRO principally operates in the field of scientific and industrial research and development in Australia. It is therefore considered that, for segment reporting, it operates in one industry and one geographical location.

1.12 Finance and Operating Leases

Owing to the commercialisation of CSIRONET operations on 1 October 1987, all material leases on computing equipment had been assigned to an associated company, Vantage Solutions Pty Ltd. The remaining leases held by CSIRO mainly relate to office equipment and it has elected not to account and disclose these leases this year because the amount involved is not considered material. This is in accordance with the Australian Accounting Standard AAS 17 "Accounting for Leases" (para. 23).

This change in accounting policy has had the effect of decreasing total assets and liabilities by approximately $120 000 and $105 000 respectively (Note 5).

1.13 Sponsored Research

CSIRO has entered into various collaborative agreements with external parties for the research and development of technologies, products and scientific know-how. Details of the ownership of intellectual properties vary from agreement to agreement. These agreements do not involve sharing in common of liabilities and interests in assets, other than assets represented by intellectual properties to which CSIRO does not attribute any value in the accounts.

All costs incurred on research and development under the terms of the agreements have been expensed in accordance with Note 1.10 above.

Where CSIRO receives licensing fees and/or royalties from sale of products or technologies developed under the collaborative agreements, these have been brought to account when earned.

1.14 Insurance

CSIRO carries its own risks, with the exception of the insurance on the Oceanographic Research Vessel *Franklin*.

1.15 Grants and Contributions

Grants received in advance represent unearned revenue. The balance includes amounts which may subsequently be refunded to contributors. Specific research debtors represent revenue earned not yet received by CSIRO.

No offsets have been made for contributors appearing in both grants received in advance and specific research debtors.

Note 2 Other Revenue

	1988 $'000	1987 $'000
CSIRONET computing services	2 500	12 204
Department of Primary Industry's contribution to the cost of the Australian Animal Health Laboratory	4 622	4 400
Interest	4 578	3 406
Royalties	9 778	742
Sale of publications	1 507	920
Sale of produce and livestock	805	699
International consultancies	739	724
Profit on disposal of fixed assets	3 417	438
Profit on disposal of CSIRONET operations	142	–
Miscellaneous	3 481	3 060
	31 569	**26 593**

Proceeds from the sale of fixed assets and CSIRONET operations amounted to $16 381 000 (1987, $5 139 574).

Note 3 Expenses

	General Research Funds $'000	Specific Research Funds $'000	Total 1988 $'000	Total 1987 $'000
Research programs				
Animal Production & Processing	54 262	25 830	80 092	80 080
Industrial Technologies	48 005	5 317	53 322	53 742
Information & Communications Technologies	19 112	1 676	20 788	18 934
Minerals, Energy & Construction	48 666	10 489	59 155	57 554
Natural Resources & Environment	42 548	6 846	49 394	46 510
Plant Production & Processing	68 644	13 803	82 447	85 772
	281 237	**63 961**	**345 198**	**342 592**
Research Support	26 853	1 862	28 715	30 675
Corporate Centre[a]	24 298	262	24 560	34 993
National Facilities	4 932	2	4 934	4 654
	337 320	**66 087**	**403 407**	**412 914**

(a) Includes loss on sale of fixed assets $729 000 (1987, $975 000).

Note 4 Provisions and Unfunded Charges

	1988 $'000	1987 $'000
Provision for long service leave	(2 107)	–
Provision for recreation leave	560	–
Provision for superannuation	1 429	–
Provision for workers' compensation	–	1 000
Provision for doubtful debts	(238)	332
Depreciation	31 040	29 996
Amortisation	–	39
	30 684	**31 367**

Note 5 Abnormal Items (Notes 1.5 and 1.12)

	1988 $'000	1987 $'000
Prior period adjustments relating to buildings and other non-current assets brought to account this year	8 325	–
less:		
Change in accounting policies		
Consumable stores	4 612	–
Finance leases	15	–
	4 627	–
	3 698	**–**

Note 6 Debtors

	1988 $'000	1987 $'000
Specific research debtors	5 611	3 575
Interest receivable	66	387
Advances — SIROTECH Ltd	276	153
— Other	21	48
CSIRONET trade debtors	–	1 636
General research debtors	1 215	592
Associated company	–	60
Other accrued income	9 534	334
	16 723	**6 785**
Provision for doubtful debts	94	332
	16 629	**6 453**

Note 7 Land, Buildings and Leasehold Improvements (Notes 1.3 and 1.4)

	Leasehold improvements $'000	Buildings $'000	Land[a] $'000	Total 1988 $'000	Total 1987 $'000
At valuation	16 492	455 012	79 862	551 366	553 095
Accumulated depreciation	3 033	32 049	–	35 082	17 823
	13 459	422 963	79 862	516 284	535 272
At cost	366	6 553	4 025	10 944	547
Accumulated depreciation	20	4	–	24	–
	346	6 549	4 025	10 920	547
Work in progress	–	26 830	–	26 830	14 170
	13 805	**456 342**	**83 887**	**554 034**	**549 989**

[a] Crown land and land held in Commonwealth title totalling $12 950 000 (1987, $12 950 000) have been included in the above land values. Negotiations have taken place between CSIRO and the Commonwealth Government to have leases or title deeds issued in CSIRO's name.

Note 8 Other Non-current Assets (Notes 1.3 and 1.4)

	At cost $'000	Accumulated depreciation $'000	Written-down value 1988 $'000	Written-down value 1987 $'000
Equipment				
Transport equipment	11 935	1 146	10 789	8 887
Agricultural equipment	2 608	1 013	1 595	1 580
Computing equipment	50 116	21 066	29 050	28 440
Workshop equipment	7 494	3 354	4 140	4 177
Office furniture and equipment	10 391	3 414	6 977	4 944
General scientific equipment	113 819	51 702	62 117	53 975
Total equipment	**196 363**	**81 695**	**114 668**	**102 003**
National Facilities				
Oceanographic Research Vessel *Franklin*	14 409	3 512	10 897	11 977
Australia Telescope construction in progress	41 405	–	41 405	33 868
Total National Facilities	**55 814**	**3 512**	**52 302**	**45 845**
Total equipment and National Facilities	**252 177**	**85 207**	**166 970**	**147 848**

Note 9 Investments (Note 1.9)

	1988 $'000	1987 $'000
Shares — at cost		
SIROMATH Pty Ltd[a]	150	150
Network Automation Ltd[b]	–	350
Other	6	6
	156	506
Shares — at Board Members' valuation		
Vantage Solutions Australia Ltd[c]	2 220	–
Dunlena Pty Ltd[d]	315	315
Preston Group Ltd[e]	495	–
Austek Microsystems Pty Ltd [f]	100	100
Incor Ltd [g]	10	10
Aquaterre Pty Ltd[h]	300	–
	3 440	425
	3 596	**931**

Associated Companies

(a) CSIRO holds a 37·5% equity shareholding in SIROMATH Pty Ltd, a private company established to provide high-level mathematical consultancy services, primarily to Australian industry.

(b) On 1 October 1987, CSIRO's total shareholdings in Network Automation were transferred to a new associated company, Vantage Solutions Australia Ltd.

(c) On 1 October 1987, CSIRO sold its CSIRONET operations to an associated company, Vantage Solutions Australia Ltd. CSIRO was issued 2 220 000 fully paid ordinary shares of $1 each (40% equity) in Vantage Solutions Australia Ltd. CSIRO's shareholding in the company has been sold subsequent to the balance date.

(d) CSIRO was originally allotted 350 001 shares (42% equity) in exchange for the assignment of intellectual property which was valued in the shareholders' agreement at $10 000 000, and an expenditure commitment of $5 000 000 towards research and development. During the 1987 financial year 35 000 shares were transferred to SIROTECH Ltd in recognition of their contribution, on CSIRO's behalf, to the company. CSIRO currently holds 315 001 shares.

(e) In accordance with the shareholders' agreement CSIRO was allotted 550 000 fully paid "B" class shares of $1 each for the sale of intellectual property to the company. Subsequently 55 000 shares were transferred to SIROTECH Ltd. As at 30 June 1988 CSIRO holds 495 000 shares (38% equity).

Other Companies

(f) CSIRO holds 130 000 shares in Austek Microsystems Pty Ltd, at a cost of $156 585. In addition, CSIRO was allotted 250 000 shares for the assignment of licence rights. The total 380 000 shares have been valued at Board Members' valuation.

(g) As part of the licence rights agreement between CSIRO and Incor Ltd, 50 000 fully paid shares of $0.20 were accepted.

(h) In accordance with the heads of agreement CSIRO was allotted 333 333 fully paid ordinary shares of $1 each and 333 333 options for the assignment of intellectual property rights and know-how to the company. The options shall be exercisable at par on or before (at the discretion of the Board of Aquaterre) 30 July 1991. During 1988 33 333 shares and 33 333 options were transferred to SIROTECH Ltd. Currently CSIRO holds 300 000 shares and 300 000 options (18% equity).

Note 10 SIROTECH Ltd

SIROTECH Ltd was established by CSIRO, limited by CSIRO guarantee and governed by a Board of Directors. It was incorporated on 15 November 1984. SIROTECH's main source of revenue comes from an annual service fee paid by CSIRO to cover day-to-day commercial and intellectual property advice. During the year, payments made by CSIRO to or on behalf of SIROTECH totalled $3 930 280 (1987, $3 153 650). SIROTECH's net assets as at 30 June 1988 amounted to $868 097 (1987, $495 787). Due to SIROTECH's commercial activities it is considered inappropriate for its accounts to be consolidated in CSIRO's financial statements.

Note 11 Grants and Revenue Received in Advance

	1988 $'000	1987 $'000
Revenue received in advance	166	221
Grants received in advance	35 369	21 032
	35 535	**21 253**

Note 12 Contractual Capital Commitments

Anticipated payments against capital contracts entered into but not completed as at 30 June 1988 are estimated at:

	General Research Funds $'000	Specific Research Funds $'000	Total 1988 $'000	Total 1987 $'000
Buildings	14 756	1 236	15 992	12 835
Major laboratory equipment	780	–	780	1 979
National Facilities	7 145	–	7 145	4 402
Other non-current assets	8 272	1 178	9 450	3 881
	30 953	**2 414**	**33 367**	**23 097**
Current			24 143	23 097
Non-current			9 224	–
			33 367	**23 097**

Note 13 Resources Provided Free of Charge (Note 1.3)

	Buildings	Land[(a)]	Other assets	Total 1988	Total 1987
	$'000	$'000	$'000	$'000	$'000
At valuation or cost	15 414	22 813	27 768	65 995	62 730
Accumulated depreciation	1 742	–	12 452	14 194	12 677
	13 672	**22 813**	**15 316**	**51 801**	**50 053**

(a) Includes lands $10 816 000 (1987, $11 816 000) which have been purchased out of specific research funds and are in CSIRO titles. In accordance with the grant agreements, any sales proceeds from disposal of these assets shall be refunded to the grantors.

Note 14 Contingent Liabilities

Contingent liabilities for which no provision has been provided in the accounts as at 30 June 1988 were:

	1988 $'000	1987 $'000
a) Guarantee of bank accommodation and debts for associated companies, including performance guarantees.	2 035	244
(b) Estimated common law claims which are pending but not admitted and will be defended (Note 1.7)	347	5 000
	2 382	**5 244**

Note 15 Short-term Deposits

Finance Circular No. 1988/12 issued in May 1988 promulgated a recent interpretation by the Attorney-General's Department on the investment and borrowing powers of certain Statutory Authorities.

The Attorney-General's Department has advised that Ministerial approval must be obtained before entering into arrangements where a transaction exceeds the specified contract limits.

Between July 1987 and January 1988 a number of amounts were invested in excess of the threshold for Ministerial approval of $250 000. Since February 1988 all surplus funds have been managed by Westpac Banking Corporation through the Central Flexible Deposit Account which is the main operating account.

Note 16 Moneys Held in Trust

16.1 Trust funds are represented by the following investments at cost and cash at bank:

	1988 $'000	1987 $'000
Investments		
Reserve Bank of Australia	50	50
State Electricity Commission of Victoria	12	12
Primary Industry Bank of Australia	–	96
Canberra Building Society	346	1 685
National Bank of Australia	–	12
Commonwealth Bank of Australia	1 551	–
Australian Industry Development Corporation	20	–
	1 979	**1 855**
Cash at bank	**44**	**44**
Total funds held as at 30 June 1988	**2 023**	**1 899**

16.2 The components of trust funds are as follows:

William McIlrath Trust Fund	123	110
David Rivett Memorial Lecture Fund	64	55
F.D. McMaster Bequest	1 725	1 629
Sir Ian McLennan Achievement for Industry Award	111	105
Total funds held as at 30 June 1988	**2 023**	**1 899**

Note 17 Auditor's Remuneration

The total amount paid and payable to the Auditor-General for the audit of CSIRO amounted to $303 390 (1987, $258 275). No other benefits were received by the Auditor-General.

Note 18 Executive and Board Members' Emoluments

Emoluments or other benefits received or due and receivable directly or indirectly by full-time and part-time Board Members were as follows:

	1988 $'000	1987 $'000
Executive		
Full-time members	–	116
Part-time members	–	17
Board		
Full-time member	93	51
Part-time members	101	54
	194	**238**

These rates are in accordance with determinations of the Remuneration Tribunal.

Due to amendments to the *Science and Industry Research Act* 1949, Executive Members were replaced by Board Members from 5 December 1986.

Certification of Statements

In our opinion the Statement of Activity, Statement of Capital Accumulation, Statement of Assets and Liabilities, Statement of Sources and Applications of Funds, and the accompanying notes to and forming part of the Statements, have been prepared in accordance with the Guidelines for the Form and Standard of Financial Statements of Commonwealth Undertakings, and except where stated in Note 15, show fairly the operations of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1988 and the state of affairs as at that date.

N.K. Boardman
Chief Executive
24.11.88

I.L. Farrar
General Manager
Corporate Resources
24.11.88

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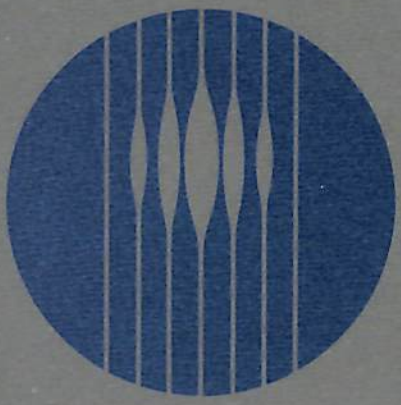

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