CSIRO
AUSTRALIA

Annual Report
1994–95

CSIRO

CSIRO—the Commonwealth Scientific and Industrial Research Organisation—is one of the largest and most diverse scientific research institutions in the world. It has a staff of more than 7000, working in laboratories and field stations throughout Australia.

CSIRO is an independent statutory authority constituted and operating under the provisions of the *Science and Industry Research Act* 1949.

CSIRO's vision

To be a world class research organisation vital to Australia's future.

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Annual Report
1994–95

Photographers

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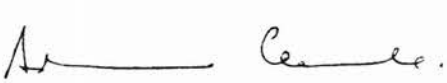
Senator the Hon Peter Cook
Minister for Industry, Science and Technology
Parliament House
CANBERRA ACT 2600

We have pleasure in submitting to you, for presentation to Parliament, the forty-seventh annual report of the Commonwealth Scientific and Industrial Research Organisation.
We commend the Organisation's achievements to you.



Adrienne E Clarke, AO
(Chairman of the Board)
October 1995

Roy M Green
(Chief Executive)

Contents

1994–95 at a glance

- Chief Executive Dr John Stocker completed his term in March 1995.
- Several external inquiries took place that may have significant impacts on CSIRO operations. Among these were the Industry Commission Inquiry into R&D and the Senate Inquiry into CSIRO's Rural Research.
- A new General Manager of Risk Assessment and Audit was appointed to enhance management control processes in CSIRO.
- An internal trial of various performance indicators took place in preparation for formal reporting in the 1995–96 financial year by all science agencies.
- Among commercialisation highlights:
  - a new drug delivery technology is being developed
  - the RACOD water quality meter is to be manufactured
  - factories are to be built in China to make insect-killing nematodes.
- Research highlights included:
  - identification of the mystery horse virus
  - genetic technology to stop browning in horticultural products
  - a new shrinkproofing process for wool.

	1993–94	1994–95
Total revenue	**$697.7m**	**$681.9m**
Appropriation funding	**$456.1m**	**$461.6m**
External revenue	**$241.6m**	**$220.3m**
External revenue as % of total revenue	**34.6%**	**32.3%**
Total expenditure	**$695m**	**$680m**
Number of Australian provisional patent applications	**237**	**158**
Staff numbers	**7402**	**7380**

Foreword

This year CSIRO has been giving much attention to its plans to play a significant role in the Australia of the twenty-first century. We have been debating new science, new operations, new visions, new structure, new behaviours.

Australia is entering an exciting future: science is on the move in this country. Business expenditure on R&D is up and the Government's Cooperative Research Centres Program is flourishing (CSIRO is now involved in 52 out of 61 of these Centres). Both the Government and the nation's peak business organisation, the Business Council of Australia, have confirmed the central role of innovation in creating a competitive Australia, with scientific R&D being a key component of that innovation. Recent surveys show that the Australian public is much more aware of science than is the public in most other countries in the developed world.

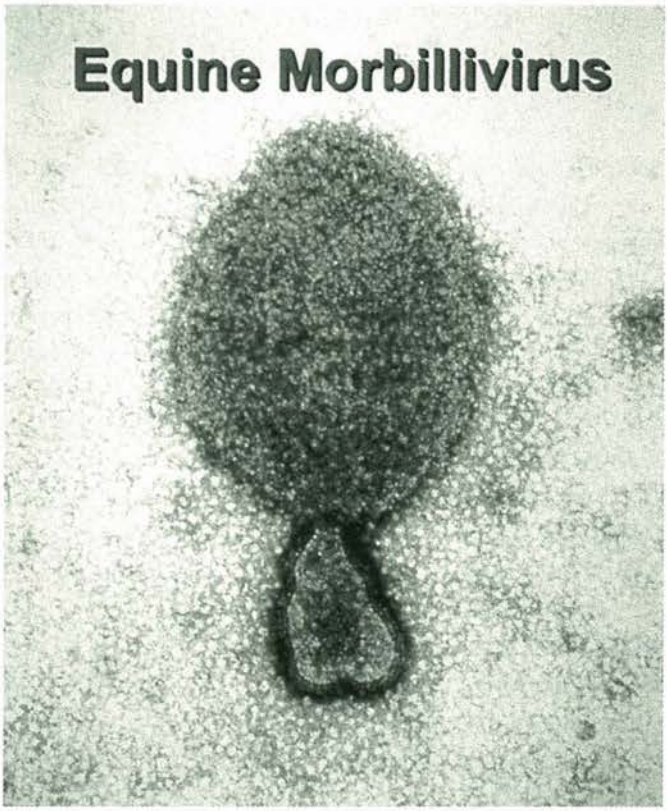
Our major contribution to the national debate about Australia's future was at the September 1994 Annual Congress of the Australian and New Zealand Association for the Advancement of Science (ANZAAS). Our scientists presented 11 scenarios to portray what could be happening in their areas of expertise in the year 2020. These scenarios were intended to highlight options, possibilities and choices and to stimulate thought and discussion about the future Australians want and the role they want science and technology to play in shaping the future.

The scenarios that sparked most interest described the new types of food we could be eating and the new forms of communications technology we would be using. Other scenarios depicted remote-controlled, environmentally-safe mining technologies, better farming practices for sustainable agriculture, the use of our oceans as a rich resource and adaption to a changed climate.

The feedback we have had on the exercise is helping to shape our plans for research in these areas. Our scenarios are now being used as part of other forecasting exercises being carried out by the Australian Science and Technology Council.

In March 1995 we saw the end of the term of Chief Executive Dr John Stocker, who led CSIRO with flair and enthusiasm for the last five years. The Board is most grateful for his dynamic leadership of the Organisation during times of significant change. The staff remember with appreciation his great interest in and support for all aspects of our research. We are all very pleased that he has moved to an area of industry where his experience and contacts with science will enhance Australia's industrial R&D efforts.

Following Dr Stocker's departure, Dr Roy Green, Director of the Institute of Natural Resources and Environment, was appointed as Acting Chief Executive, pending the appointment of a permanent Chief Executive.



Mystery horse virus used on the cover of Science

We also had changes in our key advisers. Three members of the Board have completed their terms. During the year we farewelled Sir Gustav Nossal, Dr Tony Gregson and Mr Ralph Ward-Ambler and welcomed Mr Kevin Davern (Joint National Secretary, Finance Sector Union of Australia), Mr Sandy Hollway (Secretary, Department of Industry, Technology and Commerce) and Dr Beth Woods (Director, Rural Extension Centre, University of Queensland) to the Board. We are very grateful for the valuable contributions of Sir Gustav, Dr Gregson and Mr Ward-Ambler to CSIRO over many years and look forward to their continuing interest, enthusiasm and contact with CSIRO.

In October 1994, a broadly based Evaluation Committee established by the Board began an examination of CSIRO's overall approach to doing business and its management structure. Some seven years after CSIRO's last restructuring, following the McKinsey study, we considered it appropriate to examine whether this structure was still facilitating the most effective interaction with our stakeholders and the delivery of quality research results to industry, the Government and the community.

The reconsideration of our goals and structure has involved vigorous debate amongst all staff, both through formal submissions and through lively debate using our in-house e-mail. Since this exercise began, several activities external to CSIRO have also provided input to our thinking. These include the Industry Commission Report into R&D and the Senate Inquiry into CSIRO's Rural Research.

During the evaluation process we are continuing to implement positive change whenever practical, either on the basis of the

findings of the evaluation or as part of our ongoing management ambitions to achieve best practice. For example, we have reviewed and refocused our human resources functions, devolving more responsibility to Institutes and Divisions. We have been testing research performance indicators suitable for reporting. We have revised our major travel contracts and have introduced a trial expenses-based reimbursement system that we believe will save us a significant amount of money.

Throughout these periods of change, CSIRO continues to deliver excellent science. Indeed, the changes are directed to ensure that excellent science can continue in the long term. Our value to the nation was well demonstrated last year when a team from our Animal Health Laboratory in Geelong, working with the Queensland Departments of Health and of Primary Industries, took just 12 days to identify a mysterious virus that killed one horse trainer in Queensland and 14 of his horses. The speed and thoroughness of the diagnosis and quarantine actions received international acclaim and saved the Australian racing and horse industries from a disease that could have devastated them both. It was a world class performance.

CSIRO joined in national efforts with other scientists and State departments to investigate two other urgent matters—the death and illness of children caused by contaminated mettwurst sausage and the sudden deaths of thousands of pilchards around the southern coastline of Australia. All three events illustrated how teams of scientists can swing into action and help solve unexpected problems that threaten the nation's community or economic health.

As part of our ongoing commitment in support of the rural sector, we have increased our focus on northern Australia by launching our Tropical Agri-Exports Program, in which we are devoting more resources to studying current and new tropical crops that could flourish and provide export earnings. We also recorded major achievements in genetic engineering of food crops, in improved wool processing, and in recycling transformer oils.

These achievements are helping to ensure that science and technology continue to contribute to the nation's economic health. CSIRO has been enthusiastically supported during 1995 by Senator Peter Cook, Minister for Industry, Science and Technology. The direct linking of science with his industry responsibilities has been valuable in providing focus on delivery of services to the industrial sector. We, along with colleagues from other science organisations, are delighted to have been closely consulted in the preparation of the Minister's Innovation Statement, due later this year.

While this has been a year of major change in CSIRO, we are confident that the Organisation will emerge from much debate with a strengthened purpose in serving the nation through its science and its adoption of best practice in all that it does.

Postscript: We wish to record a major event that occurred outside the financial year of this report because of its significance for the Organisation. On 21 July 1995 Minister Cook announced that Dr Malcolm McIntosh would be taking up the post of CSIRO's new Chief Executive early in 1996 and that Dr Roy Green would be Chief Executive through until Dr McIntosh's arrival.

Adrienne Clarke, AO
Chairman

Roy Green
Chief Executive

1

Corporate overview

Vision and values

Throughout the year, management and staff discussed and developed new visions and values for CSIRO. The Mission and Principles listed in last year's Annual Report (see Appendix 4, CSIRO Mission and Goals 1994–95), whilst being in operation for 1994–95, were revised. CSIRO has now adopted the statements below as espousing the spirit and aims of our operations.

Vision

To be a world class research organisation vital to Australia's future.

Purpose

We serve the Australian community through outcomes which provide

- benefit to Australia's industry and economy
- environmental benefit to Australia
- social benefit to Australians
- support to Australian national and international objectives

through excellence in science and technology and in the provision of advice and services.

Values critical to our success

Satisfied customers and supportive stakeholders; application of our research

Operating principles

- We determine our research and commercialisation priorities by listening to our customers and understanding their needs. We assess, with them, the potential benefit of our work in the context of their businesses and the world markets in which they operate.
- We contribute our expertise to the development of policy and science and technology priorities in Australia.
- We commit ourselves to excellence in technology transfer to ensure timely exploitation of research results.
- We provide quality advice and service.
- We deliver our research and services on time, within budget and in accordance with legal, contractual and ethical obligations.

CSIRO—unity of purpose, diversity of means

Operating principles

- CSIRO determines priorities and implementation strategies at all levels of the Organisation by a systematic process.
- We apply the highest standards of management practice in all operations. We pay particular attention to excellence in project management. We foster a culture of teamwork.
- CSIRO evaluates all of its activities, working towards the world's best practice in quality and productivity.
- We accept accountability for our decisions on the use of CSIRO's resources and take pride in our achievements for Australia.
- We use lessons from our own and others' practices and experience to continually improve our performance.

Top people, top performance; integrity, trust and respect

Operating principles

- CSIRO seeks to recruit the best and the brightest. We provide a stimulating environment to encourage individuals to develop their full potential. We provide career opportunities which make CSIRO an attractive development base for future industry leaders.
- We foster adaptability in our staff. We recognise exceptional performance with appropriate rewards.
- We care for the safety and well-being of our people. Our employment policies support our corporate goals.
- We foster creativity which underpins our performance and delivery.
- We draw upon the breadth and depth of our skills to assemble excellent teams to tackle major challenges. We use networks of special skills inside and outside CSIRO.
- We respect the unique skills, professionalism and knowledge of our staff, and recognise that they are responsible for creating and maintaining our reputation.

Excellent science

Operating principles

- We maintain a world standard of scientific and engineering excellence in order to deliver agreed outcomes to our customers in industry, government and the community, on time and within budget.
- The quality of our scientific research enhances Australia's standing.
- CSIRO works with Australia's education and training organisations to increase awareness of science and technology and to enhance the supply of excellent graduates into the scientific and technical workforce.

3

Charter, functions and powers

CSIRO is an independent statutory authority constituted and operating under the provisions of the *Science and Industry Research Act* 1949.

There were no amendments during the year to CSIRO's enabling legislation. However, a package of Bills designed to replace the *Commonwealth Audit Act 1901* was introduced into Parliament by the Minister for Finance in June 1994. One of the Bills, the Audit (Transitional and Miscellaneous) Amendment Bill 1994, will make consequential amendments to the *Science and Industry Research Act* 1949. The changes to be implemented by the package of Bills are primarily in the areas of financial accountability and management as well as the responsibilities of Board members and senior managers.

From 1 July 1994 to 30 June 1995 the Minister responsible for CSIRO was Senator the Hon. Peter Cook (Minister for Industry, Science and Technology, Minister Assisting the Prime Minister for Science).

Functions

CSIRO's primary functions are:

- to carry out scientific research
  - to assist Australian industry and to further the interests of the Australian community
  - to contribute to national and international objectives and responsibilities of the Commonwealth Government
- to encourage or facilitate the application and use of the results of its own or any other scientific research.

Its secondary functions include international scientific liaison, training of research workers, publication of research results and dissemination of information about science and technology.

Powers

The Organisation has power to do whatever is necessary for the best performance of its functions.

In particular it may:

- arrange for research and other work to be undertaken outside CSIRO
- form partnerships or companies
- make its discoveries and inventions available for fees, royalties or other considerations
- pay bonuses to staff for discoveries or inventions
- charge fees for research, facilities or services provided to others.

A full description of CSIRO's functions and powers can be found in Appendix 3.

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Structure, management and staff

CSIRO's current structure was established by the *Science and Industry Research Amendment Act* 1986. This established a ten-member Board 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 activities.

The Chief Executive, the six Institute Directors, the Director of Corporate Business and the Director of Corporate Services form the Executive Committee, which assists the Chief Executive in managing the activities of the Organisation.

Research is performed in 34 Divisions and research units, grouped into six Institutes. Each Institute has its own management committee, which consists of the Director and Divisional Chiefs. The Institute committee provides a forum for setting the strategic direction for the Institute and assisting in the formulation and implementation of Corporate and Institute policies for research and management.

Divisions and Institutes are located all over Australia, with many Divisions having more than one site. CSIRO also maintains a small number of field stations overseas, mainly concerned with biological studies that could benefit Australia.

On 1 January 1995 the Divisions of Mineral Products and of Mineral and Process Engineering merged to form the new Division of Minerals.

Central services are provided from a corporate services centre to support managers and staff in the development and implementation of policies, and to provide services such as organising payrolls.

CSIRO staff are employed under Section 32 of the *Science and Industry Research Act* 1949. At 30 June 1995, CSIRO had a total staff of 7380, which has an equivalent full-time value of 6978 units. The number employed in different job categories is shown in the chart on page 82.

The Board

(as at 30 June 1995)

Chairman
Professor Adrienne Clarke
AO BSc PhD FTS FAA
Director, Plant Cell
Biology Research Centre
University of Melbourne
5 Dec '91–4 Dec '96

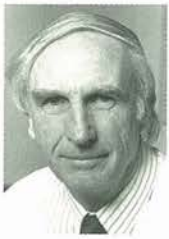
Dr John Stocker MB BS
PhD FRACP FTS
Chief Executive of CSIRO
5 March '90–4 March '95

Dr Roy Green BSc PhD
FTS
Acting Chief Executive of
CSIRO
5 March '95

Mr Kevin Davern
Joint National Secretary
Finance Sector Union of
Australia
1 Sep '94–31 Aug '97

Dr Tony Gregson PhD
DSc FRACI
Primary Producer, Director
Grains R&D Corporation
20 Dec '94–31 March '95
(reappointment)

Mr Sandy Hollway
BA(Hons)
Secretary
Department of Industry,
Science and Technology
6 Dec '94–5 Dec '97



Professor John de Laeter
AO FTS FInstP FAIP
Deputy Vice-Chancellor
(Research and
Development)
Curtin University of
Technology
5 Dec '91–4 Dec '95

Professor Sir Gustav Nossal
AC CBE MB BS BSc PhD
FTS FAA FRS
Director of the Walter and
Eliza Hall Institute of
Research
5 Dec '93–4 Dec '94
(reappointment)

Dr Max Richards BSc PhD
FAIMM
Chairman and Managing
Director
Aberfoyle Limited
5 Dec '91–4 Dec '95

Mr Doug Shears
Executive Chairman
ICM Australia Pty Ltd
5 Dec '91–4 Dec '96

continued overleaf

Mr Nigel Stokes BEc BA
Company Director
1 Sept '94–31 Aug '96
(reappointment)

Dr Beth Woods OAM
BAgrSc PhD
Director,
Rural Extension Centre
University of Queensland
9 June '95–8 June '98

Mr Ralph Ward-Ambler
AM BMechE
Company Director
8 Feb '93–7 Feb '96
(resigned 31 March '95)

Senior staff and addresses

(as at 30 June 1995)

Head Office

407 Royal Parade
Parkville, VIC 3052
Tel: (03) 9662 7111

Chief Executive (Acting)
Dr R M Green

General Manager, Risk Assessment and Audit
Mr P F O'Callaghan

Corporate Secretary
Dr E N Cain (Canberra)

Corporate Business

Director
Mr P J Bradfield

Manager, Intellectual Property
Mr K Smith

General Manager, Corporate Public Affairs
Mr L R Bevege

Corporate Services

Limestone Avenue,
Campbell ACT 2612
Tel: (06) 276 6766

Director, Corporate Services
Mr A W Blewitt

General Manager, Corporate Finance
Mr R J Garrett

General Manager, Human Resources (Acting)
Mr G Knobel

General Manager, Corporate Property
Mr G J Harley

General Manager, Information Technology Services
Mr J Potter

General Manager, Information Services
Ms J de Gooijer (Melbourne)

Principal Secretary
Dr T E Heyde

Institute of Animal Production and Processing

Director: Dr C P Mallett
105 Delhi Road
North Ryde NSW 2113
Tel: (02) 887 8250

Divisions and Chiefs

Animal Health

Chief: Dr M D Rickard
Cnr Flemington Road and Park Drive
Parkville VIC 3052
Tel: (03) 9342 9700

Animal Production

Chief: Dr O Mayo
Clunies Ross Street
Prospect NSW 2149
Tel: (02) 840 2700

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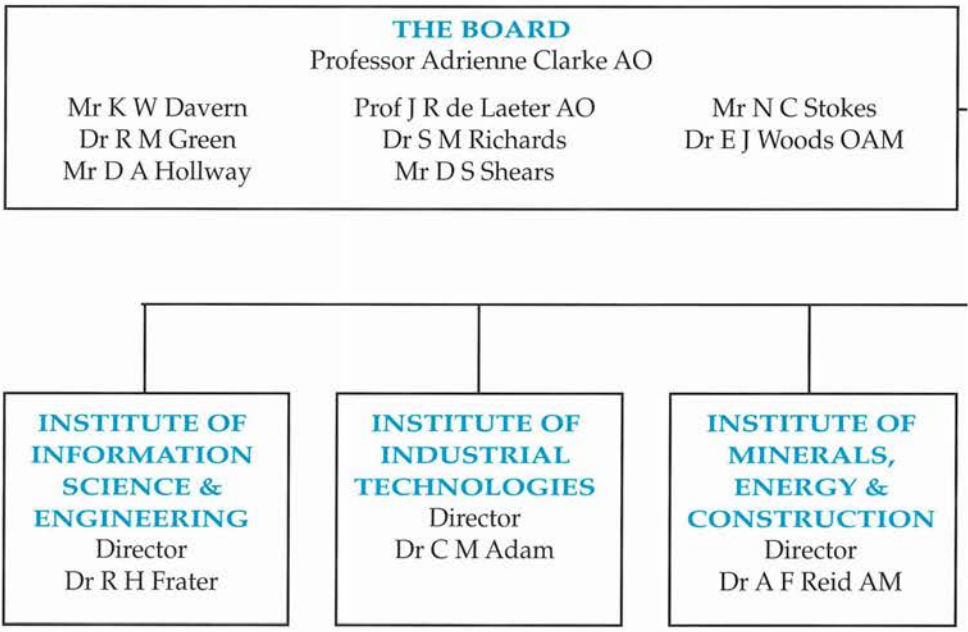
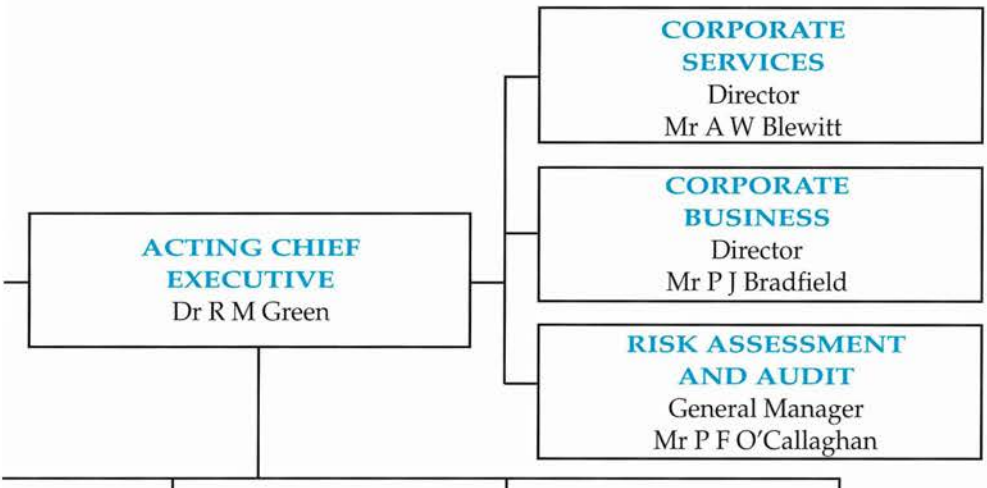
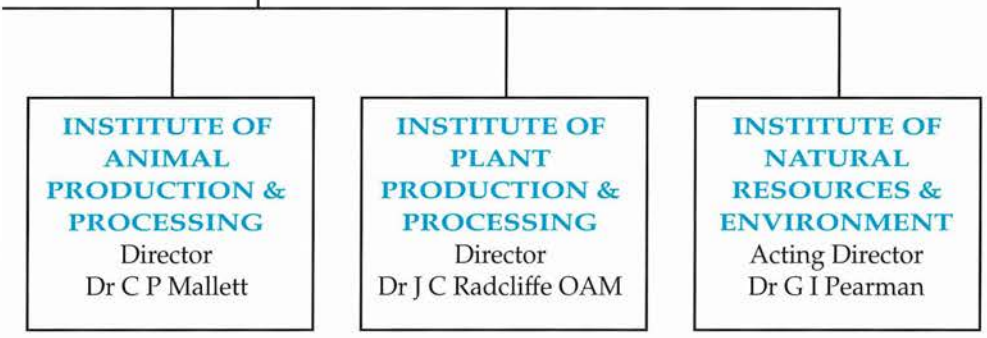
Organisational chart

(as at 30 June 1995)







DIVISIONS

Animal Health

Animal Production

Food Science and Technology

Human Nutrition

Tropical Animal Production

Wool Technology

DIVISIONS

Entomology

Forestry

Forest Products

Horticulture

Plant Industry

Tropical Crops and Pastures

Soils

DIVISIONS

Atmospheric Research

Fisheries

Oceanography

Water Resources

Wildlife and Ecology

Centre for Environmental Mechanics

CSIRO Office of Space Science & Applications (COSSA)

Food Science and Technology

Chief: Dr M Eyles (Acting)
Gate 1, Delhi Road
North Ryde NSW 2113
Tel: (02) 887 8333

Human Nutrition

Chief: Professor R J Head (Acting)
Kintore Avenue
Adelaide SA 5000
Tel: (08) 303 8800

Tropical Animal Production

Chief: Dr P A Jennings
120 Meiers Road
Indooroopilly QLD 4068
Tel: (07) 3214 2700

Wool Technology

Chief: Dr K J Whiteley
Princes Highway
Belmont VIC 3216
Tel: (052) 27 5611

Institute of Industrial Technologies

Director: Dr C M Adam
407 Royal Parade
Parkville VIC 3052
Tel: (03) 9662 7111

Divisions and Chiefs

Applied Physics

Chief: Dr A Ourmazd
Bradfield Road
Lindfield NSW 2070
Tel: (02) 413 7211

Biomolecular Engineering

Chief: Dr P M Colman
343 Royal Parade
Parkville VIC 3052
Tel: (03) 9342 4200

Chemicals and Polymers

Chief: Dr T H Spurling
Bayview Avenue
Clayton VIC 3169
Tel: (03) 9542 2244

Manufacturing Technology

Chief: Dr I Sare
Cnr Raglan and Albert Streets
Preston VIC 3072
Tel: (03) 9662 7700

Materials Science and Technology

Chief: Dr M J Murray
Normanby Road
Clayton VIC 3169
Tel: (03) 9542 2777

Institute of Information Science and Engineering

Director: Dr R H Frater
105 Delhi Road
North Ryde NSW 2113
Tel: (02) 887 8222

Divisions and Chiefs

Information Technology

Chief: Dr J F O'Callaghan
ANUTECH Court
ANU Campus
Cnr North and Daley Roads
Acton ACT 2601
Tel: (06) 216 7000

Mathematics and Statistics

Chief: Dr R L Sandland
Building E6B
Macquarie University Campus
North Ryde NSW 2113
Tel: (02) 325 3100

Radiophysics

Chief: Dr D N Cooper
Cnr Vimiera and Pembroke Roads
Marsfield NSW 2121
Tel: (02) 372 4222

The Australia Telescope National Facility

Director: Professor R D Ekers
Cnr Vimiera and Pembroke Roads
Marsfield NSW 2121
Tel: (02) 372 4100

Institute of Minerals, Energy and Construction

Director: Dr A F Reid, AM
105 Delhi Road (Gate 4)
North Ryde NSW 2113
Tel: (02) 887 8222

Divisions and Chiefs

Building, Construction and Engineering

Chief: Mr L R Little
Graham Road
Highett VIC 3190
Tel: (03) 9252 6000

Coal and Energy Technology

Chief: Dr J K Wright
51 Delhi Road
North Ryde NSW 2113
Tel: (02) 887 8666

Exploration and Mining

Chief: Dr B E Hobbs
Underwood Avenue
Floreat Park WA 6014
Tel: (09) 387 0200

Minerals

Chief: Dr R D La Nauze
Bayview Avenue
Clayton VIC 3168
Tel: (03) 9545 8500

Petroleum Resources

Chief: Dr A F Williams
Kinnoull Gove
Syndal VIC 3150
Tel: (03) 9881 1355

Institute of Natural Resources and Environment

Director: Dr G I Pearman (Acting)
Limestone Avenue
Campbell ACT 2612
Tel: (06) 276 6521

Divisions and Chiefs

Atmospheric Research

Chief: Dr B Sawford (Acting)
Station Street
Aspendale VIC 3195
Tel: (03) 9586 7666

Fisheries

Chief: Dr P C Young
Castray Esplanade
Hobart TAS 7001
Tel: (002) 32 5222

Oceanography

Chief: Dr C Fandry
Castray Esplanade
Hobart TAS 7001
Tel: (002) 32 5222

Water Resources

Chief: Dr G B Allison
Waite Road
Urrbrae SA 5064
Tel: (08) 303 8732

Wildlife and Ecology

Chief: Dr B H Walker
Barton Highway
Gungahlin ACT 2912
Tel: (06) 242 1600

Centre for Environmental Mechanics

Head: Dr J J Finnigan
Clunies Ross Street
Black Mountain ACT 2601
Tel: (06) 246 4911

CSIRO Office of Space Science and Applications (COSSA)

Head: Dr B J Embleton
Cnr North and Daley Roads
ANU Campus
Acton ACT 2601
Tel: (06) 216 7200

Institute of Plant Production and Processing

Director: Dr J C Radcliffe, OAM
Limestone Avenue
Campbell ACT 2612
Tel: (06) 276 6512

Divisions and Chiefs

Entomology

Chief: Dr M Whitten, AM
Clunies Ross Street
Black Mountain ACT 2601
Tel: (06) 246 4001

Forest Products

Chief: Dr W Hewertson
Bayview Avenue
Clayton VIC 3168
Tel: (03) 9542 2244

Forestry

Chief: Dr G A Kile
Banks Street
Yarralumla ACT 2600
Tel: (06) 281 8211

Horticulture

Chief: Dr E Heij
Hartley Grove
Urrbrae SA 5064
Tel: (08) 303 8600

Plant Industry

Chief: Dr W J Peacock, AC
Clunies Ross Street
Black Mountain ACT 2601
Tel: (06) 246 4911

Soils

Chief: Dr R S Swift
Waite Road
Urrbrae SA 5064
Tel: (08) 303 8400

Tropical Crops and Pastures

Chief: Dr R J Clements
306 Carmody Road
St Lucia QLD 4067
Tel: (07) 3377 0209

13 Research

Research highlights

Planning and reporting of CSIRO research follows the system adopted in 1991–92 for classifying the purpose of the research.

The system is a modified version of the draft national research classification used by the Australian Bureau of Statistics. CSIRO has selected sub-divisions that are relevant to science and technology and re-organised them into a form more meaningful to the Organisation. The result is a set of 17 research purposes whose principal objectives are economic development, national welfare or national security. Projects can contribute to more than one research purpose. CSIRO's work in radioastronomy is classified separately under 'advancement of knowledge'.

Purely for ease of reading in this section of the report, the 16 research purposes and radioastronomy have been grouped into six related sections as follows.

Rural industries

Plant production and primary products: field crops, horticultural crops, forestry, primary products from plants.

Animal production and primary products: livestock, fishing, primary products from animals.

Minerals and energy industries

Minerals industries: exploration, mining and extraction, processed minerals, basic metal products.

Energy resource industries and *Energy supply industries:* exploration, mining and extraction, preparation and supply, energy transformation, energy distribution, conservation and efficiency.

Manufacturing industries

Rural-based manufacturing: processed food products and beverages, fibre processing and textiles, wood products and furniture, other (processed skins, leather and leather products).

Manufacturing industries: fabricated metal products, transport equipment, machinery and industrial equipment, instrumentation, chemical, pharmaceutical and veterinary products, manufacturing services, ceramics and other industrial products.

Information and communications industries

Information and communications industries: computer hardware and electronic equipment, communications equipment, computer software and services, communications services and other information services.

Environment

Environment: climate and atmosphere, natural ecosystems, oceans, land use, water resources, environmental impact and protection, other environment.

Economic development—environmental aspects: rural production, minerals, energy resources and supply, manufacturing, construction, transport, commercial services, other.

Infrastructure, services and advancement of knowledge

Construction, Transport, Commercial services, Health, Social development, Defence, Radioastronomy.

The selection of achievements and developments described in this section demonstrates how CSIRO is achieving its corporate goals and research objectives. A complete list of research program titles is contained in Appendix 7 of this Report. The list includes the titles of the 34 Multi-Divisional Programs (MDPs) operating this year.

Contents of research highlights

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Rural industries

Goal: Improve the international competitiveness and sustainability of rural production systems.

Achievements

Browning of fruit and vegetables

The Division of Horticulture has devised a method to stop fruit and vegetables turning brown when cut. When the fruit or vegetable is for sale this browning is quite serious, because it causes the appeal and marketability of the product to plummet. The browning reaction is caused by a naturally occurring enzyme in the fruit—polyphenol oxidase (PPO). Spoilage due to browning costs food processing industries worldwide millions of dollars each year in wastage and costly chemicals to prevent the reaction.

The Division of Horticulture has isolated the genes encoding the PPO enzyme and constructed an anti-PPO gene which, when transferred into plants, blocks the expression of the naturally occurring gene and prevents manufacture of PPO. The genetically engineered plants with low levels of the PPO enzyme should have a greatly decreased susceptibility to browning when bruised or cut during handling and processing. To test this, scientists at the Divisions of Horticulture and of Plant Industry worked together to produce Australia's first non-browning potato. The new potatoes have browning levels less than 10 per cent of those of normal potatoes and are resistant to blackspot bruising, which causes significant losses in the potato industry.

CSIRO has now applied for worldwide patents for this technology. The Division of Horticulture has also isolated the PPO genes for a range of commercially important horticultural crops including beans, apples, lettuce and grapes. CSIRO is now actively seeking commercial partners to further develop economically important non-browning products.

Fish fit for a king prawn

CSIRO is a key player in a project to provide the world's expanding aquaculture industry with an alternative feed source to fluctuating, heavily exploited ocean fish stocks.

The demand for high-quality fishmeal, now worth $1100 per tonne, is expected to rise dramatically over the next five years as Asian countries in particular increase aquaculture production. Many of these are

Testing new ingredients to replace fishmeal in prawn feeds. Enclosures on the Moreton Bay Prawn Farm are used to separate groups of prawns fed on different diets.

converting to intensive farming methods which require major amounts of formulated feeds.

However, world supplies of fishmeal made from whole caught fish or fisheries waste are limited and vulnerable to fluctuations.

CSIRO scientists are collaborating with the Queensland Department of Primary Industries, New South Wales Fisheries and scientists from industry and a number of universities in the project, funded by the Fisheries Research and Development Corporation. This project should establish Australia as a key producer of manufactured fishmeal substitutes for both the domestic and lucrative export markets.

Marine scientists within the Division of Fisheries have set a standard which measures the digestibility of ingredients in animal and plant-based fish feeds. This standard is being used to assess protein-rich fishmeal substitutes currently being developed.

The project is looking at how well target species assimilate new ingredients and at the effects of any waste products on the pond ecosystems in which the fish are raised.

Marine scientists are also exploring ways to ensure that fishmeal substitutes contain enough flavour to make them palatable to fish and prawns.

Beating the green vegetable bug

The Division of Entomology has developed a management plan for the green vegetable bug (GVB) which has increased the value of the 1993–94 Australian pecan crop at Moree in New South Wales by $1.5 million. The new system is so successful that insecticide is no longer being used on the crop.

Green vegetable bug, *Nezara viridula*, thought to be of Mediterranean or African origin, is a cosmopolitan horticultural pest, particularly of legume crops. GVB has been controlled in most coastal agricultural crops in Australia since introduction of an egg parasitoid from Egypt in the 1940s. However, in some drier areas of inland Australia biological control of GVB has not been effective, especially in pecans and several legume crops including soybeans.

In 1991 scientists began a study of the bug's population changes and overwintering, the identity and activity of its natural enemies,

and the potential to improve biological control of the pest. Studies were mainly carried out at Stahmann Farms Inc. in Moree where, before the new management practices were introduced, GVB caused damage of up to $2 million a year to developing nuts.

With support from the Horticultural Research and Development Corporation and Stahmann Farms Inc., control strategies have been developed which make plants less suitable for GVB breeding. A model which determines appropriate timing for mechanical control measures was developed for control of the pest in pecans. When insecticide applications were suspended for the 1992–93 crop and control measures were instituted, pecan yields increased by an estimated $1 million. For 1993–94, after further refinements done in conjunction with the Cooperative Research Centre for Tropical Pest Management, this figure increased to $1.5 million.

Work is continuing on the model to make it more precise so that crop damage is further reduced. Research is also continuing into opportunities for biological control in the drier areas of Australia, which will reduce the incidence of the pest in other crops.

Solving the horse virus mystery

Vets working with the infected animals at AAHL wore breathing air hoods like these to prevent them from coming into contact with the virus. The tests were carried out deep inside the high security complex at AAHL.

It took just 12 days for scientists at the Australian Animal Health Laboratory (AAHL) and the Queensland Department of Primary Industries (QDPI) to identify the mystery disease that killed trainer Vic Rail and 14 horses in Queensland in September/October 1994. The new virus they discovered has now been named equine morbillivirus.

One day into the investigation, the major foreign horse diseases such as African horse sickness and equine influenza were ruled out. Within six days a virus was isolated in samples from four horses. Transmission trials confirmed that this virus was the cause of death. Later the same virus was found in samples from the late Vic Rail. Genetic analysis has shown that the virus belongs to a group known as morbilliviruses, but it is only distantly related to other members of the group, which include measles, rinderpest and canine distemper.

Once the cause was identified, AAHL developed tests which were used to prove that the outbreak had been contained. The tests were used to screen 2500 horse and 150 human samples.

The horse racing industry was severely disrupted, with the cessation of racing in south-east Queensland. The speed of the diagnosis enabled the early resumption of horse racing in Queensland and the recommencement of the export of racehorses from Australia.

The speed and quality of Australia's response to the outbreak has minimised any long-term consequences. Fast, effective and coordinated communication by CSIRO and QDPI also reduced the potential for misinformation within Australia.

Plant gene technology

CSIRO is an international leader in the development of plant gene technology, and many Divisions are using this technology as a powerful tool to serve Australian agriculture.

The Division of Plant Industry has used gene technology to develop potatoes which are resistant to an important virus. The Division has also genetically transformed peas to make them resistant to seed eating weevils, and has produced insect-resistant cotton plants which will allow a substantial reduction in the use of pesticides in the Australian cotton industry. These developments are important to the industry because many insecticides have become less effective as insects develop pesticide resistance.

Other developments from the Division include subterranean clover pasture plants with extra proteins which can significantly increase wool growth in sheep, and cloning technology which will allow scientists to manipulate the carbohydrate composition of plants to improve their nutritional quality.

Other Divisions have also been employing plant gene technology. The Division of Entomology announced in September 1994 that it had assembled an insect-specific virus in cultured plant cells. This could lead to the production of transgenic plants with built-in insect resistance. Meanwhile, the Division of Forestry has completed the first integrated 'genetic linkage map' for a eucalypt species. This will help foresters select trees for characteristics such as growth rate, wood properties, pulp yield and disease resistance at the age of just three or four months. The Division of Horticulture has also been using gene technology, and has developed potatoes which do not turn brown when they are cut (see separate item).

Eucalypt plantations for fine timber and land care

There is considerable political and commercial interest in planting eucalypts to help solve rising water table problems in the Murray–Darling Basin and simultaneously provide a profitable forest-product crop.

Preliminary work by the Division of Forest Products has demonstrated that the timber from some sub-tropical species of eucalypt grown in small plantation trials along the Murray–Darling system is of excellent quality. The trees, which are relatively young—20 to 30 years old—produce a high proportion of select grade material.

Research is now under way to work out what elements are needed for the development of a major fine timber industry in the Murray–Darling Basin. The new work includes development of seed orchards, measurement of water use, matching of species to sites, new sawing, drying and preservation trials and trials of making paper and composite board from the sawmill residues.

Federal, State and private business interests are now involved in both the research and development aspects of eucalypt plantations for fine timber production in the Murray–Darling Basin.

Antidote found for annual ryegrass toxicity

More than $10 million worth of Australian sheep die from annual ryegrass toxicity (ARGT) yearly. Currently recommended control measures, involving herbicide spraying of annual ryegrass, further reduce productivity of pastures. Many animals which survive ARGT poisoning are also likely to be less productive. Scientists at the Division of Animal Health have demonstrated that an ARGT antidote they have developed can be used to save sheep and cattle from ARGT poisoning. The antidote also speeds up their recovery.

The antidote was 100 per cent successful in a trial when sheep on a stud property, displaying early signs of ARGT, were treated quickly. In an ARGT outbreak in Western Australian cattle, nine badly affected animals were treated with the antidote and eight recovered. The antidote complements a vaccine being developed by the Division. The antidote is used to treat poisoned animals while the vaccine, when it becomes available, will help to prevent them being poisoned. The vaccine requires further development with a commercial partner, while the antidote is much closer to release, only requiring registration as a veterinary product before it can be marketed.

Surveys by agriculture departments in Western Australia, South Australia and New South Wales show that solutions to ARGT are greatly needed and would be used widely.

Commercial partners are now being sought for these two solutions which are the result of many years of research by CSIRO, with support from wool producers through the International Wool Secretariat.

Developments

Controlling rabbits safely and effectively

CSIRO has characterised a virus which may be a safe, effective biological control agent for wild rabbits, Australia's worst animal pest. A project to investigate new methods of controlling wild rabbits entered the field testing phase in 1995, when trials of the rabbit calicivirus began on an isolated island off the South Australian coast. The CSIRO Divisions of Animal Health and of Wildlife and Ecology are involved in the $3 million Australia and New Zealand Rabbit Calicivirus Disease Program, funded jointly by the Meat Research Corporation, CSIRO, the New Zealand Ministry of Agriculture and Fisheries, the Australian Nature Conservation Agency, the Bureau of Resource Sciences, the Australian and New Zealand Environment and Conservation Council, the Agriculture and Resource Management Council of Australia and New Zealand, and the International Wool Secretariat.

In March 1995 the book, *Managing Vertebrate Pests: Rabbits*, was launched by the Minister for Primary Industries, Senator Bob Collins. This joint publication from the Bureau of Resource Sciences and the CSIRO Division of Wildlife and Ecology assembles knowledge gained over 30 years of rabbit research. It features new national guidelines for rabbit control and examines attitudes to rabbits from a broad cross-section of the community.

Launch of Tropical Agri-Exports Program

CSIRO's Tropical Agri-Exports Program was launched in Townsville in November 1994. This $5 million Multi-Divisional Program, launched by the Hon. Ted Lindsay, Parliamentary Secretary to the Minister for Industry, Science and Technology, is looking at topics such as irrigation and nutrition of cashew hybrids, mango flowering and fruiting, dry season cotton, and adaptation of Asian soybeans to Australian conditions.

Unravelling the pilchard riddle

Australian Animal Health Laboratory scientists have been investigating the mysterious death of masses of pilchards in seas off southern Australia in May 1995. The Divisions of Fisheries and of Oceanography have also been collecting recent oceanographic and climate data, gathered during other research, to see if environmental influences were responsible for the deaths. The scientists are part of a team set up by the Department of Primary Industries and Energy.

Rats in rice

Researchers from CSIRO are studying rat populations and looking at ways to control these pests, which cause significant rice crop losses in South East Asia. A $1.7 million pest management project, involving CSIRO and the Australian Centre for International Agricultural Research, began in March 1995. Australian scientists will work with colleagues in Indonesia and Malaysia to

help transfer technical knowledge and expertise. This will help reduce reliance on chemical pesticides in favour of more ecologically sustainable control methods.

DNA sequencing facility

Australia's largest and most advanced DNA sequencing facility, based at the University of Queensland, celebrated a successful first year of operation in December 1994. Partner members use the facility to explore and gather genetic information. This information assists agricultural production and processing industries.

The partners are CSIRO, the University of Queensland, Queensland Department of Primary Industries, the University of New England, Southern Cross University and the Australian Equine Blood Typing Research Laboratory. The facility has been very successful since its opening: it is used almost continuously, there are new partners wanting to join, there is a steady demand for non-partner (commercial) sample analysis and some current partners want to use the facility even more.

SIRO-FLO agreement

SIRO-FLO, a patented fumigation technique developed by the Division of Entomology, will soon be available to private and on-farm grain storers. An agreement between CSIRO and The Commonwealth Industrial Gases Limited for the supply of SIRO-FLO technology was announced in November 1994. Over recent years there have been numerous requests from private grain storers and farmers for CSIRO to make the technology more widely available. This year about six million tonnes of grain has been treated with SIRO-FLO in storages belonging to the State bulk handling authorities.

Montpellier laboratory opened

The Division of Entomology's new laboratory on the Agropolis International Campus at Montpellier, France will house the world's biggest international group of biological research teams. The complex, including new laboratories for the US Department of Agriculture, the National Institute for Agricultural Research and the Centre de Cooperation International en Recherche Agronomique pour le Developpment, was opened by Mr Barry Jones MHR in October 1994.

Opening of new McMaster Laboratory

The new McMaster Laboratory for the Divisions of Animal Health and of Animal Production was opened in June 1995 by the Hon. Ted Lindsay, the Parliamentary Secretary to Senator Cook. Funds from the sale of the original McMaster Laboratory, founded at Sydney University in 1931, were used to build the new laboratory at the CSIRO Prospect site. This is part of the $8.3 million redevelopment of the Prospect site, which includes the laboratory, new lecture theatre, animal house, library extension and upgraded research facilities. The redevelopment will allow animal research into on-farm production and control of parasites to be consolidated on the one site.

Minerals and Energy Industries

Goal: Enhance the international competitiveness, productivity, safety and environmental sustainability of Australia's minerals industry over the next decade.

Increase the efficiency, productivity and safety of Australia's coal, oil and gas exploration and extraction industries to improve their international competitiveness.

Achievements

Mapping minerals from the sky

The CSIRO mid-infrared airborne carbon dioxide laser spectrometer (MIRACO$_2$LAS), developed by the Division of Exploration and Mining, has passed its mineral mapping tests with flying colours.

MIRACO$_2$LAS measures reflectance in the mid-infrared region and is used to distinguish and identify silicate minerals, many of which are important indicators of mineralisation. Existing remote sensing systems operating in the visible, near infrared and shortwave infrared regions can identify vegetation and iron oxides (visible and near infrared) and hydroxyl, carbonate and sulfate minerals (shortwave infrared), but not silicates.

Using a rapidly tuned carbon dioxide laser developed by CSIRO in the 1980s, MIRACO$_2$LAS measures reflectance in two-metre diameter 'footprints' along a line on the ground. The readings are taken from

Phil Connor (left) and Lew Whitbourn (right) with CSIRO mid-infrared airborne CO_2 laser spectrometer in F-27 aircraft

an F-27 aircraft flying at an altitude of 400 metres. The laser yields spectral reflectance 'signatures' of different minerals. These signatures are of much higher resolution than can be obtained with any other mid-infrared system in the world.

Joint tests with NASA in 1993–94 over sites near Broken Hill in New South Wales and in the northern Flinders Ranges and Olary regions of South Australia—all areas of current exploration activity—demonstrated that MIRACO$_2$LAS can identify an extensive suite of silicates along the line flown by the laser.

It is now possible to develop remote sensing systems that will identify and map the major indicator minerals found in mineralised environments. The Division is currently designing a compact operational successor to MIRACO$_2$LAS to serve the Australian mineral exploration industry.

CSIRO study reinforces mining industry

Reinforcement has been used for a number of years to control excavation stability in underground mines. Because of its success in underground applications, the mining industry assumed that stabilisation of the near surface rock mass would be sufficient to allow mining of steeper slopes and deeper pits. However, reinforcement has proved to be less effective for stabilising steeper slopes.

CSIRO's Division of Exploration and Mining, in collaboration with open pit mine operators, set out to find the reasons for the differences between the performance of reinforcement in

An example of a deep open pit mining operation

surface and underground excavations. In particular it was important to discover whether reinforcement could be used economically for mining of deep open pits.

Simple computational models for rock stability were used to show that as a pit is deepened, both the length and capacity requirements for reinforcement increase, adding considerably to mining costs. A 13-month monitoring program of a reinforced pit slope, undertaken in collaboration with the Paddington Gold Mine in Kalgoorlie, Western Australia, confirmed that the standard pattern of reinforcement could not prevent overall slope failure, but was effective in reducing the rate at which failure occurred.

Another three-stage investigation was carried out in collaboration with BHP Iron Ore's Mount Newman, Western Australia, operations to examine the equipment and procedures used for tensioning cable reinforcement, the installation of large capacity tensioned cable reinforcement and its effects on the rock mass. This CSIRO work demonstrated that tensioning has a minor role in determining the overall effectiveness of reinforcement over a large area in open pits and led to a new method for installing and tensioning reinforcement.

Complementary research sponsored by mining companies, through the Australian Mineral Industries Research Association Ltd, has led to new guidelines for reinforcement practice and the design of surface excavations. It is now clear that, compared with the option of converting to an underground operation, the economics of deep open pits must be based on slope angles that are controlled by the inherent strength of the rock mass. Reinforcement may be required to control the stability of slopes adjacent to critical infrastructure, such as haul roads, but cannot be used economically to steepen overall wall angles.

Seismic monitoring for mine planning and safety

Mining can often have unforeseen effects on the surrounding strata. Sometimes they can collapse in an unexpected manner. Some mines have been flooded by ground water or have suffered from gas leakages. Engineers from the Division of Exploration and Mining have designed and built a seismic monitoring system which will measure these types of responses, giving a better understanding of the effects of mining. BHP Australia Coal, Gordonstone Coal Management and Central Queensland University are also working on the project, which is supported by the Australian Coal Association Research Program.

The new monitoring system was successfully tested at the Gordonstone Mine in the Bowen Basin, Queensland, in 1994. During the three-month test period, half a longwall panel was extracted in Australian record time.

The results show the locations of the seismic events associated with the failure of the overlying strata caused by extraction of the

coal. Locations have been determined for over 800 of the events which occurred during the months of September and October. It is significant that, in these geological conditions, the failure occurs ahead of the working face and up to 100 metres above it.

This new understanding of the interaction between mining activity and the stress field will have an important bearing on the design and operation of mining equipment under differing geological conditions. It will also help plan mines in areas where there may be problems with ground water and gas from nearby aquifers and coal seams. The seismic monitoring system may also be able to provide warning of coal outbursts.

Further seismic monitoring in other collieries, including some of the gassy outburst-prone mines in the Wollongong area, New South Wales, is being planned with collaborators from Central Queensland University.

Hidden markers help explorers find oil

Oil explorers now have a new way to find oil, thanks to the Division of Petroleum Resources. The Division has interpreted previously unrecognised markers that show where oil can be found.

A permanent marker found within minerals in the underground reservoir rock shows whether oil ever accumulated there and, if so, in what amounts. Even if the oil is no longer there and the reservoir now produces gas or water, the marker will still be present.

Sometimes an oil accumulation is displaced downwards out of a reservoir by infiltration of more buoyant gas. Knowing that an accumulation of oil has been displaced, the explorer can use a seismic map of the shape of the subsurface rock formation to predict where the displaced oil may have gone. The explorer can then drill this new target. The absence of these oil markers indicates that there is little chance of finding oil accumulations in the area.

This technique has shown for the first time that many reservoirs on the North West Shelf now containing water or gas once contained oil that has since been displaced by gas or otherwise lost from the reservoir.

These measurements let explorers test exploration concepts about the infiltration and accumulation of oil, concepts which guide decisions about whether and where to drill. This new information will increase the probability that drilling to reservoirs will find oil, and lower the cost of finding oil. This technique currently provides competitive advantage to oil explorers in Australia and has export potential.

Recycling transformer oils

In a $2.3 million project, CSIRO Division of Coal and Energy Technology and Pacific Power are developing a new process to recycle degraded transformer oil which could save the industry tens of millions of dollars. The new process has worldwide potential.

Over 240 million litres of special imported oil, with a value of $214 million, is used as insulating material in transformers throughout Australia's electricity system. This oil slowly degrades with use, and currently there is no satisfactory way of recycling it.

The new process is technically simple and economic and will enable the oil to be renewed on-site at power stations and electricity substations. Ninety-nine per cent of the oil can be recovered and re-used and the electrical properties of the recycled oil are excellent. An added benefit of the process is that it destroys polychlorinated biphenyls (PCBs) present in some older transformer oils, converting them to harmless chloride salts.

A fully integrated prototype unit capable of processing one tonne per day of degraded and contaminated oils is currently being commissioned and expressions of interest are being sought to develop the technology.

Continuous solar power

While solar power is an attractive alternative to fossil fuels, there are many problems associated with storing and transporting energy produced in this way.

The Division of Coal and Energy Technology and Pacific Power, with additional support from the New South Wales State Energy R&D Fund and the Electricity Research and Development Corporation, have recently finished a two-year project to test the feasibility of using natural gas to solve this problem.

The team has been researching the use of concentrated solar energy and a catalyst to power a chemical reaction where carbon dioxide and methane are converted to a synthesis gas. The gas can be stored or transported and then reconverted to its components, releasing energy to generate electricity.

A major outcome of the research has been the development of highly effective catalysts for the chemical reaction and the successful demonstration of their use.

The industry participants have also worked out ways to link the chemical reactor directly with high temperature solar energy collectors. This, plus the success of scientists at The Australian National University in developing a large solar energy collector, makes the project highly attractive.

The CSIRO project has identified several potential applications for the technology and detailed technical and economic evaluations for four of these applications have been completed.

While storing electricity from solar energy makes the power more expensive, it also greatly extends its flexibility. It makes it possible to produce base load electricity and process heat from solar energy 24 hours a day, with no emissions of carbon dioxide or other greenhouse gases. CSIRO is now looking to develop a prototype chemical reactor of 10–15 kilowatts energy storage capacity and then to scale this up to 400–500 kilowatts capacity to prove its commercial feasibility.

Developments

Minerals office opens in South America

A marketing representative for the Institute of Minerals, Energy and Construction has been appointed in South America, in conjunction with Austrade. His activity will focus on enterprises with Australian involvement (such as the Escondida mine) or where experience relevant to Australia can be gained (for example, at the Chuquicamata mine, the world's largest open pit).

CSIRO minerals merger

In January 1995, the Divisions of Mineral Products and of Mineral and Process Engineering merged to form the Division of Minerals. The new Division has a staff of 300, specialising in the science and engineering of mineral and metal production and product development. With facilities in New South Wales, Victoria, Queensland and Western Australia, the new Division can better serve customers across the country. The Chief of the new Division, Rob LaNauze, said that the merger would prepare CSIRO to meet the needs of a projected upturn in the metals industry.

Manufacturing

Goal: Increase the international competitiveness, efficiency and scope of Australian manufacturing industry through research with those companies able to exploit technological opportunities and enter international markets.

Improve the competitive position of Australian rural-based manufacturing industries, and add value to plant and animal primary products used as inputs.

Achievements

Chlorine-free shrinkproofing process for wool

The public wants easy care wool clothes, ones that can be machine-washed and tumble-dried, and CSIRO is working to meet that demand.

The Division of Wool Technology and the International Wool Secretariat have developed a chlorine-free shrinkproofing process that eliminates the environmental problems normally associated with shrinkproofing wool.

Conventional processes for producing machine washable wool use chlorine, which modifies the surface of the wool. This makes it shrink-resistant. While chlorine-based treatments for wool are very successful, they do pose some environmental problems. Chlorine reacts with most organic materials, such as wool, to produce organochlorine compounds, and there are increasing restrictions on the release of organochlorine compounds to the environment. A similar situation is being encountered with the use of chlorine in the paper and pulp industries, as well as in water disinfection, and these industries are moving to use less chlorine or to replace it.

In addition, the CSIRO process produces wool which is whiter and softer than chlorinated wool, and it retains this whiteness and softness even after repeated machine washing. Another benefit is that the treated wool dyes more like normal wool than does chlorinated wool.

The CSIRO process is currently undergoing commercial-scale industrial trials, and negotiations are proceeding to license the technology to one of the world's largest wool processors.

New active packaging technology keeps produce fresh

Delivery of produce in a fresh, nutritious and hygienic state is an important component of a national health strategy. Increasing world industrialisation means food is grown further from where it is eaten and takes longer to reach its eventual consumers. This is particularly true where Australia supplies food to the Asian, European or American markets. More sophisticated packaging is being developed which has, along with traditional mechanical and optical properties, diffusion and sorption properties tailored to match the needs of the produce. Such packaging helps extend the life of fresh and processed produce.

This Multi-Divisional Program (Division of Food Science and Technology, Division of Horticulture, and the Division of Materials Science and Technology) has delivered ten patented technologies in active packaging technology since being reported on in the 1990–91 CSIRO Annual Report. CSIRO is currently assisting ANL Limited and its sub-licencees to commercialise some of these technologies. The first commercial active packaging products have recently been released to selected broccoli growers targeting export markets.

A successful proposal to establish the Cooperative Research Centre (CRC) for International Food Manufacture and Packaging Science will extend the collaboration, integrating major manufacturers all along the food production chain. Major commercial partners in the CRC include Pacific Dunlop, ANL, Pratt Industries, ACI, Arnott's, Goodman Fielder, Horticultural Research and Development Corporation, Strategic Industry Research Foundation and Tassal. A key objective of the CRC is to facilitate the delivery of fresh and minimally processed Australian food products to Asia. Another major thrust of the CRC is replacing synthetic petrochemical-derived plastics with starch-based plastics that are ultimately biodegradable. This collaboration links CSIRO Divisions with the University of Melbourne, University of Queensland, Swinburne University of Technology, Victoria University of Technology and Victoria Department of Agriculture.

Broccoli stored using Modified Atmosphere Packaging (right) stays fresh and green on the supermarket shelf for days longer than broccoli stored in air (on left).

Pure water at a fraction of the cost

A collaboration between the Division of Chemicals and Polymers, ICI Watercare and the South Australian Engineering and Water Supply Department has led to a cost-effective way to purify water, based on a new ion exchange resin.

Conventional water purification processes do not effectively remove naturally occurring coloured organic matter. Chlorine used for disinfection reacts with residual organic matter in the treated water to form undesirable halogenated organic compounds. This natural organic matter can be removed by ion exchange, but the usual way of contacting water with ion exchange resins—in steel columns—is prohibitively expensive on a large scale.

In the new process, raw water is dosed with fine beads of ion exchange resin in an existing purification plant. The resin rapidly removes the organic material, and is then collected, regenerated with brine and recycled. Capital costs are low, and operating costs are partly offset by reduced consumption of other treatment chemicals.

After successful pilot trials at the South Australian State Water Laboratory, the process is now being fine-tuned in a 300-cubic metre per day demonstration plant at Adelaide's Hope Valley treatment works.

In a second collaboration, again involving ICI Watercare, an ion exchange resin made by CSIRO has been used by the Dutch environmental engineers TAUW Milieu to purify industrial waste-waters containing dissolved heavy metal salts.

Chemical synthesis for the pharmaceutical industry

Research in the Division of Chemicals and Polymers has led to technology which can synthesise and purify a number of pharmaceutical compounds.

Isolutrol is a compound used to treat acne by normalising excessively oily skin. Until now, isolutrol has only been available from the gall bladders of sharks. However, CSIRO has developed a process to synthesise the compound from readily available materials. This is now being trialled on a small scale and, based on the success of these trials, Macfarlane Laboratories plans to manufacture synthetic isolutrol.

Macfarlane has signed a non-exclusive supply agreement with one of the world's leading cosmetic companies and is negotiating with two others. This is a significant development since the acne treatment market is estimated to be worth more than $2 billion worldwide.

However, the use of isolutrol may not be limited to the cosmetic industry. Scientists from the Royal Melbourne Institute of Technology and the University of Connecticut are looking at paracetamol poisoning in the human liver. The application of isolutrol to this condition and other liver complaints is being investigated.

It appears that toxins release free radicals which can damage the liver and isolutrol is known to be a very effective free-radical scavenger.

The Divisions of Chemicals and Polymers and of Oceanography have been working with two small companies to develop a new way to produce a dietary supplement known as squalene. Squalene is widely regarded in many Asian countries as beneficial to health and is also used in the pharmaceutical and cosmetic industries.

Squalus Pty Ltd approached CSIRO with the idea of developing a new method of producing this product, which has an established market. The compound squalene is found in shark liver oil, and staff at the Division have been able to develop a novel method for the extraction and purification of the squalene.

Another small company, ITL Australia (Chemicals), will use the CSIRO process to produce squalene. Squalus Pty Ltd has already exported tonne batches of squalene.

Environmentally friendly conversion coatings

Since late 1990 CSIRO has been working, in collaboration with Boeing, on a replacement for the environmentally hazardous, chromate-based conversion coatings currently used in the aerospace industry. Conversion coatings are applied to metal products to improve paint adhesion and corrosion resistance. The coatings are used in a wide range of industries, including the steel, automotive, architectural and aerospace industries. Conversion coatings are often applied by dipping metal products in, or spraying them with, solutions that contain chromate.

CSIRO's Division of Materials Science and Technology has developed a new type of conversion coating based on aqueous solutions of rare earth metal salts. The new coating type is non-toxic and satisfies many of the stringent Boeing requirements for aerospace applications. In collaboration with Boeing, CSIRO is now actively seeking to commercialise this technology for the aerospace industry.

As a result of this project, CSIRO has established itself as a world leader in conversion coating technology and is looking at the application of the technology to non-aerospace areas.

Research for a healthy pulp mill industry

CSIRO has played an integral part in an important program researching Australia's pulp mills. The National Pulp Mills Research Program, managed by CSIRO, was established in 1989 as part of the Commonwealth Government's Pulp and Paper Industry Package. The package contains the environmental guidelines for new bleached eucalypt kraft pulp mills.

At the Division of Forest Products, a laboratory-scale study of kraft pulping of Australian eucalypt woods showed that processes developed for pulping northern hemisphere woods were applicable. The lower lignin content of pulps prepared by these processes has important environmental implications, in that it takes fewer chemicals to remove it in the bleaching stage.

Modern bleaching processes were simulated in the laboratory using kraft pulps prepared from mature and plantation eucalypt woods. The highest quality pulps were those bleached with chlorine dioxide.

The composition of the effluent produced was studied to see if there were unusual chlorinated compounds present. Earlier concerns that large amounts of chlorinated compounds could be formed from the polyphenolic extractives in eucalypt woods were shown to be unfounded. In addition, CSIRO's work showed that as the high molecular weight fraction of bleaching effluent breaks down, it will not produce highly chlorinated compounds that will persist in the environment.

Analysis of the effluent showed that dioxin was not present in detectable amounts. This result confirmed overseas experience that dioxin formation in a bleached kraft pulp mill using modern technology is no longer an issue.

Under the guidelines, new mills must monitor the level of dioxins in the waters where they release effluent. They do this by measuring the concentration of dioxins in the hepatopancreases of crustaceans in those waters. These organs take up trace contaminants in the water, and provide the trigger for investigating discharge of dioxins. This is five parts per trillion (ppt), calculated as total toxic equivalents. Studies of crabs in the Bass Strait and Port Phillip Bay led the researchers to conclude that the 5ppt trigger level was reasonable.

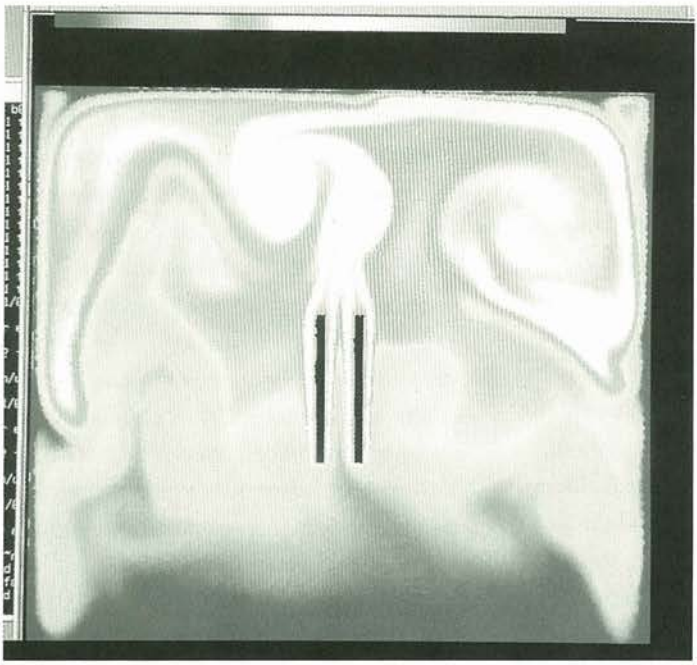
Fastflo—solving fluid flow problems

Fastflo is a new fluids-oriented computer software package designed to quickly and accurately solve complex fluid flow problems, such as predicting turbulence or the flow of molten steel. *Fastflo* was written at CSIRO's Division of Mathematics and Statistics by a team of five scientists from the Division, BHP and Compumod, a Sydney-based engineering software firm, with the help of an Australian Government Industry Research and Development grant.

BHP initiated the *Fastflo* project in 1991. Like all large mineral companies, BHP is faced with many large, complex and potentially expensive problems with fluid flow. BHP saw the need for a computational fluid dynamics package which would handle difficult problems and deliver fast solutions.

The package is much more flexible than commercial packages already on the market: as well as solving BHP's original fluid flow problems, it can be applied to unusually complex questions, including those involving heat flow and electromagnetism.

Fastflo has recently been used for some major industrial applications, including an analysis of turbulent flow of molten steel into a vessel and a study of swirling combustion. Its accuracy and robustness have also been of major assistance in a study of natural convection in collaboration with the Division of Building, Construction and Engineering. *Fastflo* is entering the commercialisation phase and has already been licensed to 14 universities.



Using Fastflo *to predict natural convection inside a room containing heated plates*

Developments

Design and prototype service for light metal products

A design and prototyping service has been established under the joint government-CSIRO Light Metal Industry Development Strategy. It provides a service to industry for optimising design of light metal die castings using the resources of CSIRO, the Cooperative Research Centre for Alloy and Solidification Technology, the Queensland Manufacturing Institute and the South Australian Centre for Manufacturing. This service is a vital part of developing Australian industry's capability to exploit identified market opportunities. The service builds on Australia's reputation in light metals technology in both the automotive and building hardware industries.

CSIRO Composite Fabrication Centre

CSIRO has reached an agreement with Holden Racing Team (TWR Australia) which will further develop CSIRO technology for producing cheap, strong and light resin composite parts. The Composite Fabrication Centre has already produced a range of composite parts for the Holden racing Commodores which are competing in the Australian Touring Car Championship. Cheaper, stronger and lighter polymer composites will be useful for many industries, including boating, mining, medical, musical and sporting goods. The Centre transfers its technology to these and other industries by offering advice, training and consultancies, and by producing prototypes.

New centre for education in materials welding and joining

Materials welding and joining for Australian industry has received a big boost with the opening of an education and training centre in Adelaide. The new centre, which cost a quarter of a million dollars, draws together the expertise of six organisations, including CSIRO. The centre is committed to lifting the standard of welding education for the benefit of Australian manufacturing as a whole. Other organisations involved in the centre are the Australian Nuclear Science and Technology Organisation, The Broken Hill Proprietary Company Ltd, the Universities of Adelaide and Wollongong, and the Welding Technology Institute of Australia.

Asia–Pacific metrology

The National Measurement Laboratory within the Division of Applied Physics will be the Secretariat for the Asia–Pacific Metrology Programme for 1994–98. This programme has 22 member countries and works to improve regional competence in metrology at the primary measurement level. The Asia–Pacific Economic Cooperation recognises the programme as a specialist body which can contribute to free trade within the region by increasing recognition and credibility of physical standards and conformance. The National Measurement Laboratory is also involved in a number of bilateral collaborations within the region, including one to gain international recognition for Indonesia's national standards.

Silicon spheres and a new mass standard

The Division of Applied Physics has manufactured a precisely round ball made from crystalline silicon. These balls will be used in experiments which will redefine the basis for the international mass standard. The balls manufactured by CSIRO are the roundest silicon spheres in the world and have enabled researchers to determine, to a factor of 20 better than known previously, the density of silicon, and ultimately how many silicon atoms are in the sphere. If the number of atoms is known, then the mass of a physical artefact such as the sphere can be linked back to the atomic mass of one atom, leading to an atomically derived mass standard. The spheres will be used by standards laboratories and researchers in Italy, Japan, Germany and Switzerland.

Diabetes research expanded

In March 1995 CSIRO signed a $7 million agreement with the pharmaceutical company Biota Holdings Ltd and the Federal Government to expand its diabetes research. The aim of the research in the Division of Biomolecular Engineering is to produce an oral drug that mimics insulin, without the disadvantages associated with insulin injections. Biota's support of the diabetes project follows its earlier investment in CSIRO's influenza research.

Drug delivery technology

CSIRO and FH Faulding & Company Limited are to develop a new drug delivery technology invented by CSIRO. The broad-based technology should have a huge market because it can be applied to a wide range of drug treatments, from the control of inflammation and skin disorders to cancer treatment.

Food poisoning outbreak

CSIRO responded quickly to the food poisoning outbreak that occurred in Australia in early 1995. One child died and several others became very ill after eating mettwurst sausage contaminated with a bacteria (*E.coli*) that causes haemolytic uraemic syndrome. The Division of Food Science and Technology gave expert comments to the media on the scientific background to this infection and provided advice and technical assistance to health authorities and meat industry organisations. This public scare has given added emphasis to a $883 000 research project being run by the Divisions of Food Science and Technology and of Animal Health to investigate the significance of these types of *E.coli* in meat safety. The project began in mid-1994 and has significant funding from the Meat Research Corporation.

Nematodes in China

An important pest of Chinese apple orchards can now be controlled, thanks to a collaborative project involving CSIRO. Pilot factories have been set up in Beijing and Guangdong to mass-produce and process insect-killing nematodes to control China's main apple pest, the moth *Carposina niponensis*. The nematodes will be cheaper than chemical insecticides. China is now ready for large-scale use of insect-killing nematodes after highly successful trials carried out last year over 1000 hectares of orchards in China. Collaboration between the CSIRO Division of Entomology, Guangdong Entomological Institute and the Biological Control Institute in Guangdong was sponsored by the Australian Centre for International Agricultural Research.

Information and Communications

Goal: Provide leverage for Australian enterprises that add value to goods and services through innovative use of information technology and telecommunications, or that contribute to reducing the trade deficit of the information and communications industries.

Achievements

Optimising mobile phone networks

Scientists in the Division of Building, Construction and Engineering have developed a technique to improve the efficiency of mobile telephone networks.

The demand for mobile telephones is increasing around the world. In Australia, Telstra's analogue (AMPS) mobile phone network is growing rapidly, with over 50 000 new users connected per month and a total national customer base approaching two million.

Faced with this tremendous growth, the task facing Telstra is to meet the demand for mobile calls while minimising the number of calls which may experience blocking or high interference. This task is becoming increasingly difficult. The problem comes down to finding an efficient method of assigning frequencies to base stations to minimise interference between calls. The method must ensure that demand is met while observing frequency separations in geographic space and radio spectrum.

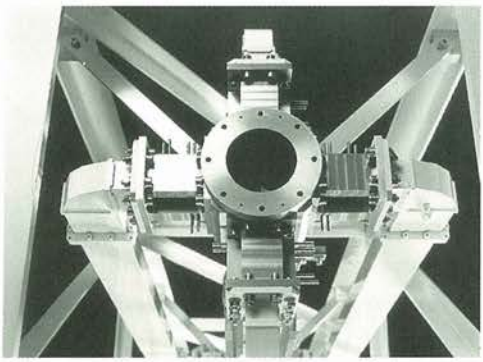
The number of possible ways of allocating frequencies to base stations in a network of Melbourne's size is so great that the world's fastest computer could never evaluate them all within the lifetime of the universe. The CSIRO scientists developed a technique to select good assignments using an efficient and adaptive random search algorithm. It forms the heart of a computer program, FASE (Frequency Assignment by Stochastic Evolution).

Telecom Mobilenet has enthusiastically received the results that not only allow for growth using their existing networks, but also provide a better service to customers. As a result, FASE is now being applied to their analogue and digital (GSM) systems in several of Australia's capital cities.

The FASE algorithm will be further developed during 1995–96 to take account of new network features. This will enhance its utility, ensuring that it continues to provide Telstra with a powerful network design tool.

Multi-frequency communications feed system

The Division of Radiophysics has developed a multi-frequency (dual band) feed system for an earth-station antenna which can increase the antenna's versatility and double the system's capacity. The innovative design, which operates simultaneously on two widely separated frequency bands, was delivered to the Department of Defence in June 1995. Involving close collaboration with the customer, the program evolved from a strategic research project into a marketable product that can be adapted for commercial use. This latest development in antenna technology will be of particular interest to military and commercial operators of major earth stations and teleports.



Dual Band Feed System designed, developed and manufactured by CSIRO Division of Radiophysics for Department of Defence

For the feed system to work properly, new techniques in antenna design had to be developed. A major difficulty was to overcome the bandwidth limitations of existing systems, as the customer demanded high performance over the two widely separated frequency bands. The Division was able to meet this demand by building on its generic antenna research work to develop broadband waveguide components.

The design of the feed system involved extensive use of theoretical, experimental and manufacturing expertise. It would not have been possible to achieve the required specifications without being able to analyse all the crucial components accurately. Where effective analysis was too difficult, the Division used experimental methods of development. With the theoretical and experimental designs, the subsequent practical manufacture of the various components often involved a number of innovative procedures. Being able to synthesise successfully the three equally important elements of theory, experiment and manufacture was fundamental to this project.

Revolutionising transport with computers

CSIRO is investigating the enormous potential of communications and computers (known as information technology) to revolutionise transport systems and services. Information technology can be used to improve planning and analytical tools, spatial models, control systems and strategies and system architecture for urban transport.

Using computer modelling and simulation, the Division of Information Technology is investigating innovative urban passenger transport. Combined with user surveys and pilot projects, this analysis can help with the development of system specifications and designs. The Division has already conducted simulations to help assess the financial feasibility of Personal Public Transport in

East Perth. The simulations have also been used for a technical evaluation of dynamic car pooling over a large part of Sydney.

The Division, in collaboration with other members of the Cooperative Research Centre for Advanced Computational Systems, is helping provide broad technical expertise in spatial and temporal optimisation, information systems engineering and parallel and distributed simulation. As a member of the CRC, CSIRO is working on the NewMAPP (Network Modelling, Abstraction, and Parallel Processing) urban traffic project which is developing parallel and distributed simulations.

Developments

World's largest technology fair

In 1995 Australia played a major role in the world's largest information technology trade fair (CeBIT). The fair was held in Hanover, Germany, in March. A team from CSIRO's Institute of Information Science and Engineering was heavily involved in planning for and participation in the fair.

Managing people movement in prisons

The Division of Radiophysics has been working on a visual simulation of a prison which will help create a space where people can move efficiently. The simulation, which the Preston Group in Melbourne has also been working on, displays graphically the layout of the prison. It will help designers explore the effectiveness of management strategies to control the movement of people—staff, prisoners and visitors—within the area. A similar technique has already been applied successfully to the complex problem of controlling staff rosters in a major airport.

Chip development and manufacture

CSIRO is developing technology which will enable specialist microchips to be developed and manufactured in Australia for military and civilian applications. The CSIRO Divisions of Materials Science and Technology and of Radiophysics, and the Department of Defence, have recently entered into a research contract to develop specialised semiconductor devices. The project combines CSIRO's Electron Beam Lithography centre in Melbourne and chip manufacturing facilities in Sydney. The systems are expected to find markets in Australia and internationally.

Environment

Goal: Achieve sustainable development in production systems and develop technologies to minimise environmental damage from economic development.

Develop ecologically sound management principles and practices for the use and conservation of Australia's natural resources.

Achievements

The Port Phillip Bay Environment Study

One of the greatest problems confronting the world's in-shore waterbodies and bays is eutrophication. This is where excessive nutrient pollution causes plant overgrowth which essentially suffocates the water ecosystem. Melbourne's Port Phillip Bay is one of the waterbodies now at risk.

The Port Phillip Bay Environment Study, designed and managed by CSIRO, is providing the scientific information needed to manage this problem in Melbourne's most famous waters.

The four-year $12 million study is funded by Melbourne Water and Melbourne Parks and Waterways, with project design and management by CSIRO.

A multi-disciplinary scientific team from CSIRO and other agencies is carrying out the study: crossing disciplinary boundaries gives a holistic picture of the ecosystem. For the first time, relationships between tidal movements, aquatic life, nutrients and toxicants will be investigated.

Despite the three million people living in its catchment, Port Phillip Bay has remained largely free of eutrophic conditions, and the latest results from the study are providing the information on why this is so. The results are showing that millions of small animals are keeping the Bay in surprisingly good condition. A huge population of crustaceans, worms and shellfish in the sediments can apparently process the entire contents of the Bay every week, which helps keep the water quality high. The activities of the animals on the bottom provide an ideal environment for bacteria which remove the nitrogen from the water and reduce the plankton biomass.

The next step is to provide properly researched information so that decisions can be made about the best ways to manage activities affecting the Bay—for example, how Melbourne's treated waste-water will be disposed of in future years.

A major outcome of the study will be a series of computer models of the Bay. These

will be a powerful predictive tool to help various authorities and groups manage the Bay over the next 20 years. The models could, for example, predict the effect of a hypothetical increase or decrease in sewage on the ecology of the Bay.

The outcomes of the study so far have already been incorporated into draft State environmental protection policies and have assisted Melbourne Water with planning for infrastructure developments.

Brassicas—the natural soil fumigants

Scientists in the Division of Plant Industry have discovered that brassicas, such as canola and Indian mustard, can control pests and diseases in agricultural and horticultural crops. Scientists have shown that pieces of brassica root can reduce the growth of take-all fungus in the laboratory. Take-all is the most serious root disease affecting Australian wheat. Compounds known as isothiocyanates (ITCs), which are produced by decaying brassica plants, suppress the growth of some soil diseases, including take-all. Brassicas are members of the cabbage family.

Scientists coined the term 'biofumigation' to describe the effect of the naturally occurring ITCs, which have the same results as commercial soil fumigants. They believe that biofumigation could control pests without synthetic chemicals. They will now work to identify brassica types with ITCs that can control other important pests of agriculture and horticulture.

Monitoring metal wastes

CSIRO has concluded that there are no significant environmental effects caused by the dumping of jarosite at sea. A CSIRO study of jarosite dumping was commissioned by the then Department of Arts, Sport, the Environment, Tourism and Territories in response to concerns about the impact of the disposal on the marine environment. The Divisions of Oceanography and of Fisheries carried out research over three years and the final report was submitted to the national Environment Protection Agency in December 1994.

Jarosite is one of the residues remaining following the zinc refining process at the Pasminco Metals-EZ zinc refinery in Hobart. Pure jarosite is a compound containing ammonia, iron and sulphate. Jarosite waste also contains small amounts of other metals, including zinc, lead, cadmium, copper, mercury and arsenic.

Since 1973 Pasminco Metals-EZ has been dumping jarosite at a site 100 kilometres south-east of Hobart in water approximately 2000 metres deep. Around 170 000 tonnes of jarosite are disposed of each year.

Oceanographic research undertaken by the Division of Oceanography examined how jarosite disperses in the ocean. Researchers using AusProbe, an instrument developed to profile the ocean water column, found that

most of the jarosite dumped in the ocean falls as a single cloud. A surface slick also resulted from hold washing operations and from jarosite which was caught up in the propeller of the dumping vessel.

Biological studies concentrated on sampling the marine organisms in the pelagic ecosystem where most of the jarosite dispersed. Forty-eight species, ranging from large sharks to small lantern fish, were analysed for heavy metals. The southern bluefin tuna, a highly mobile predator, was studied in detail as this species could be particularly vulnerable to heavy metal accumulations. Samples of southern bluefin tuna were also obtained from New Zealand and South African waters to provide a comparison.

Beyond natural variability, there were no detectable differences in the abundance or diversity of marine organisms or in concentrations of heavy metals that specifically distinguished the dump site from other locations.

AusProbe being tested at the wharfs, CSIRO Marine Laboratories, Hobart, Tasmania.

CSIRO research to reduce livestock methane emissions

Two important CSIRO research programs could reduce the production of methane by livestock, leading to an overall reduction in greenhouse gases. Current estimations indicate that emissions from cattle and sheep may account for as much as 15 per cent of the world's total methane production.

The Division of Animal Health has developed a new compound for livestock that may boost production and save farmers money. This non-toxic compound is an antimethanogen which reduces the amount of methane gas animals release to the atmosphere. Methane production is suppressed for as long as the antimethanogen additive is given. It can be applied in a variety of cattle production systems because it can be delivered as a feed additive, or by an intraruminal controlled-release device.

The treatment will also bring production benefits. If an animal's metabolism is changed in this way, it will lead to enhanced ruminant nutrition, which means more efficient use of feed. Trials with CSIRO's antimethanogen in cattle have increased live weight gains by up to 20 per cent.

CSIRO is now trialing this compound: cattle are being tested at the Tropical Beef Centre at Rockhampton, and sheep are being tested through the CSIRO Centre for Mediterranean Agricultural Research by the Division of Animal Production in Western Australia. The work is backed by farmers through support from the International Wool Secretariat and the Meat Research Corporation. Commercial partners will be sought in 1995–96.

In another project which applies a different approach to achieve similar benefits, the Division of Animal Production has developed a treatment to improve the efficiency of animal production by affecting the activity of protozoa present in the forestomach (rumen) of sheep and cattle. Removal of microfauna (protozoa) in the rumen may improve the supply of proteins to animals consuming poor quality pastures or fodder. The new treatment also has the potential to reduce ruminal production of methane. The treatment utilises a compound found naturally in some native species of plants in Australia. The Division has submitted a patent for this treatment and is continuing the research with the support of a major company in the field of veterinary and agricultural products. A decision on commercialisation of the treatment is expected shortly.

Methane emissions from cattle contribute significant amounts to the world's methane production.

Carbon dioxide: set to keep rising throughout next century

Levels of the greenhouse gas carbon dioxide are likely to keep rising for at least 100 years, according to a CSIRO report.

Carbon dioxide concentrations can only be prevented from rising to more than twice today's levels if emissions are eventually reduced to well below 1990 levels. In contrast, stabilising emissions will lead to doubling of carbon dioxide levels some time after the year 2100. Continued growth in emissions will cause doubling by 2070.

The report, by the CSIRO Division of Atmospheric Research, the US Office for Interdisciplinary Earth Studies and the Max Planck Institute in Germany, is probably the most comprehensive study of this type ever undertaken. It combines calculations from 18 groups of scientists worldwide, including two groups from Australia, with each group analysing many different aspects of possible future carbon dioxide concentrations.

The report asks what emission reductions would be required to stop carbon dioxide concentrations rising above double pre-industrial levels, what concentrations of carbon dioxide will occur if fossil carbon emissions continue to increase and what concentrations will occur if carbon dioxide emissions are stabilised by the year 2000.

The calculations will be used in the report of the Intergovernmental Panel on Climate Change (IPCC). The panel is an international group of scientists and policy-makers drawing together all that is known about climate change. The report provides vital support for the IPCC document, ensuring that details of results presented are available for scientific scrutiny.

The two Australian modelling groups included a combined team from CSIRO and the New Zealand National Institute of Water and Atmospheric Research, funded by the State Electricity Commission of Victoria, and a team from the Australian National University.

This work is collaborative, and is led by CSIRO Division of Atmospheric Research. Funding for the production of the report came from the Commonwealth Department of the Environment, Sport and Territories.

Learning about air pollution

CSIRO has been conducting studies around the country to determine the extent and degree of air pollution. The studies have looked at pollution from industry on Australia's coastline, the effect of supersonic aircraft on atmospheric ozone, and air quality monitoring.

The Western Australian Department of Environmental Protection contracted a team of scientists from across the country to examine what happens to pollution released from tall chimneys near the coastline. Under sea breeze conditions, elevated emissions may be brought to ground level in a process known as shoreline fumigation. Emissions need to be controlled to ensure that acceptable ground level concentrations are not exceeded.

Before this experiment, held in Kwinana, Western Australia, little information was available concerning this phenomenon. The experiment gathered extensive information on how pollutants behave so that scientists can better predict the impact of emissions from industrial plants. The data collected will also be used to assess whether computer models developed by the Department of Environmental Protection to simulate emission behaviour are accurate.

Scientists from the State Energy Commission, Murdoch University, Flinders University and CSIRO's Divisions of Atmospheric Research and of Coal and Energy Technology participated in the experiment. Funding came from the Western Australian Department of Environmental Protection, ANZECC and Kwinana Industry.

In recent years there has been increased interest in the causes of long-term trends in atmospheric ozone. The Division of Applied Physics, in collaboration with Boeing, has developed a state-of-the-art model which can assess how future fleets of supersonic

passenger aircraft will affect the ozone. Our present understanding of ozone chemistry suggests that the effects of supersonic aircraft will be minimal. The model is being used in a NASA program, 'The Atmospheric Effects of Stratospheric Aircraft', where its predictions are being compared with about six other models from around the world. Preliminary benchmarking exercises showed that the CSIRO model compared very favourably with the other participating models.

Managing air quality is an important consideration in planning the growth of cities. More people generally means more pollutants, so as our cities grow we must work to ensure they do not become unlivable. The Division of Coal and Energy Technology and the Division of Atmospheric Research are playing a major role in the Metropolitan Air Quality Study, which was initiated by the New South Wales Government in 1991 after a summit on air quality. The study will help us better understand the factors affecting air quality in the Newcastle–Sydney–Wollongong region of New South Wales.

The Division of Coal and Energy Technology is applying new techniques to interpret data from New South Wales Environment Protection Authority monitoring stations to show the factors controlling photochemical smog production. In addition, the Division of Atmospheric Research is working out how air moves on smog days. Macquarie University and the Environment Protection Authority, Victoria are also participating in the investigation, and the project is being managed by the Australian company Coffey Partners International.

CSIRO scientists have also collaborated with colleagues from the Flinders Institute for Atmospheric and Marine Sciences to obtain data on the air above Perth. The data generated during these studies have given Perth authorities an overview of smog levels above the city which will be used in an extensive air quality survey currently in progress.

Developments

RACOD meter

The RACOD meter developed by the Division of Chemicals and Polymers offers on-line automatic measurement of organics in waste-water or sewage 24 hours a day. The meter can be applied to raw waste-water or to the effluent from a treatment process prior to discharge. It can also be used as the primary sensor in a process control system. Alternatively, it can be used for real time alarm monitoring of effluent discharges to minimise licence violations and environmental impact, or as part of an active effluent discharge optimisation scheme. Wallace and Tiernan Pacific have been licensed to further develop, manufacture (in Australia), market and distribute the RACOD meter worldwide.

Granitgard

The Division of Forest Products has negotiated an agreement with Granitgard

Pty Ltd to extend the potential of physical termite barriers. The R&D Manager of the company has been seconded to the Division as part of the agreement.

Biodiversity information management

The Division of Plant Industry is participating in an Indonesian Government/World Bank Biodiversity Project, managed by Harvard University. This project represents a major initiative of the Government of Indonesia in managing information on biodiversity.

Oceanographic expedition

CSIRO is taking part in a study to increase our knowledge and understanding of Antarctica and boost our capacity to predict future climatic changes. Scientists from CSIRO's Division of Oceanography, the Antarctic Cooperative Research Centre and four US academic institutions are involved in a joint program aimed at understanding the dynamics of the Antarctic Circumpolar Current, the world's largest ocean current. In March 1995, RV *Melville*, the oceanographic research vessel of the Scripps Institution of Oceanography (United States), joined the Southern Ocean expedition.

Pacific atmospheric chemistry experiment

The Division of Atmospheric Research and the Office of Space Science joined with researchers from the Japanese Meteorological Research Institute in a series of major airborne experiments over the Western Pacific during October 1994. The Pacific is a natural laboratory, and the studies enabled the collaborators to observe climatic processes such as air movement and cloud formation, which will help assess the influence of human activities.

Australian National Herbarium opened

The new Australian National Herbarium was officially opened by Senator Faulkner, Minister for the Environment, on 23rd May. The new building houses some of the best specialist collections of plants in the world, including a eucalypt collection of over 65 000 specimens and selections of a flora collection made on Captain Cook's expedition in 1770. The herbarium is a key feature of the Centre for Plant Biodiversity Research, a joint venture between CSIRO and the Australian Nature Conservation Agency through the Australian National Botanic Gardens.

Infrastructure, Services, Advancement of Knowledge

Goal: Enhance productivity and effectiveness in provision of infrastructure and services, particularly health and construction.

Operate and develop the Australia Telescope National Facility as a prestigious and world class radio astronomical observatory dedicated to the advancement of knowledge.

Achievements

Modification of milk fat

Milking time at dairy feedlot, Hawkesbury. The milk is used to produce a range of healthier dairy products.

Science and Technology, and Human Nutrition are using this fat-modified milk to develop a range of healthier dairy products.

As people become more health conscious, the demand for products with improved health potential is increasing. Dairy foods are often avoided by people seeking to reduce their intake of saturated fats, but all that is about to change. CSIRO has developed specialised feed supplements which, when fed to dairy cows, reduce the level of saturated fats in milk. In conjunction with Rumentek Industries, the CSIRO Divisions of Animal Production, Food

The specialised supplements are based on oilseeds, such as canola, that have been treated to protect the oils from breakdown in the animal's stomach. The technique, Protected Nutrient Technology, is the outcome of more than 20 years research at the Division of Animal Production. The technique ensures that the protected supplements pass through the first stomach of the cow to the small intestine. There the oil supplement is absorbed and metabolised

by the cow to produce up to 30 per cent more milk containing higher levels of unsaturated fats.

A 200-cow feedlot dairy, constructed by Rumentek Industries in collaboration with the University of Western Sydney, is now in full production and is conducting trials with these supplements. Fat-modified milk from these animals is being used by CSIRO to develop a range of products including cheese, butter and icecream. Human nutritional tests conducted this year using the modified milk and products have been very successful and have led to significantly lower cholesterol levels than conventional dairy products. Subjects in this study rated the novel dairy products very highly compared to their conventional counterparts. The use of products from animals fed protected supplements may help to reduce the incidence of heart disease in western nations.

Negotiations with the dairy industry are well advanced and the milk should be on the market in early 1996. It has the same total fat content as full-cream milk, but 25 per cent less saturated fats and a higher proportion of healthier unsaturated fats. Significantly, levels of the two saturated fats thought to directly increase cholesterol levels are both halved.

PIRAT in the sewers

PIRAT, a prototype system for sewer inspection by a new and objective technique, has demonstrated its capabilities by inspecting 5 kilometres of sewers in Melbourne.

Melbourne and Sydney each have approximately 20 000 kilometres of sewers with a replacement cost of more than $5 billion, and these are less than 1 per cent of the world's sewers. Some sewers are over a century old, and their condition is affected by many factors. Regular inspection is essential to avoid costly and environmentally damaging collapses and spills, and sewer inspection is receiving higher priority worldwide.

The PIRAT system consists of a small-diameter, self propelled mini-vehicle fitted with scanners and sensors, which continuously measures the internal geometry of the sewer. These data are analysed using artificial intelligence software to produce defect reports for asset managers.

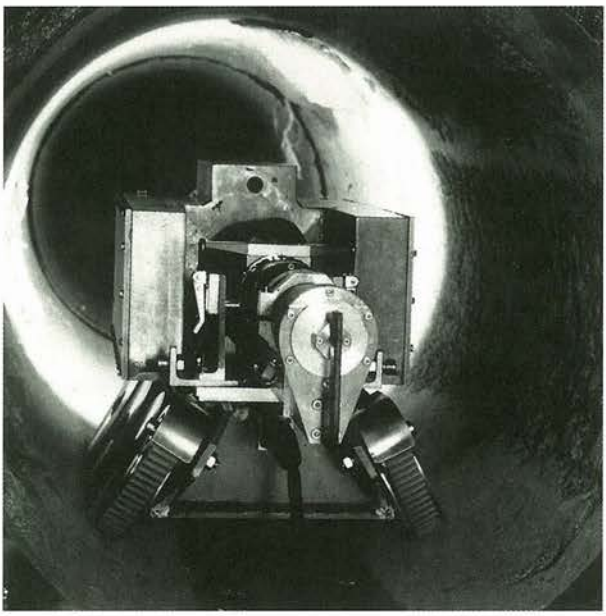
Currently, inspections are performed by operators, usually with a remotely controlled video camera. The results are unreliable due to limitations of the video and the unachievable skill and concentration demanded from operators. Melbourne Water saw the need to improve their inspection techniques, and in 1991 commissioned CSIRO to develop a better method.

The PIRAT system was jointly developed by the Division of Manufacturing Technology and the Division of Building, Construction and Engineering. The PIRAT mini-vehicle is linked by a hybrid cable to a mobile control vehicle fitted with computers, instruments and control equipment. The advanced scanner and data communications

technology is packaged to operate in the confined, hazardous, and potentially explosive, sewers. The artificial intelligence software which interrogates the data detects, identifies and rates defects according to accepted criteria.

The system provides assessments which are unaffected by operator differences and concentration lapses. PIRAT has demonstrated this by providing more reliable results than current methods. The geometry data have proven valuable for assessing repair options.

As water authorities worldwide are giving higher priority to inspections and recognising the need for improved techniques, PIRAT has a large potential market.



The PIRAT remote probe

Close encounters of the pulsar kind

In January 1994 CSIRO radio telescopes watched as a rare type of pulsar performed a very unusual manoeuvre. The pulsar PSR B1259-63, found with the Parkes telescope, is one of only two pulsars known to travel through space with a massive, 'mainstream' kind of star. The pulsar is in a highly elliptical orbit around its companion and every three and a half years passes very close to it.

This year the encounter was closely watched with radio telescopes, optical telescopes, and X-ray, gamma-ray and UV satellites. The most exciting results came from observations with CSIRO's radio telescopes—the Parkes radio telescope and the Australia Telescope Compact Array near Narrabri, New South Wales.

Astronomers timed the pulsar's radio pulses over several months and found that after the encounter the pulsar was 'ticking over' more slowly. This is probably because matter from the larger star 'fell' towards the pulsar and was fended off by the pulsar's magnetic field; this effort sapped the pulsar's energy, causing it to slow down. The effect was predicted years ago but this is the first time it has been seen in a radio pulsar.

As the pulsar swung in close to the bigger star, its radio pulses had to fight their way through a 'wind' of particles streaming off the star. From looking at how certain characteristics of the pulses changed, we now have a picture of the shape, size, density and magnetic field strength of this wind—a picture rather different from that expected.

Taken together, the observations suggest that this double star system is a missing link—a unique example of a pulsar system evolving from one phase of its life (a radio pulsar) to another (an X-ray binary).

Developments

International building consultation

At the request of the Indonesian Minister for Public Works, the Division of Building, Construction and Engineering took part in five days of intensive workshops in Jakarta and Bandung in January 1995. Four major project areas were identified as being of priority for the advancement of Indonesia's building industry, housing and urban development. They were urban and regional planning, road planning, low-cost housing materials and harmonisation of building regulations, as well as software development to support this.

SiroFire

A computer package that can predict a bushfire's spread was publicly launched in November 1994. SiroFire, the result of over 25 years of research into bushfires by CSIRO, simulates the spread of a bushfire on a computer screen map. The package enables local area fire controllers who have a PC to deploy fire-fighters to best effect. SiroFire is also useful in training fire controllers. The computer program's development has been assisted by the Rural Access Program of the Department of Primary Industries and Energy through the Australian Fire Authorities Council.

SETI Project

From February to the end of May 1995, US scientists brought their search for extraterrestrial life to CSIRO's radio telescope at Parkes, New South Wales. The search, called Project Phoenix, is looking for specific types of radio signals that may emanate from technology similar to our own. Project Phoenix is run by the SETI Institute, a non-profit privately funded organisation. CSIRO received over $2 million from the Institute for the use of the telescope and for the development of special equipment for the project.

CSIRO and the Cooperative Research Centres Program

The Cooperative Research Centres (CRC) Program supports collaborative research between industry, Commonwealth and State government instrumentalities, universities and other research providers such as CSIRO.

In 1994–95 CSIRO is a participant in 52 of the 61 CRCs already established or recently announced under the CRC Program. The principle guiding the Organisation's involvement is that the objectives of the CRC must be consistent with the priorities determined by CSIRO in its response to national research needs. Most CRCs are unincorporated joint ventures, but CSIRO is also an associate of six of the ten CRCs which are incorporated.

For each year of the program, CSIRO's contribution averages $1.3 million per CRC. This contribution occurs mainly through the provision of staff (some 560 person-years in professional research staff and 138 person-years in other staff), infrastructure, administrative support and access to research knowledge. The Organisation makes a major contribution to the program through its experience in collaborating with industry and by applying its research management skills. These contributions, in numbers and quality of staff and other resources, have significant implications for the Organisation.

The CRC Program helps capture benefits from Australia's considerable investment in public research infrastructure and creates opportunities for research students to gain experience in a research environment involving industry and other research users. Through the program and similar collaborative ventures, CSIRO has links with 29 different universities. As a result of the Organisation's participation in the program, CSIRO staff are now jointly supervising over 170 additional PhD and other postgraduate students; the total number of postgraduate students supervised is over 630. Through the program, CSIRO staff are also involved in undergraduate lectures, summer schools, seminars for industry and similar extension and training activities.

The CRCs and CSIRO's Multi-Divisional Programs focus the Organisation's multi-disciplinary skills on complex issues. CSIRO staff gain valuable experience in managing joint ventures involving public and private sector participants. The CRC Program ensures the early involvement of research users in projects and increases the possibilities for successful technology transfer and commercialisation. Full details of CRC activities are available through their annual reports and publications.

The CRC Program Evaluation, which is currently being undertaken, is expected to comment on the interactions of CSIRO with the CRC Program. The Steering Committee for the evaluation has CSIRO's Dr T E Heyde, Principal Secretary, Government Business and International Scientific Liaison, as a member.

The CRCs in which CSIRO is involved are shown in the following table.

Cooperative Research Centres in which CSIRO is a participant (Total = 52)

CRC	CSIRO Divisions
Manufacturing Technology	
CRC for Materials Welding and Joining	Manufacturing Technology
CRC for Polymer Blends	Chemicals and Polymers
CRC for Molecular Engineering and Technology: Sensing and Diagnostic Technologies	Food Science and Technology Applied Physics Biomolecular Engineering
CRC for Industrial Plant Biopolymers	Food Science and Technology
CRC for Intelligent Manufacturing Systems and Technologies	Manufacturing Technology
CRC for Alloy and Solidification Technology	Manufacturing Technology
CRC for International Food Manufacture and Packaging Science	Materials Science and Technology Food Science and Technology
Information and Communications Technology	
CRC for Intelligent Decision Systems	Information Technology
CRC for Robust and Adaptive Systems	Radiophysics
Australian Photonics CRC	Applied Physics
CRC for Advanced Computational Systems	Information Technology
Research Data Network	Information Technology
Mining and Energy	
CRC for Mining Technology and Equipment	Exploration and Mining Minerals Manufacturing Technology Coal and Energy Technology
GK Williams CRC for Extractive Metallurgy	Minerals
AJ Parker CRC for Hydrometallurgy	Minerals
Australian Petroleum CRC	Petroleum Resources
CRC for Australian Mineral Exploration Technologies	Exploration and Mining
Australian Geodynamics CRC	Exploration and Mining
CRC for New Technologies for Power Generation from Low Rank Coal	Minerals

CRC	CSIRO Divisions
CRC for Landscape Evolution and Mineral Exploration	Exploration and Mining
CRC for Black Coal Utilisation	Coal and Energy Technology
Agriculture and Rural Based Manufacturing	
CRC for Sustainable Sugar Production	Tropical Crops and Pastures Soils
CRC for Legumes in Mediterranean Agriculture	Centre for Mediterranean Agricultural Research
CRC for Plant Science	Plant Industry
CRC for Tropical Plant Pathology	Tropical Crops and Pastures
CRC for Tropical Pest Management	Entomology
CRC for Temperate Hardwood Forestry	Forestry
CRC for Hardwood Fibre and Paper Science	Forest Products
CRC for Viticulture	Horticulture
CRC for Premium Quality Wool	Animal Production Wool Technology
CRC for the Cattle and Beef Industry (Meat Quality)	Animal Production Animal Health Food Science and Technology Tropical Animal Production
CRC for Aquaculture	Fisheries
CRC for Sustainable Cotton Production	Plant Industry Entomology
CRC for Food Industry Innovation	Food Science and Technology Human Nutrition
CRC for Quality Wheat Products and Processes	Plant Industry
CRC for Weed Management Systems	Entomology
Environment	
CRC for Waste Management and Pollution Control	Water Resources Chemicals and Polymers
CRC for Soil and Land Management	Soils
CRC for Catchment Hydrology	Water Resources

CRC	CSIRO Divisions
CRC for Biological Control of Vertebrate Pest Populations	Wildlife and Ecology
CRC for Antarctic and Southern Ocean Environment	Oceanography
CRC for Freshwater Ecology	Institute of Natural Resources and Environment
CRC for Southern Hemisphere Meteorology	Atmospheric Research
CRC for Tropical Rainforest Ecology and Management	Tropical Forest Research Centre
CRC for Sustainable Development of Tropical Savannas	Wildlife and Ecology Tropical Crops and Pastures
CRC for Water Quality and Treatment	Chemicals and Polymers
Medical Science and Technology	
CRC for Tissue Growth and Repair	Human Nutrition
CRC for Cellular Growth Factors	Biomolecular Engineering
CRC for Eye Research and Technology	Chemicals and Polymers Biomolecular Engineering
CRC for Cardiac Technology	Biomolecular Engineering Chemical and Polymers
CRC for Vaccine Technology	Animal Health
CRC for Diagnostic Technologies	Biomolecular Engineering

Awards

The Chairman's Medal

Left to right: Dr John Stocker, Professor Adrienne Clarke, Dr Dharma Shukla and Dr Colin Ward

The 1994 Chairman's Medal and CSIRO Medals were presented on 24 November 1994 by Professor Adrienne Clarke AO, Chairman of the CSIRO Board.

The winners of the Chairman's Medal were Dr Dharma Shukla and Dr Colin Ward, of the Division of Biomolecular Engineering, for their contributions to the characterisation of the largest family of plant viruses.

Sir Ian McLennan Achievement for Industry Award

This award was established by the former CSIRO Advisory Council in 1985 to recognise outstanding contributions by CSIRO scientists to Australian industry.

The 1994 Awards were presented on 6 October 1994 by the Hon. Jeff Kennett, Premier of Victoria. Joint winners were Dr Ray Smith and his Lateritic Environments Team of the Division of Exploration and Mining for their contributions to the mineral exploration industry in Australia, and Dr John Possingham, former Chief of the Division of Horticulture, for his contributions to the grape growing and wine industries of Australia.

Left to right: The Hon. Jeff Kennett, Dr Ray Smith, Dr John Possingham and Sir Peter Derham

CSIRO Medals

Left to right: Dr John Doran, Mr Steve Midgley, Dr John Stocker, Professor Adrienne Clarke, Dr Dharma Shukla, Dr Colin Ward, Dr Wayne Meyer, Mr Tim Vercoe, Mrs Beryl Thompson, Dr Chris Harwood, Mr Brian Gunn, Ms Jane Blackmore, Dr Ron Sharpe, Mr Stephen Oakes

The CSIRO Medals for 1994 were awarded to:

- Dr Wayne Meyer, of the Division of Water Resources, for outstanding research in irrigation water management
- The Australian Tree Seed Centre, of the Division of Forestry, represented by Mr Stephen Midgley, Dr John Doran, Dr Chris Harwood, Mr Brian Gunn, Mrs Beryl Thompson and Mr Tim Vercoe, for its outstanding work on the exploration of forest genetic resources
- Dr Ron Sharpe, of the Division of Building, Construction and Engineering, for outstanding work on the development and commercialisation of BCAider, an expert system for the Building Code of Australia.

The 1995 Australia Prize

Three CSIRO scientists and an American academic shared the 1995 Australia Prize, which honoured achievement in the field of remote sensing. Dr Ken McCracken (centre), founding chief of CSIRO's Division of Mineral Physics, and Dr Andrew Green (right) and Dr Jonathan Huntington (left), of the Division of Exploration and Mining, shared the prize with Dr Richard Moore, Emeritus Professor of Electrical and Computer Engineering at the University of Kansas.

Special CSIRO Medal

A special CSIRO Medal was awarded in February 1995 to Dr Elwood Zimmerman, a distinguished scientist of the Division of Entomology, for his outstanding work on Australian weevils. Dr Zimmerman also won the Pacific Science Association's Herbert Gregory Medal.

Technology transfer

Selected highlights

The DNA sequencing facility in which CSIRO is a partner has been most successful in commercial operations to assist agricultural industries (see page 23).

An agreement has been signed with The Commonwealth Industrial Gases Limited to supply SIRO-FLO grain fumigation technology to private and on-farm grain storers (see page 23).

CSIRO and Pacific Power are jointly developing a process to recycle transformer oils (see page 28).

CSIRO and the Department of Defence have entered a research contract to develop specialised semiconductor devices (see page 40).

A design and prototyping service has been established to help industry optimise the design of light metal die castings (see page 36).

A new drug delivery technology developed by CSIRO is now being commercialised in conjunction with FH Faulding & Company Limited (see page37).

China is building factories to mass-produce insect-killing nematodes, following successful trials and technology transfer last year (see page 37).

An agreement has been made with Wallace and Tiernan Pacific to develop and manufacture the RACOD water quality meter (see page 46).

CSIRO and Melbourne Water are further developing the PIRAT pipeline and sewer inspection device (see page 49).

Intellectual property

The management of intellectual property was reviewed during 1994–95 and recommendations to further improve management practice were implemented. Important actions were the establishment of panels of overseas attorneys to handle CSIRO patents in the USA and Europe, and intellectual property and legal workshops which were held for 500 professional staff. An Intellectual Property Standing Committee was established to oversee intellectual property management and advise on strategic issues.

Interests in companies

The companies in which CSIRO had a significant shareholding interest as at 30 June 1995 are as follows:

Name of company	CSIRO's interest (%)	Principal activity
Bio-Coal Briquette Company Pty Ltd	17.2	Non-operational
Dunlena Pty Ltd	47	Trustee and management company for a joint venture in the discovery and commercialisation of agricultural chemicals
Gene Shears Pty Ltd	34.7	Conduct of research projects based on ribozyme technology and the investigation of licensing and development of commercial applications
GroPep Pty Ltd	35.1	Development, manufacture, licensing and sale of biotechnology products
Ceramic Fuel Cells Limited	43	Development of a prototype demonstration fuel cell
Biomolecular Research Institute Limited	43	Development of pharmaceutical and biological products
The Preston Group Pty Ltd	16.1	Computer simulation development, sales and consultancy, particularly to the aviation industry
Queensland Metals Corporation Ltd	1.96	Development of the Kunwarara Magnesite Deposit

Legal issues

The Corporate Legal Service office has been relocated to Melbourne and a number of new staff, with extensive commercial and litigation experience, have been appointed. Corporate Legal Service workshops are held bi-monthly and are attended by the Director, Corporate Business, all Institute solicitors and members of Corporate Legal Service. These workshops canvass legal issues of concern to solicitors working within the Organisation and provide an important forum for discussion.

An out-of-court settlement was reached in relation to a major dispute regarding the commercialisation of one of CSIRO's technologies in October 1994. The precise terms of settlement have not been disclosed because of the nature of the technology which was the subject of the dispute.

All other significant disputes are monitored by Corporate Legal Service and a number of minor disputes were settled throughout the year.

CSIRO international scientific liaison

The International Affairs Group of the Corporate Business department was re-organised in March, following the departure of Dr Barry K Filshie, former General Manager International, from CSIRO. In its place, the International Scientific Liaison Group was established within the Corporate Services department to handle corporate aspects of international scientific activities relating to government. Responsibility for international business activities remained within the Corporate Business department.

CSIRO's interactions with scientists in the Asian region have continued to multiply, based on our corporate science and technology agreements with counterpart organisations. These are the Chinese Academy of Sciences, the Institute of Physical and Chemical Research in Japan, the Indonesian Institute of Sciences, the University of Indonesia, the Standards and Industrial Research Institute of Malaysia, the Thailand Institute of Scientific and Technological Research and the National Centre for Science and Technology in Vietnam. To these should be added CSIRO's involvement in projects of the Australian Centre for International Agricultural Research, which is providing a valuable means of establishing partnerships that extend the Organisation's scientific network in Asia.

CSIRO was pleased to welcome the Indonesian Minister of State for Research and Technology, Professor Dr Ing B J Habibie, who met with the Acting Chief Executive and other senior staff. He visited two CSIRO sites to learn more about our research activities, with a view to developing further collaboration. In addition, there were visits by delegations from the Indonesian Agency for the Assessment and Application of Technology and the Indonesian Institute of Sciences, both of which explored the possibility of establishing twinning arrangements with CSIRO to help

them develop such areas as management and commercialisation practices.

Exchange visits between CSIRO and the Chinese Academy of Sciences under our agreement are continuing on a regular basis. This relationship was further strengthened this year with joint seminars on soil and water management held in each country as a result of an initiative taken by the former Chief Executive, Dr John Stocker. Based on discussions associated with these seminars, several new joint research projects are being planned.

CSIRO is continuing its interactions with the National Research Council of Italy under the arrangement established in 1991, covering such areas as physical standards, grain proteins and grapevine 'fingerprinting'. Exchange visits in the newly selected areas of forestry and soil science have been agreed upon.

A reciprocal visit by a CSIRO delegation to the Republic of South Africa's CSIR with which CSIRO has a collaboration agreement, was led by Dr R M Green, then Director of the Institute of Natural Resources and Environment. This relationship with South Africa complements the Australian Government's recent initiative to develop collaboration between temperate countries of the southern hemisphere.

Small-to-medium sized enterprises

Improvements have been made to the delivery of an excellent front-line service to SME enquirers. The CSIRO Information Network is listed as CSIRO's point of contact in AusIndustry's SME database 'BizLink'. Work is now underway within the CSIRO Information Network to improve the systems and tools which are used to assist in answering enquiries from SMEs.

Specifically, a computerised method of tracking enquiries has been developed to find out how an enquiry has been handled within a Division and what an SME did with the information provided.

A database of referral contacts is also being developed and directories have been prepared to improve access to information about research in CSIRO and other science and technology agencies.

A Divisional staff member has been seconded to the Information Network to evaluate the service and implement new procedures. A training course, including representatives from NIES, Department of Industry, Science and Technology, AusIndustry and Institutes, was held in May.

The Institute of Industrial Technologies has introduced a new program specifically designed to assist those SMEs which have the potential to enhance their international competitiveness by using CSIRO's expertise and technologies. A network of Industry Liaison Managers contact the SMEs each month and provide assistance and advise on technical issues. This program has been warmly received by the manufacturing industry.

Corporate Business Department

Major activities for the year have been enhancing links with industry partners and improving services to CSIRO Institutes and Divisions.

Improving the cost-effectiveness of services to Divisions and Institutes has continued to be a priority. Specifically, further work has been carried out in intellectual property management and the legal service. International activities have been realigned, and scientific liaison functions have been separated from the business activities.

High-level delegations from Indonesia and Korea have visited CSIRO, leading to new opportunities in the joint development of drugs with the Korean Government. It is expected that interactions with the Indonesian Government and scientific institutions will increase as a result of the visit of Minister Habibie. Further details on international activities appear on page 61.

The Corporate Business Department has been encouraging interactions with existing and potential industry partners. For example, successful discussions have been held with the Australian Technology Group about the continuing relationship between the two organisations. Discussions have also been held with Broken Hill Proprietary Limited, CRA Limited, DuPont (Australia) Limited, National Foods Limited, AWA Limited, Australian Industry Development Corporation and Australian National Line, amongst others.

Some highlights of the year follow.

- CSIRO has prepared a proposal for the Olympic Co-ordination Authority about the extensive range of advice and services which CSIRO could provide. Emphasis was placed on environmental issues such as water use and quality, energy efficiency, air quality, event scheduling, movement of people and transport simulation, and security issues.
- An exciting opportunity to showcase Australian science to the world is being drawn up. Best, a biennial international science and industry fair, is being developed in close cooperation with major industry partners.
- Construction began on an Interpretative Display on Tropical Rainforests to be housed at the Barron Falls stop of the Skyrail Cable Car running between Cairns and Kuranda. The Hon. Ted Lindsay announced the initiative, which includes the planned establishment of a foundation to support tropical rainforest research.
- The Department and Dr Peter Colman, Chief of CSIRO's Division of Biomolecular Engineering, made a presentation to the Victorian Government concerning the future of the Biomolecular Research Institute.
- The Director of Corporate Business is a council member for the Australian Industrial Property Office and was involved in discussions on improving systems relating to petty patents. The Director also participated in the Intellectual Property Workshop held on 10 May at the request of Minister Cook as part of the Innovation Statement Initiatives.

Funding

1994–95 was the first year of the Organisation's third triennium appropriation budget.

Non-recurrent funding provided by the Government in the 1989 Science and Technology Statement and in two separate amounts of infrastructure funding during the previous triennium came to an end in 1993–94. However, in the Working Nation statement the Government increased CSIRO's recurrent funding and significantly reduced the 'efficiency dividend' by exempting research activities. The effect is that during the triennium CSIRO will receive an average of around $28 million per year more than it would have received under the original estimates. The additional funding enabled CSIRO both to support a range of programs in all Institutes which would have been affected had the efficiency dividend continued at its earlier rate, and to initiate a further 14 high-priority projects of special national importance.

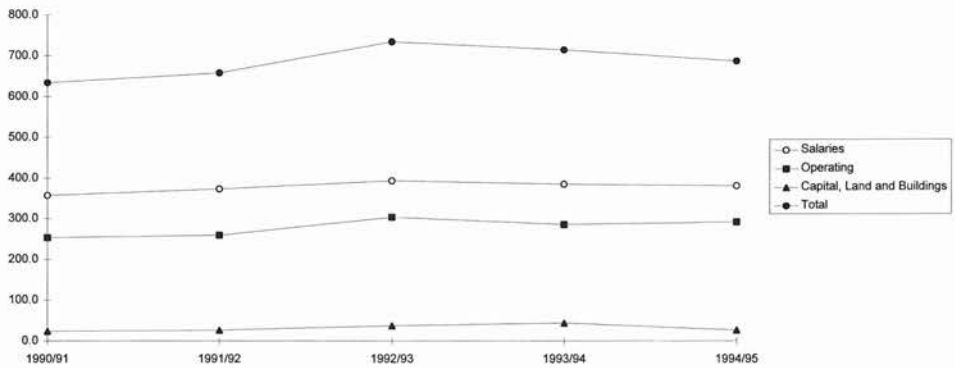
CSIRO also took advantage of triennium funding provisions to bring forward $20 million from 1995–96 to minimise disruptions in adjusting research directions between the two trienniums.

The Organisation's external revenue was $220.3 million, which represented 32.3 per cent of its total revenue. Expenditure of external earnings by source of funds is shown in the following table.

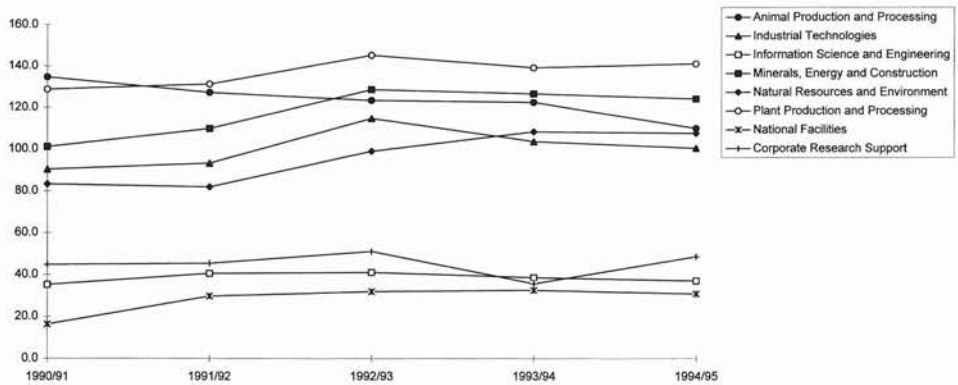
Expenditure of external earnings by source 1994–95

	$M	%
Rural Industry R&D Corporations/Councils	44.041	19.5
NERDCC/ERDC	1.154	0.5
Other competitive funding schemes	7.797	3.5
Commonwealth and State Governments	39.017	17.3
Cooperative Research Centres	28.808	12.8
Australian industry	61.660	27.4
Overseas bodies	8.925	3.9
Miscellaneous	10.542	4.7
Earned revenue	23.368	10.4
Total expenditure of external earnings	225.312	100

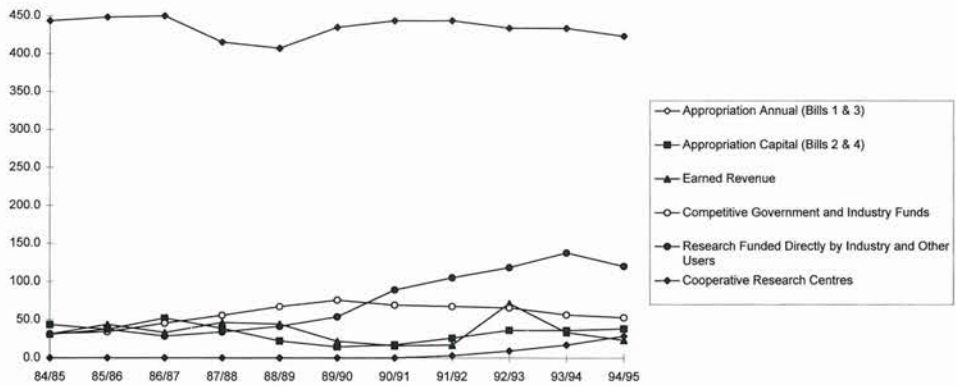
CSIRO expenditure by category—1994 dollars



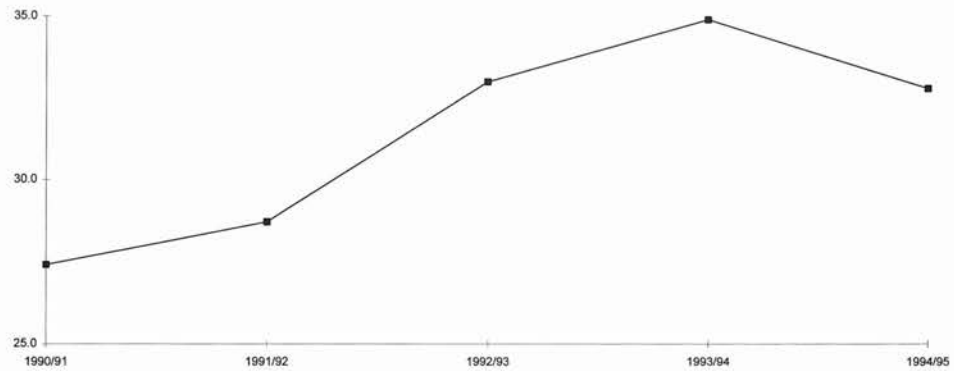
CSIRO expenditure by Institute—1994 dollars



CSIRO expenditure by source of funds—1994 dollars



CSIRO external-funded expenditure as a proportion of total expenditure—1994 dollars



Corporate development

Planning and evaluation

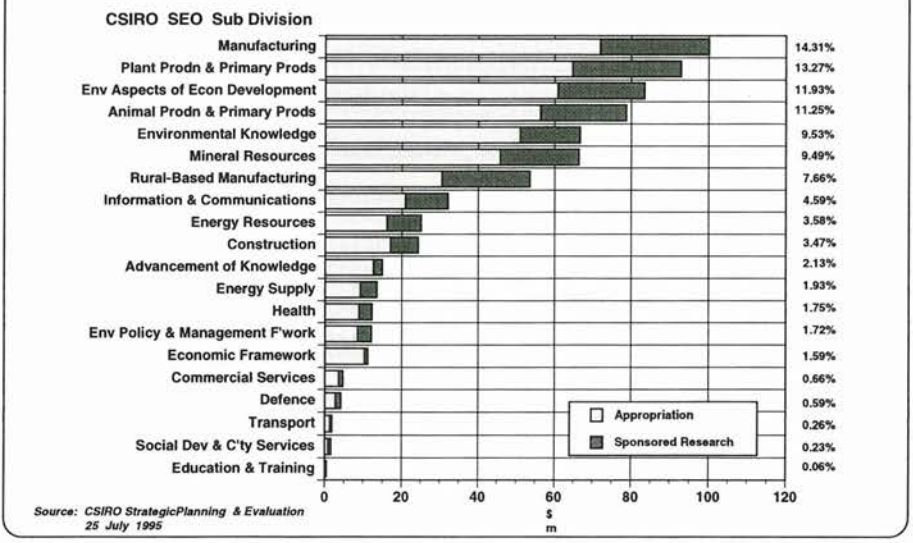
Goal: Further strengthen mechanisms for assessing research priorities, determining resource allocation and evaluation performance across the Organisation.

Research priorities, 1994–95 to 1996–97

In 1994–95, several new research programs commenced. These were established as part of CSIRO's research priority decisions for the 1994–95 to 1996–97 triennium. Priority research areas for the triennium are mineral resources, manufacturing, information and communications, environmental aspects of economic development and environmental knowledge. Additional funds provided to CSIRO by the Government in the 1994–95 Budget as part of Working Nation were allocated to programs in these priority areas and to priority rural research programs, including Mediterranean agriculture, aquaculture, processed foods and the Murray–Darling. Funds were also provided to CSIRO to facilitate an increase in its research for small-to-medium sized enterprises.

In late 1994 CSIRO released *Research Priorities and Strategies, 1994–95 to 1996–97*. This research plan documents the key outcomes from CSIRO's second triennial review of research priorities (conducted during 1993–94), including priority assessments and decisions and goals and strategies for each socio-economic objective sub-division (research purpose). Priority research areas and potential outcomes are identified for each purpose.

Distribution of research effort, 1994–95



Planning

In August 1994 a Strategic Planning and Evaluation Strategy for CSIRO was endorsed by the Executive Committee. The strategy was developed by a project control group comprising internal managers and Mr Alex Zadnik from CRA Exploration and Mining. Key elements of the strategy include the introduction of an annual business review to address performance and prospects in a strategic context, and revisions to aspects of the Organisation's processes for setting research priorities.

CSIRO's first annual business review is scheduled for September 1995 and will be an important part of the Organisation's preparations for its next Strategic Plan.

Good progress is being made towards achieving the aims of the CSIRO Strategic Plan, 1991–92 to 1995–96, according to a report presented to the CSIRO Board in August 1994. Satisfactory progress was reported for all 54 planned outcomes for 12 major research purposes.

Evaluation

The CSIRO Board decided early in the year that there should be an evaluation of the Organisation's management and structure. The Board feels that CSIRO should be delivering service and new knowledge to its customers, developing more flexibility to redirect resources quickly and effectively to tackle new problems and opportunities, and further improving the mechanisms to marshal the best talent from across the Organisation into focused multi-disciplinary teams to respond to national needs. A Board committee comprising Professor Clarke, Mr Hollway, Dr Frater, Dr Green (from March 1995), Dr Richards, Mr Shears, Dr Smyth (CPSU) and Dr Stocker (until March 1995) was established to undertake the evaluation.

Consideration was given to CSIRO's relationship with government and its service delivery to customers. Departmental responses to the Evaluation Committee indicated that arrangements for accountability to government were satisfactory. The committee proposed that a useful mechanism to enhance interaction with government could be an annual workshop linked to CSIRO's strategic and operational planning cycle. The committee also considered a variety of international and national arrangements for strengthening interactions with customers and put forward options for further examination.

In April 1995 the committee released a discussion paper. This canvassed possible changes to the roles of Institutes and Institute Directors, interaction between the Board and the Executive, the roles of Divisions and Chiefs, internal networking and communication, possible structural changes and ensuring the efficiency and effectiveness of support services. Responses were received from more than 80 individuals and groups inside and outside CSIRO. The discussion paper and a summary of the responses are to be provided to the next Chief Executive of CSIRO as a basis for recommendations to the Board on implementation.

Performance indicators

During 1994–95 a set of generic performance indicators was trialed in seven Divisions. The purpose of the trial was to evaluate the practicality and utility of the set of indicators, which were recommended by an in-house steering group. In May 1995, following an evaluation report, the Executive Committee agreed to extend the trial to all Divisions for the remainder of the current triennium. Indicators which will be on trial over the next two years include:

- external earnings for research and services consistent with CSIRO's mission
- contracts successfully completed as a proportion of total contracts completed
- shift of resources according to agreed priority decisions
- adoption by users of practices, instruments and processes developed by CSIRO
- level and quality of publications
- teaching.

In addition to further trials, it was recommended that suitable human resource indicators be developed and that in-kind contributions and repeat business be further investigated for possible adoption as generic indicators.

Performance indicators will be reported in future CSIRO Annual Reports, commencing with the 1995–96 report. The six performance indicators listed above are also included in CSIRO's Triennium Funding Agreement. This was agreed following discussions with the Department of Industry, Science and Technology, the Australian Nuclear Science and Technology Organisation (ANSTO), and the Australian Institute of Marine Science (AIMS). The discussions were aimed at developing a set of indicators common to the three science agencies.

Corporate development

Goal: Provide efficient and effective R&D support services across the Organisation.

Finance

The Unibis accounting package was restructured in the second half of the financial year. The package now runs with a centralised general ledger and a single fixed assets register. These changes were designed to facilitate a move to full accrual reporting and management.

Accrual accounting and reporting were successfully implemented throughout the Organisation before the target date of 1 July 1995. Accrual reporting to management was introduced in February 1995. Balance sheets, operating statements and cash flow statements at cost centre, Institute and corporate level are now available directly from the finance systems.

Work commenced on specifying a new project information and management system for managers at all levels by a working party established by the Executive Committee. The system will be designed to provide research management, accounting and human resources management information on individual projects, with aggregation of information at a corporate level also possible.

A new travel policy was developed and promulgated following a decision that the Organisation would move to expense-based travel arrangements. The new arrangements were implemented in selected Divisions from April 1995 on a 12-month trial basis.

Contracts have been arranged with Diners Club International for the provision of a travel charge card, and with Ansett Australia for the provision of travel agency services. The contracts give CSIRO considerable benefits, including Ansett travel offices on CSIRO sites at North Ryde and Clayton and a dedicated Ansett office in Canberra.

Risk assessment and audit

In early 1994 the Board commissioned a review of the internal audit function by KPMG Peat Marwick. Subsequent to the review, the role of internal audit was expanded to include a comprehensive risk evaluation process. As a result the Risk Assessment and Audit Unit was established.

The General Manager Risk Assessment and Audit reports directly to the Chief Executive and has responsibility for three broad functions: policy development for internal management control, risk assessment and audit activities. He is also required to attend the Board's Audit Committee meetings and report on progress relating to the strategic audit plan and risk assessment activities.

Risk assessment encompasses:

- identifying key risk areas that will, or have the potential to, prevent the Organisation achieving its goals and objectives
- providing advice to management on these risk areas and assisting with the implementation of appropriate control procedures
- providing advice to the Chief Executive and the Audit Committee on the effectiveness of CSIRO's risk assessment procedures and management control systems.

The main responsibilities for the internal audit function are:

- reviewing CSIRO processes, practices and procedures to ensure the adequacy and effectiveness of internal controls and the efficient use of resources
- reviewing and providing advice to management on the annual financial statements and the impact of significant changes in accounting policies
- reviewing the Organisation's compliance to internal policies and procedures and external requirements.

Additionally, the General Manager provides advice to the Chief Executive on CSIRO's statutory and legal responsibilities and areas of significant control weakness.

During 1994–95, risk assessments were completed for five Divisions within CSIRO. The risk assessment process provided the basis for the identification of key risks reviewed in detail as part of CSIRO's audit program. Fifteen Divisional and Departmental audits were completed during the year and specialist reviews of commercial practices (11 Divisions), information technology security (eight Divisions) and financial management (one Institute) were undertaken. Additionally, regular meetings were held with the Australian National Audit Office to ensure that synergies between internal and external audits were maximised.

The Unit is committed to providing added value to the Organisation by working with management to identify and manage key risks areas. This includes, in the longer term, working with management to build an internal control infrastructure supported by a self-assessment auditing process for low-risk areas.

Information technology services

CSIRO's Information Technology Steering Committee has continued to address policy issues in relation to corporate Information Technology (IT) services. A significant task has been the undertaking of an IT awareness program to install a common software toolkit on every networked PC and to provide training in these network facilities.

Other significant developments overseen by the steering committee have been the use of the World Wide Web as a point of access for all CSIRO information and activities; the encouragement of standard word processing and email software throughout CSIRO; a set of policy guidelines for email usage; the establishment of a user group to manage the evolution of the CSIRO wide-area network; and the continued development of a framework for effective IT management within CSIRO by allocating responsibilities, outlining effective IT planning and providing job descriptions for a variety of IT managers.

The project to transfer the corporate mainframe systems to the new UNIX corporate servers has been achieved on schedule and within budget.

The CSIRO telecommunications network remains the backbone of the IT program and provides the capacity for corporate IT products to be delivered in flexible and efficient ways. The TCP/IP network uses a combination of internal networking and AARNet to provide a cost-effective network infrastructure for CSIRO. Virtually all CSIRO sites are now connected to the network and access is possible for the majority of CSIRO researchers to email, corporate administrative systems, and information and resource discovery services.

The ITSB Helpdesk continues to support CSIRO staff in the corporate applications and network.

The Auditor-General's Report No.31 of 1993–94 reported unsatisfactory matters to the Parliament on Information Technology (IT) Security within CSIRO. Follow-up audits conducted by the Australian National Audit Office and CSIRO's Risk Assessment and Audit Unit in 1995 report a general improvement in the areas of logical security, backup control and disaster recovery planning.

An IT Security Officer has been appointed and an IT security awareness program has commenced. A plan is being developed with the Risk Assessment and Audit Unit to rollout IT risk assessments across CSIRO over the 1995–96 fiscal year.

A high-level task force has been established to develop an integrated security policy encompassing all aspects of security, including physical, personnel and IT security.

Under the PABX replacement program, six fourth-generation PABXs were installed for the integration of voice and data and access to high-quality digital services (ISDN).

The focus for the Financial Systems and the Human Resource Systems has been on maintenance and incremental enhancements. The Executive Information System (EIS) was moved to a UNIX server and major enhancements were made to the Finance and Reuters components. In addition, the use of EIS is growing as managers come to appreciate the rapid and easy access to summary financial and resource data.

Ferntree was the successful tenderer with the Voyager library system and the Structured Information Manager product (SIM). SIM is a powerful and sophisticated information retrieval tool which has been implemented throughout CSIRO as a part of the Universal Access IT Awareness Training program. Data sets that have been implemented are Index of Publications by CSIRO authors, OHS safety data sheets, the SCANfile bibliographic database of science policy and management articles, and Current Contents. Other data sets including Corporate Manuals will become available via SIM.

Property

Project administration

Continued emphasis on effective property management has resulted in a number of major initiatives and a focus on specific issues. These activities should achieve further efficiencies in the overall management of CSIRO's diverse and complex property portfolio. A comprehensive Property Management Plan, designed to guide CSIRO's property management until the year 2000, was approved by the Board in December 1994.

Following the CSIRO Board's approval in June 1994 of a revised Capital Investment Plan for the 1994–97 and 1997–2000 triennium projects, a plan of $240 million (48 items), broken into four phases, has been developed (with phases I, II and part of III funded). Current work on these is running within budget and on time.

Major works completed during the year included:

- construction of the McMaster Laboratory at Prospect, NSW
- replacement of facilities at the Division of Radiophysics at Epping, NSW
- replacement of the Division of Information Technology building at the ANU campus, ACT
- redevelopment of obsolete facilities at the Division of Building, Construction and Engineering at Highett, Victoria
- introduction of Fire Technology facilities at the Division of Building, Construction and Engineering at North Ryde, NSW
- redevelopment of existing accommodation at the Division of Minerals at Clayton, Victoria

- extension of the Herbarium for the Division of Plant Industry at Black Mountain, ACT
- upgrading of laboratories and amenities at the Division of Horticulture at Merbein, SA
- development of a child care centre at Urrbrae, SA.

Major works presently in progress include those at:

- the Division of Biomolecular Engineering at Parkville, Victoria
- the Division of Manufacturing Technology at Woodville, SA
- the Division of Entomology at Black Mountain, ACT
- the Division of Horticulture at Urrbrae, SA
- the Division of Tropical Crops and Pastures at Townsville, Qld
- the Division of Fisheries, Marmion, WA.

Riverside Corporate Park

Infrastructure and development work continues at Riverside Corporate Park, NSW. A marketing program will be introduced in July 1995. Sales of three lots are on line for late 1995.

Aerial view of Riverside Corporate Park, NSW

Property acquisition/disposal

During 1994–95 four properties were disposed of and there were no major acquisitions.

Internal Leasing Scheme

As from July 1994 the Internal Leasing Scheme covering CSIRO's real property assets was implemented on a real cost basis.

The scheme has three main objectives:

- to identify to users the real cost of providing research accommodation
- to provide incentive to users to rationalise their accommodation, thereby saving rental
- to provide an internal mechanism for funding all capital and repairs and maintenance programs.

Security

A comprehensive security policy embracing all facets of security is being developed and will be implemented late in 1995.

Human resources development

Goal: Maximise CSIRO's capacity to attract and retain a high quality workforce in order to produce the best possible research and development for Australia.

Review of CSIRO's human resources function

In September 1994 a review team finalised its report on the human resources (HR) function in CSIRO. In formulating their recommendations, the members of the team consulted widely, including with private sector organisations.

While acknowledging positive feedback about past performance, the report found that CSIRO needs to:

- ensure HR at all levels closely serves CSIRO's varying business needs
- increase ownership by line managers of their HR responsibilities
- clarify and adjust accountabilities for HR-related matters
- build HR skills in business units
- concentrate at corporate level on strategies and policies, collaboratively developed
- develop flexible policies which add value.

In order to address these matters the report made a number of recommendations, including a new structure which separates strategic and service functions at the corporate level and strengthens HR expertise in the business units. It also identifies a number of strategies to support those recommendations.

A new strategy group is to provide strategic advice and policy development across all HR areas in close collaboration with business unit HR staff. The functions of the services group include payroll, coordination of occupational health and safety, documentation support and HR information systems.

Given the uncertainty created by the review, activities this year have tended to focus on shorter term objectives.

Classification and performance management

Performance appraisal

CSIRO's Performance Appraisal system (PPE) has again been cited as an example of national best practice and information has been sought by other organisations about the program. A team-based PPE system is being developed by one of CSIRO's Divisions.

Competencies

In an effort to enhance the competency framework which underpins the PPE process, a competency development project has collected descriptions of 66 roles in 23 job families and surveyed these descriptions across 10 per cent of staff and their managers. It provides an excellent database about roles in CSIRO. A Performance and Development Framework has been prepared and is currently being checked for alignment with the National Training Board competencies before work teams begin to develop the links to PPE, selection, training and development, career management and promotion.

Employment relations

Consultative Council

The Consultative Council is the central forum for consultation between management and staff (unions) of CSIRO. Under Section 56 (2) of the Science and Industry Research Act, Council has a duty to consider, report on, and where appropriate, make recommendations to the Board on matters affecting, or of general interest to, the officers of the Organisation. Council met three times during the year.

Issues which have been considered by Council in the past year include the CSIRO EEO Program, progress with the implementation of the Aboriginal and Torres Strait Islander Strategy, the competency review, implementation of the new travel arrangements in the Organisation, evaluation of the use of industrial participation in CSIRO Divisions and transfer of responsibility for child care facilities to sites at which they are located.

Redeployment and redundancy

The table below shows the trend over the past three years. In 1993–94 there were 206 redundancies, with almost half resulting from a fall in industry-sourced research funds affecting the Divisions of Wool Technology and of Animal Production. In 1994–95 the reduction in funds for rural research, in part the result of lowered production levels as a consequence of the drought, continued to affect CSIRO Divisions undertaking rural research. In addition, all Divisions are continually assessing the mix of skills required and are reorganising and rationalising infrastructure and priorities to reduce overhead and research support costs.

The number of compulsory retrenchments is minimised by applying workforce planning principles and using skills analysis, substitution, staff retraining and redeployment.

CSIRO works closely with the unions to ensure that all redeployment and retraining opportunities have been exhausted prior to final redundancy decisions being made.

Retrenchments

1992–93	1993–94	1994–95
112	206	220

Enterprise bargaining

A CSIRO Productivity Agreement was certified in February 1995.

The agreement provided for salary increases of 3 per cent funded by productivity gains. These resulted from a range of reforms to work and management practices primarily aimed at removing prescriptive allowances and substituting a culture of reimbursement of reasonable expenses; developing a performance management culture; establishing a culture of flexible work practices consistent with management requirements; and building an environment of cooperation with unions which will assist CSIRO to achieve the major changes required.

Equal Employment Opportunity

Corporate EEO policy is encompassed in the EEO Program, which recognises the need to develop and implement policies and practices that promote equitable staff management in CSIRO, and to implement strategies to increase the representation of under-represented groups in CSIRO. A new EEO Program for the 1995–98 period was developed and endorsed to strengthen the accountabilities for line managers in achieving organisational EEO objectives. It obligates business units to include EEO objectives in their strategic planning documents, and line managers will have EEO objectives and performance indicators included in their performance contracts.

The day-to-day responsibility for EEO rests with each line manager and supervisor. They are advised of their specific

responsibilities through the EEO Program and the CSIRO Code of Conduct, which includes EEO responsibilities for all staff. The EEO Unit within the Corporate Services department provides specialist advice to managers and staff. It is responsible for policy development of a specific EEO nature and also has input into the development of human resources policy to ensure it is underpinned by equity principles. The Unit supports an EEO network of contact officers and human resource managers throughout CSIRO. The Senior Executive responsible for EEO is the Director Corporate Services.

Some of the specific initiatives introduced over the past year are listed below.

Flexible work practices primarily aimed at helping staff to balance their work and family responsibilities in the Enterprise Productivity Agreement have been introduced. These include home-based work, personal leave to enable staff to care for sick dependants or attend cultural and religious ceremonies, and enhanced use of flextime and the introduction of a 40/52 scheme that enables staff to take up to 12 weeks per year without pay and to average their pay and entitlements over the whole year.

Child care initiatives are continuing, with the opening of CSIRO's fourth work-based child care centre at the Urrbrae site in Adelaide (a joint venture with the University of Adelaide and the South Australian Government through the SA Research and Development Institute), and the introduction of a pilot emergency dependent care project in the Division of Animal Production in Brisbane.

The Unit has published *What is Fair? What is Not?—A Hitchhiker's Guide to Legislation Underpinning Human Resource Management Practices* which provides information on the legislative responsibilities of management and staff, avenues of complaint, and case study examples.

The Unit has had input into human resource policy development, specifically from the outcomes of the Review of EEO Policies and Structures.

Implementation of CSIRO's Aboriginal and Torres Strait Islander Recruitment and Career Development Strategy is continuing with the development of a booklet series of guidelines for human resource and line managers for recruitment options under the strategy. Several Divisions have initiated recruitment action, including:

- the Divisions of Animal Production and Fisheries, which have selected five cadets who commenced at universities in January 1995
- the Division of Soils, Townsville, the Division of Animal Production, Armidale, and the Division of Radiophysics, Sydney, all of which have recruited staff under the Technical Training Program
- the Division of Wildlife and Ecology, Helena Valley, Western Australia, which has also recruited an officer under the Technical Program
- the Division of Tropical Animal Production, Brisbane, which was the first Division to recruit staff under the Administrative Program.

Under the strategy, career development programs are available for existing Aboriginal and Torres Strait Islander staff seeking to enhance their career prospects. An officer from the Division of Soils, Townsville, has used this option in seeking to gain a Master of Business Administration degree.

A promotional package of video, poster and brochure titled *Getting Somewhere* was developed to encourage Aboriginal and Torres Strait Islander students to consider science as a career. The package has been distributed widely through the school system and the Commonwealth Employment Service.

There has been an increase in the number of Aboriginal and Torres Strait Islander staff from eight last year to twenty-three at June 1995.

Scholarship programs for students with disabilities and Aboriginal and Torres Strait Islander students provide sponsorship for students in years 11 and 12 and employment options on the successful completion of year 12.

EEO data collection has been upgraded through the Human Resources Information System to ensure that CSIRO can fulfil its statistical reporting requirements on staff with disabilities and staff from non-English speaking backgrounds from the 1995–96 financial year.

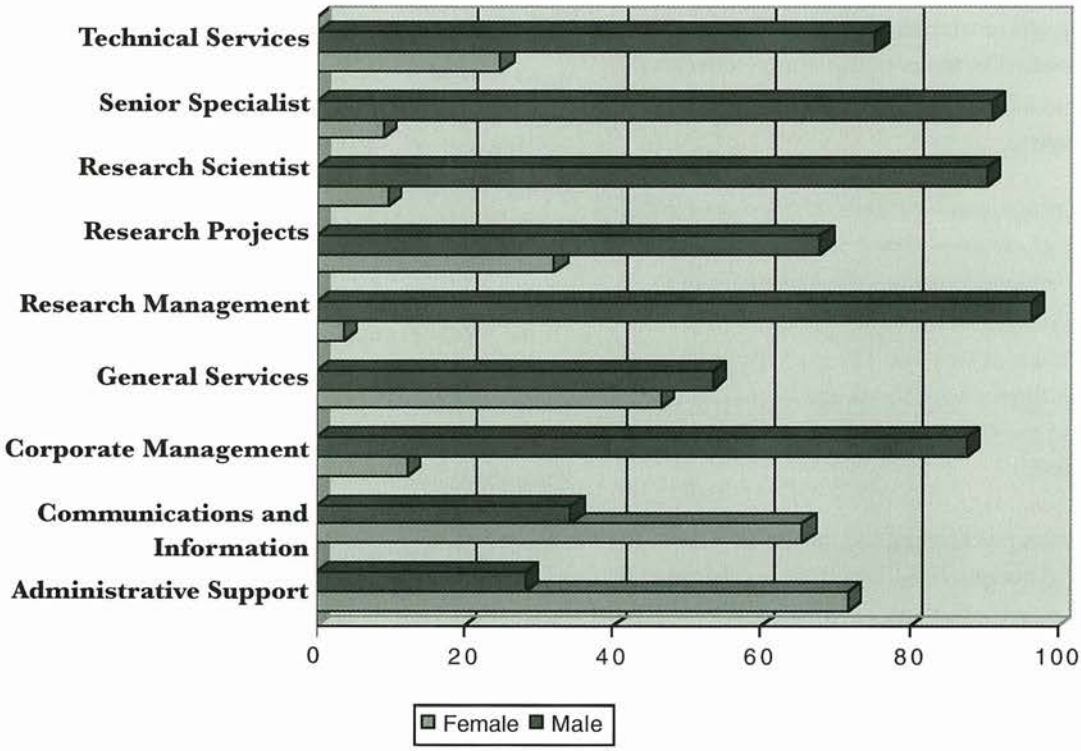
CSIRO's staffing profile

The steady increase in the representation of female staff has continued from 27.0 per cent in 1986 to 33.4 per cent in 1994 and 34.7 per cent in June 1995. While this upward trend is continuing and the gender balance in the technical support area is evening out, there has been no significant change in the ratio of female to male research scientists (9 per cent female) or scientific project staff (23 per cent female). A primary objective of the new EEO Program for the 1995–98 period is to achieve significant increases in the representation of women in both of these groups.

Preliminary information from the recently updated EEO statistics indicates that 7.9 per cent of staff have a disability, and that people from non-English speaking backgrounds represent approximately 12 per cent of our staff.

The Aboriginal and Torres Strait Islander Recruitment and Career Development Strategy has had a positive impact on the staffing profile. There has been an increase in Aboriginal and Torres Strait Islander staff from 0.11 per cent in June 1994 to 0.29 per cent in June 1995.

Percentage of staff by gender and principal functional area: 30 June '95



	Female	Male
Administrative Support	71.81	28.19
Communications & Information	65.58	34.42
Corporate Management	12.31	87.69
General Services	46.54	53.46
Research Management	3.79	96.21
Research Projects	32.05	67.95
Research Scientist	9.72	90.28
Senior Specialist	9.09	90.91
Technical Services	24.76	75.24

Human resource development programs

The Leadership Development Program is CSIRO's premier executive development program. It is an individually tailored two-year program, focused on the 'high fliers' within CSIRO who are considered to have potential to be future leaders in CSIRO. Unlike other CSIRO management development programs, selections are made by the Executive Committee. During 1994–95, 40 senior managers participated in the Leadership Development Program.

The Research Management Program has been restructured into two five-day modules, separated by a five-month period. During this period, each participant undertakes an action learning project negotiated with his or her manager. There were 40 participants in this program during 1994–95.

A pilot Middle Management Development Program was delivered in 1994–95, targeting non-scientist research administrators. The program was offered on a modular basis, with the first module in September 1994 and the second module in February 1995. The program had 19 participants. Between the two modules, each participant undertook an action learning project negotiated with his or her manager.

Eighty research staff completed CSIRO's Project Leaders Course during the year. The course is aimed at researchers who have taken on a project leader role and those who may soon be required to do so.

Major organisational initiatives during 1994 included facilitation with Chiefs, commercialisation workshops, advice on process for communication of outcomes of Board review, facilitation of change workshops with the Institutes of Minerals, Energy and Construction and of Information Science and Engineering, strategic planning, change management and team building workshops. In addition, consultancies were undertaken for the Australian and New Zealand Association for the Advancement of Science and for the Office of the Commissioner for the Environment's *State of the Environment Report.*

A subscription to the Global Business Network has been arranged to provide access to current management concepts and potential opportunities for challenging secondments for Chiefs and Corporate Managers with major global organisations.

Occupational health and safety

As a result of the introduction of National Uniformity Standards for occupational health and safety across all Australian jurisdictions, Comcare has begun to adopt a large number of prescriptive regulations covering a wide range of occupational health and safety issues. These are mandatory in CSIRO and require commitment and resources at all levels of the Organisation if they are to be met in an effective way.

During the last year CSIRO's occupational health and safety network continued to deliver consistently professional, timely and cost-effective health and safety advice, resources and services to all levels of the Organisation. A CSIRO Claims Managers' Resource Kit was developed and distributed to assist the administration of rehabilitation and compensation throughout the Organisation. As part of a long-term strategy, a comprehensive range of occupational health and safety resources have been mounted on World Wide Web to enhance their accessibility to those at the work bench.

Whilst claim frequency has remained similar to last year, the average claim cost was reduced from $6823 to $3512 in 1994–95. CSIRO's premium rate and average claim cost remain around 50 per cent of the Commonwealth average. In spite of this performance, the premium is set to rise in line with increases across the Commonwealth. This will result in an increase from 0.84 per cent of salary dollar to 0.95 per cent. In absolute dollar terms, this will represent an increase from $1.95 million in 1994–95 to $3.26 million in 1995–96.

Communication

Goal: Increase recognition by government, industry and the general public of CSIRO's contribution to the nation.

Improve Australia's ability to interpret and disseminate scientific and technical knowledge for the economic benefit of our industries.

Major communication activities

Public events such as the Sydney Royal Easter Show provided CSIRO with an opportunity to display its latest interactive travelling exhibition on food, called eatSmart. Launched in October 1994, it began its national tour in Melbourne, helping consumers understand more about healthy and safe eating. An evaluation study of the exhibition showed that a significant number of visitors claimed they intend to change the way they purchase and prepare food, and had been inspired to seek further information regarding nutrition and diet. eatSmart continued its tour around the country, visiting Westfield shopping centres in Canberra, Melbourne and Brisbane. Other venues included the Investigator Centre, Adelaide, and Scitech Discovery Centre, Perth.

Other public events included an open day at the Kapalga Research Station in the Northern Territory's Kakadu National Park in April 1995. The open day commemorated the research station's achievements since it was established in 1976. CSIRO established Kapalga to conduct long-term landscape-scale experiments as a basis for managing the unique region. After two decades of ecological research, the station ceased its operation in May. The event was launched by Federal Minister for Primary Industries and Energy, Senator Bob Collins, a former CSIRO research officer and one of the first to work at Kapalga in the 1970s.

The Organisation continued to maintain its strong presence at agricultural shows in capital cities and at a

eatSmart on display

number of major rural centres, including Toowoomba, Queensland, and, for the first time, Henty, New South Wales.

CSIRO participated in the third Australian Science Festival in Canberra where the general public were able to discover hands-on science at the 'The Amazing World of Science' exhibition. The Institute of Industrial Technologies provided a display on its research for the aerospace industry and the Double Helix Science Club had a hands-on display for children. Other festival activities included several popular CD-ROMs on insects and rainforests which were featured at a display in the Botanic Gardens. CSIRO's Parkes telescope had a public lecture on the search for extra-terrestrial life.

In September 1994 CSIRO scientists were invited to present personal papers on their vision for the year 2020 at the 1994 Congress of the Australian and New Zealand Association for the Advancement of Science (ANZAAS). The papers presented scenarios about how science and technology, creatively applied, could contribute to a preferred vision for Australia.

CSIRO heightened its profile during October 1994 with Manufacturing Month—an initiative aimed at alerting the public and the business community to what the Organisation is doing, and can do, for the manufacturing industry. This is the third Manufacturing Month to be held, and this year there was a stronger corporate focus with 16 Divisions involved in preparations for the various seminars, workshops, functions, displays and tours.

As a follow-up to the Scientific Co-operation Agreement signed between Italy and Australia in December 1993, CSIRO assisted the Italian Embassy with an extensive series of science and technology seminars around Australia. CSIRO hosted a number of these seminars at various sites, the first at the Division of Radiophysics focusing on telecommunications. This seminar was held to coincide with the 100th anniversary celebrations of Italy's Guglielmo Marconi, who invented the radio. Opportunities such as participating in a variety of mobile communications projects and postgraduate student exchange programs are being explored as a result.

A touch-screen computer program designed to bring Australians to grips with the marine environment proved popular in a marine information centre at Bunbury, Western Australia. Called 'Ecotrekker IV', the program was developed by the CSIRO Division of Fisheries and CSIRO Information Services group. The program highlights the need for quality information in good decision-making for the marine environment.

Last year the first edition of the magazine *Research Results* offered a prize of $25 000 for the company that submitted the best proposal for CSIRO to develop links with industry and the business community. The response was so overwhelming that two winners were selected: AGEN Biomedical Co. and Radio Frequency Systems. CSIRO is exploring collaborative and commercial work with several other entrants. CSIRO continued to publish the magazines, *Ecos* (on science and the environment) and *Rural Research.*

CSIRO continued to be widely covered in the print and electronic media. The in-

house media and presentations skills courses for scientists and managers continued to be very popular, with 300 people in CSIRO benefiting from the courses.

Major media events included the outbreak of food poisoning in fermented meats. Corporate Public Affairs assisted the Division of Food Science and Technology in giving the public accurate and timely information on food safety and fermented meat products. A 0055 information line was established, which received hundreds of calls. CSIRO also briefed the ABC's *Four Corners* program on the scientific matters associated with the food safety.

Corporate Public Affairs also assisted the Australian Animal Health Laboratory communicate the outcomes of the search for the virus that killed Mr Vic Rail and 14 of his horses. There was an extraordinary international interest in this event.

Public information services

The CSIRO Information Network handled about 35 000 enquiries from its six regional offices.

Some of the key outcomes for the year are listed below.

- Eleven popular student project topic packs were developed and sold. The topic packs were developed for year 11 and 12 students across Australia. They were designed to communicate useful information on a range of commonly requested topics such as biotechnology, pollution and food safety. The packs include articles, topic overviews, reading lists and revision questions and provide a complete resource delivered in a short time to meet students' deadlines. More than 1400 packs have been sold to date.
- A 0055 hot-line service was set up for immediate response to enquiries from the general public, especially on hot issues such as the *E.coli* food poisoning scare and the mystery horse virus.
- An enhanced computer-based enquiry recording and tracking system with associated contacts database was developed, and software was sold to industry. This unique software assists in the recording, management and reporting of the hundreds of enquiries handled each day by the CSIRO Information Network. The contacts database enhancement will allow consistent, accurate and prompt referrals for enquirers.

Scientific information services

CSIRO delivers scientific and technical information to clients within CSIRO, to customers in the academic and research sectors worldwide, and to the business, education and general public markets in Australia.

Key outcomes for 1994–95 were:

- $4 million revenue from sales of scientific journals, books, and CD-ROMs
- collaboration with CSIRO Information Technology Services staff, librarians and user groups to implement the SIM information search system
- development of records management guidelines for use throughout CSIRO
- development of service level agreements for the centralised services provided to the CSIRO library network
- feasibility assessment for separating the externally focused publishing activities from the CSIRO-focused library and information management services to form two separate business units.

CSIRO clients

Information professionals and scientists throughout CSIRO now have direct access to core scientific databases following the implementation of SIM, the Structured Information Management system. Information Services staff coordinated the purchase of the Current Contents database and collaborated with Information Technology Services staff and librarians on the design, testing, training and user-support services. Materials safety data sheets, the CSIRO Index of Publications, and other important databases have also been installed on SIM. Uptake and usage of SIM has been strong.

Guidelines for records management were developed to support CSIRO's information management practices, especially focusing on management of records of intellectual property and commercial negotiations.

The CSIRO Library Network was supported by quality control of the combined CSIRO library catalogue and centralised purchase of over 11 400 journal subscriptions valued in excess of $6.5 million.

External clients

About 40 per cent of total funding for the Information Services group came from sales to external customers, including export earnings of almost $2 million. This represents a significant export of value-added scientific products and places CSIRO as Australia's premier publisher of Australian scientific research. Sales of the Australian Journals of Scientific Research generated most of the export earnings. 80 per cent of subscribers are from outside Australia.

The monographs team commenced publication of titles originating from the Australian Biological Resources Survey, including new titles in the Flora of Australia and the Zoological Catalogue of Australia series. Other new books included *Genes at Work*, which won a major design award, and *Challenge to Change: Australia in 2020*, which presented the collected vision for the future of Australia's leading scientists.

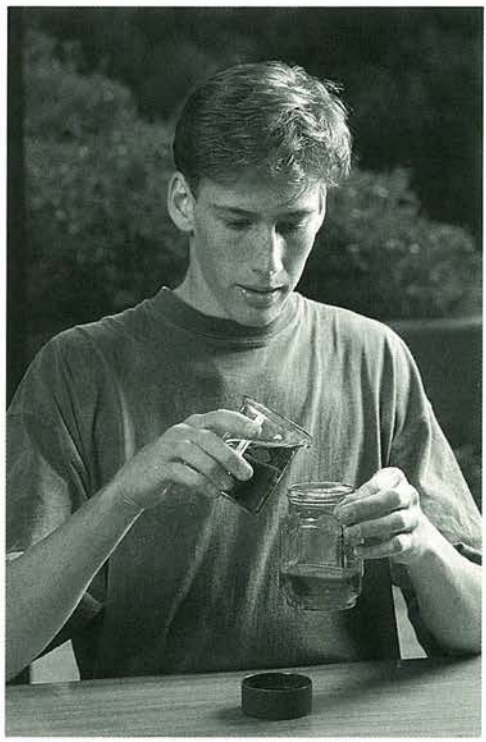
Information Services also secured the contract to publish the *State of the Environment Report* in 1996 on behalf of the Department of the Environment, Sport and Territories. Publishing and database production services for the Standing Committee on Agriculture and Resource Management were continued.

Sales of CD-ROM products doubled to more than $0.25 million. Major contributors were SAGE (the index to Australia's most popular science and geography magazines), Ag.Round, (databases on Australia's agricultural research), and the multimedia CD-ROMs, Insects—A World of Diversity and eatSmart.

Education programs

A new project, CREST, was started in 1995. CREST stands for Creativity in Science and Technology. Initial funding was received from the Department of Employment, Education and Training to develop this project which provides support for teachers to include research projects in the science and technology curriculum. Trials of the project are currently under way and further support is being sought to enable the project to operate nationally.

CSIRO's Double Helix Science Club grew to 24 000 members, with the club's magazine, *The Helix*, gaining an audited circulation of 27 300. The 1995 national experiment for members involved the collection and identification of dung beetles to assist research scientists to compile an up-to-date distribution of dung beetle species across Australia. Over 1700 members of the club took part. The second stage of the experiment will involve the release of dung beetles into areas which do



CREST projects allow students to experience research with applied outcomes at school.

not currently have high populations and where the climate has been shown to suit their particular species.

BHP continued its sponsorship of the club. The merchandise operation for the club has grown to create an annual operating budget of $100 000 and now offers members a comprehensive range of goods through the Double Helix Catalogue which is circulated with *The Helix* magazine.

The national network of nine CSIRO Science Education Centres (CSIROSECs) expanded its operation by offering the CSIRO Science and Technology Show to many more schools in Victoria and New South Wales. This almost doubled the number of students contacted to over 100 000. The school students and teachers who visit CSIROSECs experience interactive experiments and demonstrations which show the contribution of scientific research, especially CSIRO research, to our community.

The CSIROSECs travelled to regional centres in each State with continued support from the Science and Technology Awareness Program of the Department of Industry, Science and Technology. Funding was also received during 1995 from the Visions of Australia program, which is operated through the Department of Communications and the Arts. This funding allowed CSIROSECs to travel interstate to offer their interactive travelling programs to towns in close proximity across the border.

The Townsville Centre staged the North Queensland Science and Engineering Fair in Mt Isa with 2426 people, 10 per cent of the town's population, visiting during its three days.

The CSIRO Student Research Scheme placed 445 senior secondary students under the supervision of practising scientists. The scheme was again assisted by the Institution of Engineers, Australia, and the Science and Technology Awareness Program of the Department of Industry, Science and Technology.

The BHP Science Awards, jointly run by CSIRO and BHP, continued to operate successfully. The student competition, in which students undertake an independent research project, gained over 1100 entries. The teacher awards attracted 59 high-quality entries.

Contribution to public policy

CSIRO provides information to the Minister for Industry, Science and Technology on matters related to his portfolio, and to the relevant Department. In May 1995 the Organisation made a submission to the Minister on the Government's proposed Innovation Statement.

CSIRO's respected position in the community and expertise in science and technology frequently require it to contribute to Government consideration and public debate on a wide range of issues. Similarly, given its size and multi-disciplinary nature, the Organisation attracts considerable public scrutiny of its direction and mode of operation. Consequently, CSIRO participates in or responds to a large number of Commonwealth and State Government and Parliamentary inquiries and reviews, and its officers are members of national councils, authorities and standing committees, such as the Prime Minister's Science and Engineering Council, the Coordination Committee on Science and Technology, the Australian Science and Technology Council, and the Standing Committee on Agriculture and Resource Management.

CSIRO chaired the Steering Committee of Commonwealth, State, R&D Corporation, university and National Farmers' Federation representatives which drafted a National Agricultural Research Strategy for Australia. This was noted by Ministers at the Agriculture and Resource Management Council of Australia and New Zealand in February 1995 and was to be the subject of an Roundtable sponsored by the National Farmers' Federation in August 1995.

During the year CSIRO submissions were made to a broad range of inquiries, including:

- Senate and House of Representative Standing and Joint Committee inquiries into the Funding and Resourcing of CSIRO's Rural Research, Review of Landcare Policies and Programs in Australia, Devolution of Running Costs Flexibilities, Financial Management and Audit Legislation, Dangers of Radioactive Waste, and Australia's Export of Services to Indonesia and Hong Kong
- Industry Commission inquiries into Research and Development in Australia, Competitive Tendering and Contracting by Public Sector Agencies, New Industrial Materials, and the Winegrape and Wine Industry
- Evaluation of the Cooperative Research Centres Program
- Department of Industry, Science and Technology drafting of a Wood and Paper Industries Strategy, and an Inquiry into Australia's Standards and Conformance Infrastructure
- National Food Authority study of Functional Foods
- Australian Coal Industry Council study of Black Coal
- Western Australian Taskforce on Research and Development in the Building Industry.

Appendixes

1. 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 vi–ix, 1–2 and 59–91);
- 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 on 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 114–144);
- the Auditor-General's report on these statements (see page 111).

The Minister made no determinations, gave no directions or guidelines, and notified no policies under the *Act* during the year.

The Government issued general guidelines for reporting by statutory authorities in 1982 and CSIRO's compliance with these requirements is listed in Appendix 2.

2. Index of compliance with reporting guidelines for statutory authorities issued in 1982

Enabling legislation: page 3

Responsible Minister: page 3

Powers, functions and objects: pages 3 and 94–95

Membership and staff: pages 4–12

Financial statements: pages 114–144

Activities and reports: pages 13–91

Operational problems: pages 69–91

Subsidiaries: pages 60 and 128–129

3. Functions and powers of CSIRO

Functions of the Organisation

1. The functions of the Organisation are

(a) to carry out scientific research for any of the following purposes:

(i) assisting Australian industry;

(ii) furthering the interests of the Australian community;

(iii) contributing to the achievement of Australian national objectives or the performance of the national and international responsibilities of the Commonwealth;

(iv) any other purpose determined by the Minister;

(b) to encourage or facilitate the application or utilisation of the results of such research;

(ba) to encourage or facilitate the application or utilisation of the results of any other scientific research;

(bb) to carry out services, and make available facilities, in relation to science;

(c) to act as a means of liaison between Australia and other countries in matters connected with scientific research;

(d) to train, and to assist in the training of, research workers in the field of science and to co-operate with tertiary-education institutions in relation to education in that field;

(e) to establish and award fellowships and studentships for research, and to make grants in aid of research, for a purpose referred to in paragraph (a);

(f) to recognise associations of persons engaged in industry for the purpose of carrying out industrial scientific research and to co-operate with, and make grants to, such associations;

(g) to establish, develop and maintain standards of measurement of physical quantities, and in relation to those standards

(i) to promote their use;

(ii) to promote, and participate in, the development of calibration with respect to them; and

(iii) to take any other action with respect to them that the Chief Executive determines;

(h) to collect, interpret and disseminate information relating to scientific and technical matters; and

(j) to publish scientific and technical reports, periodicals and papers.

2. The Organisation shall

(a) treat the functions referred to in paragraphs (1) (a) and (b) as its primary functions; and

(b) treat the other functions referred to in sub-section (1) as its secondary functions.

Powers of the Organisation

1. The Organisation has power to do all things necessary or convenient to be done for or in connection with the performance of its functions and, in particular, may

(a) arrange for scientific research or other work to be undertaken, on behalf of the Organisation, by any person or body;

(b) join in the formation of a partnership or company;

(c) make available to a person, on such conditions and on payment of such fees or royalties, or otherwise, as the Chief Executive determines, a discovery, invention or improvement the property of the Organisation;

(d) pay to officers, or to persons undertaking work on behalf of the Organisation, such bonuses as the Chief Executive, with the approval of the Minister, determines in respect of discoveries or inventions made by them; and

(e) charge such fees, and agree to such conditions, as the Chief Executive determines for research and other services carried out or facilities made available by the Organisation at the request of any person.

2. The Organisation shall not, without the written approval of the Minister, hold a controlling interest in a company.

3. An approval under sub-section (2)

(a) may be of general application or may relate to a particular company or proposed company; and

(b) may be given subject to conditions or restrictions set out in the instrument of approval.

4. Where the Organisation commences to hold a controlling interest in a company, the Minister shall

(a) cause to be prepared a statement setting out particulars of, and the reasons for, the holding of that controlling interest; and

(b) cause a copy of the statement to be laid before each House of the Parliament within 15 sitting days of that House after—

(i) the Organisation commenced to hold that controlling interest; or

(ii) if the Minister is of the opinion that the disclosure of the holding of the controlling interest would affect adversely the commercial interests of the Organisation, the Minister ceases to be of that opinion.

5. Nothing is invalid on the ground that the Organisation has failed to comply with sub-section (2).

6. Where the Organisation holds a controlling interest in a company, the Organisation shall ensure that the company does not do any act or thing that, if done by the Organisation, would not be within the functions of the Organisation.

4. Mission and goals 1994–95

Mission

To serve Australia by being the world's most effective multi-disciplinary research organisation.

Principles

Our business

We serve Australia through research and technological development which delivers economic, environmental and social benefits.

We serve the public interest by maintaining a research effort in areas of national importance.

We contribute our expertise to the development of policy and science and technology priorities for Australia.

Effectiveness

We communicate effectively with our customers to understand and serve their needs.

We maintain a world standard of scientific and engineering excellence in order to deliver agreed outcomes to our customers in industry, government and the community on time and within budget.

We commit to excellence in technology transfer to ensure timely exploitation of our research results.

Skills

We draw upon the breadth and depth of our skills to assemble excellent teams to tackle the major challenges. We use networks of special skills inside and outside CSIRO.

Our people

CSIRO recruits the best and the brightest. We provide a stimulating environment to encourage individuals to develop their full potential. We provide career opportunities which make CSIRO an attractive development base for future industry leaders.

We foster adaptability in our staff. We recognise exceptional performance with appropriate rewards.

We care for the safety and well-being of our people. Our employment policies support our corporate goals.

Ethics

CSIRO's activities and those of our staff conform to the highest ethical standards.

Creativity

We foster creativity which underpins our performance and delivery.

Management practice

CSIRO determines priorities and implementation strategies at all levels of the Organisation by a systematic process. We apply the highest standards of management practice in all our operations. We pay particular attention to excellence in project management. We foster a culture of teamwork.

International outlook

Our international perspective and experience contributes to the success of Australian companies and supports Australia's national interests.

The quality of our scientific research enhances Australia's standing.

Learning organisation

We use lessons from our own and others' practices and experiences to improve our performance continually.

Education and training

CSIRO works with Australia's education and training organisations to increase awareness of science and technology and to enhance the supply of excellent graduates into the scientific and technical workforce.

Performance evaluation

CSIRO evaluates all of its activities, working towards the world's best practice in quality and productivity.

Corporate goals

Research

- Improve the competitiveness of Australia's primary and manufacturing industries.
- Develop ecologically sound management principles and practices for the use and conservation of Australia's natural resources.
- Achieve sustainable development in production systems and develop technologies to protect the environment.
- Improve the competitiveness of the information and communications industries.
- Enhance productivity and effectiveness in provision of infrastructure and services.

Research support

- Further strengthen mechanisms for determining and assessing research priorities and resources allocation across the Organisation.
- Provide efficient and effective R&D support services across the Organisation.
- Maximise CSIRO's capacity to attract and retain a high-quality workforce in order to produce the best possible research and development for Australia.
- Increase recognition by government, industry and the general public of CSIRO's contribution to the nation.
- Improve Australia's ability to interpret and disseminate scientific and technical knowledge for the economic benefit of our industries.

5. Freedom of Information

The following information is presented in accordance with the requirements of section 8 of the *Freedom of Information Act* 1982 (the Act).

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

In the year to 30 June 1995, CSIRO received 26 requests under the Act.

At the end of October 1991, the Act was amended to provide that an employee may not request access to his or her personnel records under the Act unless the employee has first sought access to the records under the agency's internal procedures for staff access to records.

In the year to 30 June 1995, CSIRO received two requests from officers of CSIRO for access to their own personnel records.

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* (staff newspaper)
- film catalogue
- list of saleable publications
- information service leaflets issued by Divisions on a wide range of technical subjects attracting frequent inquiries from the general public
- conditions of CSIRO post-doctoral awards
- press releases
- information on careers in CSIRO.

Archives and disposal arrangements for documents

CSIRO maintains an archives collection in Canberra which has records dating from the establishment in 1916 of the Advisory Council for Science and Industry, the original predecessor of CSIRO. Certain Australian Archives Regional Officers also hold quantities of CSIRO records. The disposal arrangements for CSIRO records are made in accordance with the provisions of the *Archives Act* 1983. Access to records over 30 years old is provided in accordance with that Act.

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 coordinator 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:

FOI Coordinator
CSIRO
Limestone Avenue
Campbell ACT 2612

or

PO Box 225
Dickson ACT 2602
Tel: (06) 2766123

In accordance with the Freedom of Information Act, formal requests to CSIRO should be addressed to the Chief Executive of CSIRO.

Privacy

The *Privacy Act* 1988 came into operation on 1 January 1989. The Act applies to both the Commonwealth and ACT Governments and requires Departments and agencies to comply with certain Information Privacy Principles (IPPs). They govern:

- methods used to collect personal information
- storage and security of personal information
- notice of the existence of record systems
- access by individuals to their own information
- use of personal information and its disclosure to third parties.

The Act allows the Privacy Commissioner to investigate and report on an act or practice which may be an interference with the privacy of an individual.

During 1994–95 the Privacy Commissioner did not undertake any investigations under s.36 of the *Privacy Act* 1988 in relation to CSIRO.

Privacy procedures and initial contact points

A central Privacy Coordinator manages CSIRO's privacy responsibilities.

Initial enquiries should be made to:

Privacy Coordinator
CSIRO
Limestone Avenue
Campbell ACT 2612

or

PO Box 225
DICKSON ACT 2602
Tel: (06) 2766123

6. Trust funds

Science and Industry Endowment Fund

This fund was established under the *Science and Industry Endowment Act* 1926. Over the years, applications have been made in writing to the Secretary, and a selection committee has advised the Chief Executive, the Trustee of the Fund, on appropriate grants to applicants. The fund has provided small grants to groups or individuals who could not obtain support elsewhere, such as retired professional scientists, amateur naturalists, and small educational groups. The science grants came from the annual return on the £A100 000 originally allocated to the fund by the Act.

During the year, the future operation of the fund was being reviewed and various options for changed operations have been put forward for consideration by the new Chief Executive.

FD McMaster Bequest Trust Fund

From this fund, seven Fellowships were awarded in 1994–95, totalling $210 500. They were given to support eminent overseas scientists selected to work for a period in CSIRO Divisions.

Six Research Fellowships and one Visiting Fellowship were awarded. For the former, the Fellow is actively involved in a CSIRO research project for three to 12 months. For the latter, the Fellow undertakes to review and make recommendations on a specific area of research, or a program of public lectures and high level discussions on research policy and management, or other activities approved by the selection committee.

The late Sir Frederick McMaster, a prominent NSW grazier, bequeathed in his will a substantial proportion of shares in his pastoral company to CSIRO on the condition that the proceeds from their sale be used to undertake research in agriculture or veterinary science.

Sir Ian McLennan Achievement for Industry Award

Established in 1985, the Sir Ian McLennan Achievement for Industry Award recognises outstanding contributions by CSIRO scientists to national development.

The winning scientist receives a medal and a grant of up to $15 000 to undertake an overseas study visit appropriate to the achievement. The company or organisation involved in the development or marketing of the innovation is presented with a plaque.

The award recognises the contributions of Sir Ian McLennan to the application of science and technology to Australia's industrial development. Details of this year's winners can be found on page 56.

Ken and Yasuko Myer Plant Science Research Fund

The Ken and Yasuko Myer Plant Science Research Fund is continuing its support of the area of plant science. The current project assisted by the bequest from the late Kenneth Myer investigates the role which genetic engineering could play in controlling plant flowering. The post doctoral researcher working on the project since July 1995 is Candice Sheldon.

7. Research programs 1994–95

Multi-Divisional Programs

Multi-Divisional Programs (MDPs) assemble multi-disciplinary teams to respond to research problems and opportunities. They involve more than one Division and have their own formal management structures or steering committees.

Plant Production and Primary Products

Gene Shears

Novel Management Techniques for Plant and Plant Product Pests

Improving Forestry

Rejuvenating the Murray–Darling Basin with Forest Products Industries*

Tropical Agricultural Exports*

Strengthening Infrastructure for Mediterranean Agricultural Industry Opportunities*

Animal Production and Primary Products

Fibre Utilisation

Gene Mapping

CSIRO Aquaculture Initiative (CAI)*

Mineral Resources

Alumina Production

Aluminium Production

Heavy Mineral Processing

Integrated Geological, Geophysical, Mine Design Visualisation

Iron Ore Processing

Magnesium Alloys

Magnesium Production

Rural-Based Manufacturing

Active Packaging

Manufacturing

Biomaterials and Medical Devices

Boeing–CSIRO Joint Research Effort

Process and Maintenance Optimisation in Manufacturing

Biosensors

Smart Manufacturing

Commercial Services

Urban Water Systems

Environment Knowledge

Climate Change

Conserving Biodiversity for Australia's Future

Data Acquisition and Utilisation

Climate Variability and Impacts

Environmental Aspects of Economic Development

Algal Research Program

Coastal Zone Program

Management of Marine Living Resources

Minesite Rehabilitation

Air Quality

Management of Eucalypt Forests

Dryland Farming Systems for Catchment Care

* These programs were established during the reporting period.

Institute of Animal Production and Processing

Animal Health

Control of Bacterial Diseases

Control of Parasitic Infections

Plant Associated Toxins

Avian Diseases

International Projects and Consulting

Effective Vaccine Development

Animal Production

Sustainable Grazing Systems and Livestock Production

Breeding for Improved Wool Quality and Production Efficiency

Manipulating Skin Function for Quality Wool

Livestock Growth and Meat Quality

Australian Animal Health Laboratory

Diagnosis and Epidemiology of Exotic Diseases

New Approaches to Disease Diagnosis

Molecular Virology and Vaccine Development

Biometrics Unit

Statistics for Animal Science

Statistics for Food Science

Food Science and Technology

Food, Safety and Quality

Food Ingredients

Meat Technology

Cheese and Cultured Goods

Food Process Engineering and Manufacturing

Food Packaging and Distribution

Human Nutrition

Consumer Research: Market and Consumer Assessment

Functional Foods: Protective Dietary Agents for Human Health

Nutrition Linked Cancers and Bowel Health

Tissue Growth and Repair

Tropical Animal Production

Animal Health

Livestock Improvement

Efficient and Sustainable Production

Wool Technology

Raw Wool Specification

Scouring and Effluent Treatment

Mill and Testing

Physical Processing

Instrumentation and Computing

Dyeing, Finishing and Chemical Processing

Fabric Quality

Fibre Structure and Function

Novel Products

Comfort

Hides, Skins and Leather

Institute of Industrial Technologies

Applied Physics

Electrotechnology

Applied Electricity and Magnetism

Thermal and Electromagnetic Technologies

Acoustics and Surface Mechanics

Optical Technology

Biomolecular Engineering

Protein Engineering

Gene Therapeutics

Receptors and Cytokines

Biomaterials and Tissue Repair

Protein Structure*

Virus Replication and Assembly*

*programs of the Biomolecular Research Institute

Chemicals and Polymers

Chemical Discovery

Biomaterials and Chemical Devices

Polymer Production and Processing

Specialty Chemicals and Environmental Technologies

Manufacturing Technology

Industrial Automation

Casting and Solidification

Joining and Surfacing

High Energy Processing

Manufacturing Management Systems

Materials Science and Technology

Alloys Research and Development

Ceramics and Refractories

Photonics

Particle, Fibre and Film Technologies

Electron Beam Lithography

Institute of Information Science and Engineering

Australia Telescope National Facility

National Facility Operation

Astrophysics

Instrumentation

Computing Support

Astronomy Education Centres

Information Technology

Knowledge-based Systems

Spatial Decision Support Systems

Human-Computer Interfaces and Visualisation

Distributed Systems

Software Engineering

Supercomputing Support Group

Mathematics and Statistics

Computational Fluid Dynamics

Display, Analysis and Interpretation of Large Data Sets

Experimental Design

Graphical Presentation of Data

Image Analysis

Process Modelling

Quality Improvement

Remote Sensing

Sampling and Monitoring

Scheduling, Simulation and Optimisation

Software Quality

Statistics for Management

Radiophysics

Telecommunications

Signal and Imaging Technology

Antenna and Microwave Technology

GaAs IC Design, Test and Prototyping
Wireless Local Area Networks
Medical and Ultrasonics Imaging

Institute of Minerals, Energy and Construction

Building, Construction and Engineering

Construction Materials
Structural Engineering
Engineering Products and Services
Construction Systems
Housing and Urban Development
Fire Technology

Coal and Energy Technology

Coal Preparation
Coal Utilisation
Natural Gas Utilisation
Environmental Protection
Environmental Process Technologies

Exploration and Mining

Area Selection
Area Evaluation
Australian Geodynamics CRC
Deposit Delineation
Coal Mining
Australian Mineral Exploration Tech CRC
Metalliferous Mining
Minesite Rehabilitation

Minerals

Non Ferrous Beneficiation
Ferrous Metal Production
Non-ferrous Metal Production
Iron Ore Processing
Magnesium Production
Energy Storage
Alumina Production
Aluminium Production
Heavy Mineral Processing
Magnesite Processing
Gold Production

Petroleum Resources

Petroleum Exploration Technologies
Reservoir Characterisation
Reservoir Testing and Stimulation
Petroleum Production Engineering

Institute of Natural Resources and Environment

Atmospheric Research

Atmospheric Pollution
Atmospheric Processes
Global Atmospheric Change
Climate Modelling

Centre for Environmental Mechanics

Atmosphere and Plant Processes
Soil and Plant Processes
Aquatic Processes

CSIRO Office of Space Science and Applications (COSSA)

Access to Research Aircraft Facilities
Environmental Multispectral Imaging
Data Acquisition and Utilisation

Fisheries

Tropical Fisheries Resources
Pelagic Fisheries Resources
Mariculture

Temperate and Deepwater Fisheries Resources

Marine Environment

Oceanography

Climate and Ocean Processes

Marine Environment and Resources

Regional Seas and the EEZ

Water Resources

Catchment Management

Urban Water Management

Groundwater Management and Site Remediation

Rivers and Wetlands

Irrigation Systems and Dryland Salinity Management

Wildlife and Ecology

National Rangelands

Ecology and Conservation Management of Tropical Forests and Savannas

Resource Ecology Assessment

Biology of Australia's Vertebrate Fauna : Applications and Pest Control

Land Use and Biological Diversity

Resource Futures

Institute of Plant Production and Processing

Entomology

Stored Products and Structural Pests

Weed Management

Pest Management

Natural Resources and Biodiversity

Biotechnology

Forestry

Softwood Plantations

Australian Tree Resources

Regrowth Forest Management

Hardwood Plantations

Forest Products

Pulp and Paper Products

Biodeterioration and Preservation

Composites and Chemical Products

Wood Science and Technology

Horticulture

Crop Management

Crop Improvement

Plant Industry

Sustainable Agricultural Systems

Gene Expression and Plant Development

Australian Flora Resources and Management

Genetic Engineering for Plant Improvement

Wheat Germplasm and Grain Quality

Improvement of Rainfed Crops and Pastures

Cotton Management and Production

Soils

Soils and Environmental Quality

Soils and Rural Production

Soils and Land Resources

Tropical Crops and Pasture

Crop Improvement and Management

Pasture Management and Livestock Production

Pasture Plant Improvement

8. Institute/sector advisory committees

Institute/sector advisory committees provide an important link between CSIRO and its research users. Members are drawn from business, government and other bodies, and are chosen for the contribution they can make to the setting of priorities for an Institute's research, the evaluation of that research and the effectiveness of the Institute in transferring the results of its research into commercial or other practice.

CSIRO Agricultural Sector Advisory Committee

This Committee deals with matters relevant to the Institute of Animal Production and Processing, the Institute of Plant Production and Processing, and the Institute of Natural Resources and Environment. The Institute Directors attend meetings of the Committee.

Chair

Mr Trevor Flugge
Wool and grain producer, WA; Chairman, Australian Wheat Board; Past President, Grains Council of Australia

Members

Mrs Marion Becker
Grazier (beef cattle), central Queensland

Mr Keith Campbell
Grazier, southern NSW; commercial grazing consultant; Committee member, Wool Council of Australia and General Council & Wool Committee of NSW Farmers' Federation

Dr Brian Fisher
Executive Director, Agriculture and Forestry, Department of Primary Industries and Energy

Dr John Keniry
Food industry scientist, Ridley Corporation Limited

Mr John Mackenzie
Treasurer, National Farmers' Federation (NFF), several NFF committees; Chairman of Directors, Farmwide, Agricultural consultant

Mr Ian Macrow
Grain and cattle producer, central Queensland; Chairman, Grains Research Foundation; Northern Regional Panel, Grain R&D Corporation

Mr Doug McGuffog
Managing Director, McGuffog & Co Pty Ltd; Agricultural chemicals consultant

Dr Kevin Sheridan
Director-General, NSW Agriculture

Dr Ross Squire
Managing Director, 'Sylvaterre'; Silviculture and forestry consultant

Professor Harold Woolhouse
Director, Waite Agricultural Research Institute

Institute of Natural Resources and Environment Advisory Committee

Chair

Mr Neil Inall
Media consultant, Cox Inall Communications

Members

Mr Colin Griffiths
Deputy Executive Director
Department of the Environment, Sport and Territories

Mr Alex Campbell
Past General President, WA Farmers' Federation

Professor Ann Henderson-Sellers
Director Climatic Impacts Centre, Macquarie University

Mr Ken Matthews
Executive Director
Department of Primary Industries and Energy

Mr George Littlewood
Vice President, External Affairs, CRA Limited

Mr Michael Rae
World Wide Fund for Nature

Mr Bob Wilson
Wilson Corporate and Environmental Services Pty Ltd

Institute of Information Science and Engineering Advisory Committee

Chair

Mr Ian J Kowalick
Consultant

Members

Professor Tony Cantoni
Director, Australian Telecommunications Research Institute

Mr Tony Henshaw
General Manager, Federal Region, Aspect Computing Pty Ltd

Mr Chris Howells
Managing Director, NetComm (Australia) Pty Ltd

Dr Peter Robinson
Chief, CSIRO Division of Manufacturing Technology
(resigned 1 May '95)

Mr Mel Ward
Consultant

Mr Michael Williams
General Manager, Technology and Quality, AWA Ltd

Mr David Wills
General Manager, MIS Division, Woolworths Ltd

Institute of Minerals, Energy and Construction Advisory Committee

Chair

Dr Ian Gould
Group Executive, CRA Ltd

Members

Mr J J Linden
General Manager—Marketing, Gwalia Consolidated Ltd

Mr P Favretto
Director, Projects Finance Group

Mr David Chandler
Pioneer Property

Dr S M Richards
Aberfoyle Ltd

Mr R J Flew
Group General Manager, BHP Australia Coal Ltd

CSIRO Manufacturing Advisory Board

Chair

Sir Russel Madigan
Chairman, Remproc Ltd

Members

Dr Colin Adam
Director, CSIRO Institute of Industrial Technologies

Dr John Burgess
General Manager, Research, BHP Limited

Mr Jonathon Crockett
Principal, Water Technology, Gutteridge, Haskins & Davey

Mr Keith Daniel
Senior Executive Vice President, Research and Technology, Nucleus Limited

Mr Noel Godfrey
Electrical Engineering Manager, BHP Engineering Pty Ltd

Mr Sandy Hollway
Secretary, Department of Industry, Science and Technology

Mr John Innes
Group Executive, Technical Resources, CRA Limited

Dr John White
Chief Executive, Transfield Shipbuilding Pty Ltd

Dr Don Williams
Chairman, Australian National

Mr Ken Windle
Managing Director, Glaxo Australia Ltd

9. Publications

Every year CSIRO publishes about 4000 scientific papers, monographs and reports, annual or biennial reports from its Institutes and Divisions, brochures, information leaflets and books. It is not practicable to list all these in CSIRO's Annual Report, but full details can be found in the reports of each of CSIRO's Divisions, from CSIRO Information Services (314 Albert Street, East Melbourne, VIC 3002) or through the National Library's OZLINE database service.

Corporate publications during the year have included:

- *Annual Report 1993–94*
- *CSIRO data book 1995*
- *Ecos* magazine (quarterly)
- *Rural Research* magazine (quarterly)
- *Research Results* magazine (two issues)
- *The Helix* (quarterly magazine for Double Helix Club members)
- *Challenge to Change: Australia in 2020*, eds R. Eckersley & K. Jeans.

Financial statements

AUSTRALIAN NATIONAL AUDIT OFFICE

Address all mail to:
GPO Box 707
CANBERRA
ACT 2601

INDEPENDENT AUDIT REPORT

To the Minister for Industry, Science and Technology

Scope

I have audited the financial statements of the Commonwealth Scientific and Industrial Research organisation for the year ended 30 June 1995. The statements comprise:

- Statement by Board Members
- Operating Statement
- Statement of Financial Position
- Statement of Cash Flows, and
- Notes to and forming part of the Financial Statements.

The members of the Board are responsible for the preparation and presentation of the financial statements and the information contained therein. I have conducted an independent audit of the financial statements in order to express an opinion on them to the Minister for Industry, Science and Technology.

The audit has been conducted in accordance with the Australian National Audit Office Auditing Standards, which incorporate the Australian Auditing Standards, to provide reasonable assurance as to whether the financial statements are free of material misstatement. Audit procedures included examination, on a test basis, of evidence supporting the amounts and other disclosures in the financial statements, and the evaluation of accounting policies and significant accounting estimates. These procedures have been undertaken to form an opinion whether, in all material respects, the financial statements are presented fairly in accordance with Australian Accounting Concepts and Standards, other mandatory professional reporting requirements and statutory requirements so as to present a view which is consistent with my understanding of the Organisation's financial position, the results of its operations and its cash flows.

The audit opinion expressed in this report has been formed on the above basis.

Audit Opinion

In accordance with sub-section 51(12) of the *Science and Industry Research Act 1949*, I now report that the statements are in agreement with the accounts and records of the Organisation, and in my opinion:

(i) the statements are based on proper accounts and records;

(ii) the statements show fairly in accordance with Statements of Accounting Concepts, applicable Accounting Standards, and other mandatory professional reporting requirements the financial transactions and results, and cash flows, for the year ended 30 June 1995 and the state of affairs of the Organisation as at that date;

(iii) 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 Act, and

(iv) the statements are in accordance with the *Guidelines for Financial Statements of Commonwealth Authorities*.

Australian National Audit Office

D.S. Lennie
Executive Director

For the Auditor-General

Canberra
18 September 1995

Centenary House, 19 National Circuit, Barton, ACT 2600. Telephone (06) 203 7300 Facsimile (06) 203 7777

Board Members' Statement

In our opinion, the statements of the Commonwealth Scientific and Industrial Research Organisation have been prepared in accordance with the Guidelines for Financial Statements of Commonwealth Authorities and present fairly:

- the state of affairs as at 30 June 1995
- the operating surplus for the year ended 30 June 1995
- the cash flows for the year ended 30 June 1995
- other matters required to be disclosed by the Guidelines.

Signed at Canberra this 18th day of September 1995 in accordance with a resolution of the Board Members.

Adrienne E Clarke
Chairman

Roy M Green
Chief Executive and Board Member

Commonwealth Scientific and Industrial Research Organisation

Operating statement for the year ended 30 June 1995

	Notes	1995 $'000	1994 $'000
NET COST OF SERVICES			
Operating expenses	2		
Research Programs			
Animal Production and Processing		126 152	135 390
Industrial Technologies		96 770	100 642
Information Science and Engineering		40 555	41 909
Minerals, Energy and Construction		119 387	122 097
Natural Resources and Environment		100 156	102 862
Plant Production and Processing		132 886	127 907
National Facilities		15 190	16 561
Research Support		49 073	47 670
Total operating expenses		**680 169**	**695 038**
Operating revenues from independent sources			
Revenue from research activities and user charges		200 695	221 626
Other revenue	3	19 583	19 973
Total operating revenues from independent sources		**220 278**	**241 599**
Net cost of services		**(459 891)**	**(453 439)**
REVENUES FROM GOVERNMENT			
Parliamentary appropriations received	2	**461 583**	**456 089**
Operating surplus of net cost of services over revenues from government		**1 692**	**2 650**
Accumulated surpluses at beginning of reporting period		650 234	647 584
Accumulated surpluses at end of reporting period		**651 926**	**650 234**
Current assets			

The accompanying notes form part of these statements

Commonwealth Scientific and Industrial Research Organisation

Statement of financial position as at 30 June 1995

	Notes	1995 $'000	1994 $'000
Cash	4	11 913	11 320
Receivables	5	24 556	20 553
Investments	6	60 163	62 352
Other	7	16 623	18 465
		113 255	112 690
Non-current assets			
Investments	6	73 788	68 773
Property, plant and equipment	8	978 220	977 392
		1 052 008	1 046 165
Total assets		**1 165 263**	**1 158 855**
Current liabilities			
Creditors and borrowings	9	17 449	14 990
Leases	12	562	2 622
Provisions	10	54 627	55 563
Other	11	63 890	68 737
		136 528	141 912
Non-current liabilities			
Creditors and borrowings	9	10 220	10 220
Leases	12	19 327	19 703
Provisions	10	75 258	70 207
Other	11	72 273	66 848
		177 078	166 978
Total liabilities		**313 606**	**308 890**
Net assets		**851 657**	**849 965**
Equity			
Accumulated surpluses		651 926	650 234
Asset revaluation reserve		199 731	199 731
Total equity		**851 657**	**849 965**

The accompanying notes form part of these statements

Commonwealth Scientific and Industrial Research Organisation

Statement of cash flows for the year ended 30 June 1995

	Notes	1995 $'000	1994 $'000
Cash flows from operating activities			
Parliamentary appropriations	2	461 583	456 089
Receipts from research activities and user charges		209 204	228 686
Interest received	2	5 454	2 054
Dividends received	3	–	24
Payments to suppliers and employees		(613 940)	(636 248)
Finance lease charges	2	(599)	(484)
Net cash flows provided by operating activities	13(b)	**61 702**	**50 121**
Cash flows from investing activities			
Payments for property, plant and equipment		(67 609)	(87 522)
Proceeds from sale of property, plant and equipment		11 824	9 488
Proceeds from sale of investment		198	1 316
Net cash flows used by investing activities		**(55 587)**	**(76 718)**
Cash flows from financing activities			
Loan from the Commonwealth		–	5 156
Principal repayment under finance leases		(2 436)	(2 679)
Net cash flows provided/(used) by financing activities		**(2 436)**	**2 477**
Net increase/(decrease) in cash held		**3 679**	**(24 120)**
Cash at beginning of reporting period		140 520	164 640
Cash at end of reporting period	13(a)	**144 199**	**140 520**

The accompanying notes form part of these statements

Commonwealth Scientific and Industrial Research Organisation

Notes to and forming part of the financial statements

Note 1 Summary of significant accounting policies

1.1 Significant Accounting Policies

The significant accounting policies adopted by CSIRO are stated in order to assist in a general understanding of its financial statements. These policies have been consistently applied except as otherwise indicated.

1.2 Basis of Accounting

As required by sub-section 57(1)(a) of the *Science and Industry Research Act* 1949, the financial statements are prepared in accordance with the Guidelines for Financial Statements of Commonwealth Authorities which incorporate the Australian Accounting Standards and Statements of Accounting Concepts.

The financial statements are prepared on an accrual basis and in accordance with the historical costs convention, except for certain assets which are at valuation.

1.3 Principles of Consolidation

As at 30 June 1995, CSIRO's in-kind contributions provided approximately 43% of the total resources of both Biomolecular Research Institute Limited and Ceramic Fuel Cells Limited. These contributions have been accounted for in CSIRO's Operating Statement (Note 14). CSIRO does not have the capacity to control the Boards or financial and operating policies of the companies. Having considered this matter and their immaterial effect on CSIRO's financial statements, CSIRO has, in accordance with Australian Accounting Standard AAS24, elected not to consolidate its accounts.

1.4 Economic Dependency

CSIRO receives approximately two thirds of its funding from the appropriation of moneys by the Commonwealth Parliament.

1.5 Foreign Currency

Foreign currency transactions are translated to Australian currency at the rates of exchange ruling at the dates of the transactions. Amounts receivable and payable in foreign currencies at balance date are translated at the rates of exchange ruling at that date.

Exchange differences relating to amounts payable and receivable in foreign currencies are brought to account as exchange gains or losses in the Operating Statement.

Hedges

All non-specific hedge transactions are recorded at the spot rate at the date of the transaction. Hedges outstanding at balance date are translated at the rates of exchange ruling on that date and any exchange gains or losses are brought to account in the Operating Statement.

Where hedge transactions are designed to hedge the purchase or sale of goods or services, exchange differences arising up to the date of purchase or sale, together with any costs or gains arising at the time of entering into the hedge, are included in the measurement of the purchase or sale.

1.6 Income Tax

In accordance with section 53 of the *Science and Industry Research Act*, CSIRO is not subject to income tax.

1.7 Insurance

CSIRO has adopted a risk management policy which includes external insurance cover for a range of risks including industrial special risks, professional indemnity, public and product liability and motor vehicles. The insurance cover is designed to protect CSIRO from extreme losses in excess of normal self insurance.

1.8 Reporting by Segments

CSIRO principally operates in the field of scientific and industrial research and development in Australia with a small overseas presence related to specific Australian research objectives. It is therefore considered that for segment reporting, it operates in one industry (scientific research and development) and one geographical location.

1.9 Revenue Recognition

Parliamentary appropriations are recognised as revenue in the year of receipt in accordance with the Guidelines for Financial Statements of Commonwealth Authorities.

Revenue from contract research activities is recognised in the Operating Statement when work is performed; the balances of research activities in progress are accounted as either research work in progress or contract research moneys received in advance in the Statement of Financial Position.

A surplus/deficit is recognised on completion of each research activity. However, where a deficit is anticipated over the life of the research activity then it is brought to account when first recognised.

Other revenue, including licensing fees and royalties from the sale of products or technologies developed under agreements, is brought to account when received. While this basis of accounting constitutes a departure from an accrual basis, the effect is not material to the financial statements.

1.10 Consumable Stores

Stocks of consumable stores mainly consist of fuel and lubricants, chemical supplies, maintenance materials and stationery. The value of consumable stores is not material in terms of total expenditure or total assets and is expensed during the year of purchase.

1.11 Finance and Operating Leases

CSIRO accounts for and discloses finance and operating leases in accordance with AAS17 (Note 12). Assets acquired under finance leases are included in property, plant and equipment (Note 8).

Finance leases effectively transfer from the lessor to the lessee substantially all the risks and benefits incidental to the ownership of the leased assets. Where assets are acquired by means of finance leases, the present value of the minimum lease payments is recognised as an asset at the beginning of the lease term and amortised on a straight line basis over the expected useful life of the leased asset. A corresponding lease liability is also established and each lease payment is allocated between the liability and finance charge.

Other leases under which all the risks and benefits of ownership are effectively retained by the lessor are classified as operating leases. Operating lease payments are expensed over the period of expected benefit.

1.12 Receivables

Provision for any doubtful debts is based on a review of all outstanding amounts at year end. Bad debts are written off in the period in which they are identified.

1.13 Investments

Equities

Where, in the opinion of the Board, there has been a permanent diminution in the value of any equity investment, the carrying amount of the investment is written down to its recoverable amount. In doing so, the Board considers the nature of the underlying net assets with particular regard to any deferred expenditure on research, development and intellectual property (Note 1.14).

Controlled Entities

There are no controlled entities.

Associated Companies

Investments in associated companies are carried at cost or Board valuation. An associated company is one in which CSIRO exercises significant influence over the company and the investment is long-term. Dividends are brought to account as they are received.

Other Companies

Investments in other companies are carried at cost or Board valuation.

Managed Funds

Managed funds comprise government, semi-government and bank endorsed securities which are valued at market values on 30 June 1995.

1.14 Research and Development and Intellectual Property

All research and development costs and intellectual property including patents and trademarks are expensed as incurred, except where benefits are expected, beyond any reasonable doubt, to equal or exceed those costs.

1.15 Co-operative Research Centres

The activities attributable to the interests of CSIRO in Co-operative Research Centres have been expensed consistent with Note 1.14. CSIRO's interests in Co-operative Research Centres are disclosed in Note 21.

1.16 Property

All land, buildings and leasehold improvements at Board valuation were revalued in June 1993. The bases of valuation were :

Land which will continue to be used for research activity was valued by CSIRO's registered valuer at "in use value".

Land and buildings designated for sale were valued by registered external valuers at market values.

Buildings and leasehold improvements which will continue to be used for research activity were valued based upon the written down replacement costs using external building price indices to arrive at current replacement costs less accumulated depreciation having regard to the age and condition of the buildings.

Building valuations include plant, fixtures and fittings which form an integral part of the building.

Property under construction

Interest costs on borrowings specifically financing assets under construction are capitalised up to the date of completion of each asset to the extent those costs are recoverable.

1.17 Plant and Equipment

All plant and equipment are valued at historical cost. The capitalisation threshold limit is $3,000. Assets costing less than the threshold limit are expensed in the year of purchase. Computer software, scientific glassware, experimental prototype equipment, and library monographs and serials are not capitalised as non-current assets owing to either their uncertain useful lives or the uncertainty of benefits to be derived from their development.

Property, plant and equipment which are purchased from contract research funds and where their sale proceeds are refunded to the contributors under the terms of the agreements, are expensed during the year of purchase. Separate records for these assets are maintained (Note 17).

1.18 Depreciation and Amortisation

Depreciation is calculated on a straight line basis so as to write off the net cost or revalued amount of each item of building, plant and equipment over its expected useful life. A review of the estimated useful lives of the National Facilities (Note 8) was made during the year. The effect of the change is reported in Note 2 as an abnormal item.

The cost of improvements to or on leasehold properties is amortised over the unexpired period of the lease or the estimated useful life of the improvement, whichever is the shorter.

Profits and losses on disposal of property, plant and equipment are taken to account in determining the operating results for the year.

1.19 Employee Entitlements

Provision for employee entitlements are calculated in accordance with the Australian Accounting Standard AAS 30, which represents a change in policy from previous years. The effect of the change is not material and not adjusted in the financial statements. Entitlements which are expected to be paid within the next 12 months are disclosed as current liabilities.

1.20 Superannuation

CSIRO is an approved authority for the purposes of the *Superannuation Act* 1976 and the *Superannuation Act* 1990 and is required to meet the employer's share of the cost of benefits payable pursuant to those Acts to employees in accordance with Government policy. CSIRO discharges this liability by periodic payments to the Commonwealth of amounts, expressed as a percentage of the salary for superannuation purposes of eligible employees, estimated by the Commonwealth to be sufficient to meet CSIRO's share of the full accruing cost both of lump sums or pensions granted on the retirement or death of such employees and any subsequent pension increases.

CSIRO meets its liability for the productivity superannuation benefit on a pay-as-you-earn basis to the Commonwealth Public Sector Superannuation Scheme (PSS) and the Commonwealth Superannuation Scheme (CSS) and other approved superannuation schemes and no further accrual is required.

Productivity superannuation benefit payments under the *Superannuation (Productivity Benefit) Act* 1988 were made to the Australian Government Employees Superannuation Trust, the Australian Retirement Fund and other

approved superannuation funds. These funds provide a lump sum benefit on retirement or death.

1.21 Workers' Compensation

CSIRO's workers' compensation liability is covered by the premium paid to the Commission for the Safety, Rehabilitation and Compensation of Commonwealth Employees (COMCARE) and no additional provision for liability is required.

1.22 Cash Flows

For the purpose of the Statement of Cash Flows, cash includes cash at bank and on hand, deposits at call, term deposits and managed funds which include investments in money market instruments which are readily convertible to cash.

1.23 Comparative Figures

Where necessary, comparative figures have been adjusted to conform with changes in presentation in the current year.

Note 2 Operating surplus

	1995 $'000	1994 $'000
Operating surplus has been determined:		
After crediting as operating revenues:		
Parliamentary appropriations		
- annual (Bill 1)	423 283	424 034
- capital (Bill 2)	38 300	32 055
Interest received or due and receivable	5 454	2 054
Abnormal item - prior period adjustment relating to non-current assets	(4 382)	–
After charging as operating expenses:		
Finance lease charges	599	484
Loss on sale of land and buildings	–	565
Loss on sale of plant and equipment	275	–
Wages and salaries related payments	294 201	293 587
Superannuation (including productivity benefits)	49 518	49 673
Provision for legal settlements	–	2 012
Provision for long service leave	13 651	7 753
Provision for recreation leave	30 101	28 340
Provision for doubtful debts	331	246
Provision for refit of research vessels	200	200
Depreciation and amortisation	55 360	55 315
Bad debts written-off	38	566
Loss on sale of investment	62	–
Abnormal item - depreciation writeback as a result of changes to depreciation rates on the National Facilities (Note 1.18)	(3 359)	–

Note 3 Other revenue

	1995 $'000	1994 $'000
Department of Primary Industries and Energy's contribution to the cost of the Australian Animal Health Laboratory	5 944	5 818
Dividends	–	24
Interest	2 635	1 061
Royalties	2 428	2 533
Sale of produce and livestock	995	859
Profit on sale of investments	–	966
Fees for provision of services	4 875	3 928
Rental proceeds	1 170	988
Net foreign exchange gains	122	315
Profit on sale of land and buildings	578	–
Profit on sale of plant and equipment	–	1 648
Miscellaneous	836	1 833
Total other revenue	**19 583**	**19 973**

Note 4 Cash

	1995 $'000	1994 $'000
Cash at bank and on hand	11 708	9 057
Deposits - at call	–	489
Managed funds - at call	205	1 774
Total cash	**11 913**	**11 320**

Note 5 Receivables

	1995	1994
	$'000	$'000
Trade debtors	25 880	21 354
Advances	127	319
	26 007	**21 673**
Provision for doubtful debts	(1 451)	(1 120)
Total receivables	**24 556**	**20 553**

Ageing of receivables

	1995	1994
	$'000	$'000
Less than 30 days	15 975	13 475
Between 30 and 60 days	5 067	4 480
Greater than 60 days	4 965	3 718
	26 007	**21 673**

Note 6 Investments (Note 1.13)

	Notes	1995 $'000	1994 $'000
Current			
Managed funds			
Government and semi-government stocks and bonds		6 646	30 600
Bank endorsed bills and government guaranteed promissory notes		53 517	19 019
Negotiable certificate of deposits		–	8 996
		60 163	58 615
R&D Syndicate deposits			
Term deposits - under contract	16	–	3 737
		60 163	**62 352**
Non-current			
R&D Syndicate deposits			
Term deposits - under contract	16	72 123	66 848
Shares - at valuation			
	% CSIRO interest		
Associated companies			
Bio-Coal Briquette Pty Ltd	17.2	88	88
Dunlena Pty Ltd	47.0	5	5
Gene Shears Pty Ltd	34.7	501	501
Gropep Pty Ltd	35.1	101	101
Preston Group Ltd	16.1	784	784
		1 479	1 479
Provision for diminution in value		(1 479)	(1 479)
		–	–

continued

	Notes	1995 $'000	1994 $'000
Shares - at cost			
Listed companies			
Mineral Control Instrumentation Ltd		–	260
Queensland Metals Corporation NL		1 655	1 655
Unlisted companies			
Other corporations		7	7
Debentures and unsecured notes - at cost		3	3
		1 665	1 925
		73 788	**68 773**
Total investments		**133 951**	**131 125**

Queensland Metals Corporation NL is a public listed company. As at 30 June 1995 the total market value was $1 988 721. CSIRO is a minority shareholder (less than 5%) in the company.

Note 7 Other assets

	Notes	1995 $'000	1994 $'000
Current			
Prepayments		1 803	1 097
Property held for resale - at acquisition cost		657	720
Research work in progress - at cost	1.9	14 163	16 648
Total other assets		**16 623**	**18 465**

Note 8 Property, plant and equipment (Notes 1.16, 1.17 and 1.18)

	1995 $'000	1994 $'000
Land (a)		
At cost	4 159	4 159
At valuation	177 515	178 767
	181 674	182 926
Buildings		
At cost	40 956	7 363
At valuation	524 552	524 906
	565 508	532 269
Accumulated depreciation	(36 444)	(17 904)
	529 064	514 365
Capital works in progress - at cost	29 348	54 342
	558 412	568 707
Leasehold improvements		
At cost	19 798	2 545
At valuation	31 691	31 702
	51 489	34 247
Accumulated amortisation	(3 257)	(1 503)
	48 232	32 744
Plant and equipment		
Equipment - at cost	312 547	300 591
Research vessel 'Southern Surveyor' - at cost	16 753	16 753
	329 300	317 344
Accumulated depreciation	(209 742)	(195 127)
Provision for refit of research vessel	–	(200)
	119 558	122 017

	1995 $'000	1994 $'000
National facilities		
Oceanographic research vessel 'Franklin' - at cost	15 318	15 288
Australia Telescope - at cost	48 560	48 707
	63 878	63 995
Accumulated depreciation	(15 343)	(16 316)
Provision for refit of research vessel	(300)	(200)
	48 235	47 479
Buildings and equipment under finance lease		
Buildings	20 094	20 094
Equipment	6 545	6 455
	26 639	26 549
Accumulated amortisation	(4 530)	(3 030)
	22 109	23 519
Total property, plant and equipment	**978 220**	**977 392**

(a) Includes Crown land and land held in Commonwealth title totalling $2 610 000 (1994 $2 610 000). Negotiations are continuing between CSIRO, the Commonwealth Government and ACT Government to have leases issued in CSIRO's name.

Total property, plant and equipment (Summary)		
At cost	514 078	476 297
At valuation	733 758	735 375
	1 247 836	1 211 672
Accumulated depreciation and amortisation	(269 316)	(233 880)
Provision for refit of research vessels	(300)	(400)
Total property, plant and equipment	**978 220**	**977 392**

Note 9 Creditors and borrowings

	1995 $'000	1994 $'000
Current		
Trade creditors	14 647	13 576
Other creditors	2 802	1 414
	17 449	**14 990**
Non-current		
Loan from the Commonwealth (a)	**10 220**	**10 220**
Total creditors and borrowings	**27 669**	**25 210**

(a) The loan of $10 220 000 (1994 $10 220 000) from the Commonwealth is the drawdown of an approved loan of $10 million and an inflation component of $220 000 for the North Ryde Redevelopment Project. The loan is repayable in full on 1 October 1997 and interest is paid annually. Interest totalling $824 372 (1994 $486 462) has been capitalised on the North Ryde Redevelopment Project.

Note 10 Provisions

	Notes	1995 $'000	1994 $'000
Current			
Provision for recreation leave	1.19	44 364	43 978
Provision for long service leave	1.19	10 263	9 573
Provision for legal settlements		–	2 012
		54 627	**55 563**
Non-current			
Provision for long service leave	1.19	**75 258**	**70 207**
Total provisions		**129 885**	**125 770**

Note 11 Other liabilities

	Notes	1995 $'000	1994 $'000
Current			
Accrued expenses		4 174	2 826
Research revenue received in advance	1.9	55 868	57 478
Unearned revenue - "R&D Syndicates"	16	–	3 887
Trust monies		3 848	4 546
		63 890	**68 737**
Non current			
Unearned revenue - "R&D Syndicates"	16	**72 273**	**66 848**
Total other liabilities		**136 163**	**135 585**

Note 12 Lease commitments (Note 1.11)

Total operating and finance lease rentals contracted for at balance date:

	1995 $'000	1994 $'000
Payable no later than one year	3 167	5 504
Payable later than one year, but no later than two years	2 782	2 781
Payable later than two years, but no later than five years	7 388	6 498
Payable later than five years	23 070	26 690
Total lease commitments	**36 407**	**41 473**
Representing:		
Non-cancellable operating leases	9 384	11 381
Finance leases	27 023	30 092
Total lease commitments	**36 407**	**41 473**

continued

	1995 $'000	1994 $'000
Non-cancellable operating lease commitments contracted for but not provided for in the accounts:		
Payable no later than one year	1 907	1 826
Payable later than one year, but no later than two years	1 826	1 580
Payable later than two years, but no later than five years	4 607	3 885
Payable later than five years	1 044	4 090
	9 384	**11 381**
Finance lease commitments contracted for and provided for in the accounts:		
Payable no later than one year	1 259	3 678
Payable later than one year, but no later than two years	957	1 201
Payable later than two years, but no later than five years	2 781	2 613
Payable later than five years	22 026	22 600
	27 023	30 092
Deduct, future lease expenditure not provided for in the accounts:		
Maintenance charges	(69)	(477)
Future finance charges	(7 065)	(7 290)
Total lease liabilities	**19 889**	**22 325**
Representing lease liabilities		
Current	562	2 622
Non-current	19 327	19 703
Total lease liabilities	**19 889**	**22 325**

Note 13 Statement of Cash Flows (Note 1.22)

(a) Reconciliation of cash

For the purpose of the Statement of Cash Flows, cash includes cash at bank and on hand, deposits at call, managed funds and term deposits in the Statement of Financial Position as follows:

	Notes	1995 $'000	1994 $'000
Cash at bank and on hand	4	11 708	9 057
Deposits - at call	4	–	489
Managed funds	4 & 6	60 368	60 389
Term deposits - under contract	6	72 123	70 585
		144 199	**140 520**

(b) Reconciliation of operating surplus with net cash flows from operations

	Notes	1995 $'000	1994 $'000
Operating surplus		**1 692**	**2 650**
Non cash flows in operating results			
Depreciation and amortisation	2	55 360	55 315
Net loss/(profit) on disposal of property, plant and equipment	2&3	(303)	(1 083)
Loss/(profit) on disposal of investment	2	62	(966)
Increase in provision for doubtful debts	5	331	246
Increase in provision for employee entitlements	10	6 127	1 691
Increase/(decrease) in provision for refit of research vessel	8	(100)	200
Increase/(decrease) in provision for legal settlements	10	(2 012)	(7 488)
Changes in assets and liabilities			
(Increase)/decrease in receivables	5	(4 334)	(5 999)
(Increase)/decrease in other assets	7	1 842	14 302
Increase/(decrease) in creditors and borrowings	9	2 459	5 080
Increase/(decrease) in other current and non-current liabilities	11	578	(13 827)
Net cash outflows from operating activities		**61 702**	**50 121**

Note 14 Related Entities (Note 1.3)

During the year CSIRO has provided in-kind contributions in the form of scientific staff and accommodation to the value of $3 262 985 to Biomolecular Research Institute Limited (BRI) and $1 833 454 to Ceramic Fuel Cells Limited (CFC). These contributions have been accounted for in CSIRO's Operating Statement.

BRI is principally a research and development company involved in the development of pharmaceutical and biological products and CFC's principal activity is the research and development of ceramic fuel cell technology.

Note 15 Agreements equally proportionally unperformed

Research agreements

Total research contracts with external parties including Co-operative Research Centres and other non cancellable agreements contracted for at balance date but not provided for in the accounts:

	1995 $'000 Income	1995 $'000 Expend	1994 $'000 Income	1994 $'000 Expend
Receivable/payable no later than one year	97 951	113 429	104 524	116 982
Receivable/payable later than one year, but no later than two years	48 504	47 297	51 647	52 778
Receivable/payable later than two years, but no later than five years	29 590	30 942	40 303	41 010
Receivable/payable later than five years	282	232	3 728	3 659
	176 327	**191 900**	**200 202**	**214 429**

Other agreements

Total expenditure commitments contracted for at balance date but not provided for in the accounts :

	1995 $'000	1994 $'000
Payable no later than one year	20 746	19 914
Payable later than one year, but no later than two years	1 694	722
Payable later than two years, but no later than five years	912	–
Payable later than five years	432	–
	23 784	**20 636**

Note 16 Research and Development Syndicates

CSIRO has entered into several agreements whereby the Research and Development Syndicates have provided funds in respect of Research and Development projects.

The funds provided by the Syndicates and held in interest bearing deposits are subject to these agreements and have been drawn upon in accordance with the terms of those agreements to meet CSIRO's research contract obligations. The balance of deposits represents an amount held as security for CSIRO's obligations under put options.

CSIRO has certain obligations and indemnities relating to its performance in respect of the research and other agreements.

Note 17 Resources provided free of charge and not included in the Statement of Financial Position

	Land	Buildings	Plant and equipment	Total 1995	Total 1994
	$'000	$'000	$'000	$'000	$'000
At valuation or cost	18 031	30 673	42 092	90 796	88 601
Accumulated depreciation	–	(2 308)	(31 698)	(34 006)	(30 303)
	18 031	**28 365**	**10 394**	**56 790**	**58 298**

CSIRO has free use of the above resources at little or no cost in accordance with contract research agreements with contributors. They are assets controlled and accounted for in the contributors' books and any proceeds from their disposal are refundable to the contributors. The above assets have either been purchased out of contract research monies and expensed in the year of purchase in accordance with the accounting policy noted in 1.17 or provided to CSIRO at little or no cost whilst control of the assets remains with the contributors. The fair value of the in-kind contributions of these assets could not be reliably determined and therefore were not brought to account in the Operating Statement.

Note 18 Monies held in trust

Monies held in trust are not included in the Statement of Financial Position and are represented by the following investments at cost and cash at bank:

	1995	1994
Investments	**$'000**	**$'000**
Advance Bank	206	94
Commonwealth Bank of Australia	2 522	2 475
St George Bank	138	128
M F Cash Management Fund	1 045	1 002
	3 911	3 699
Cash at bank	76	228
	3 987	**3 927**
The components of trust funds are as follows:		
William McIlrath Trust Fund	251	235
David Rivett Memorial Lecture Fund	90	85
FD McMaster Bequest	2 442	2 450
Sir Ian McLennan Achievement for Industry Award	159	155
The Ken and Yasuko Myer Plant Science Research Fund	1 045	1 002
	3 987	**3 927**

Note 19 Contingent liabilities

Contingent liabilities for which no provision has been made in the accounts as at 30 June 1995 were:

	1995	1994
	$'000	**$'000**
Performance guarantee	92	184
Estimated personal injury and workers compensation claims pre 1988 which are being defended.	80	1 000
	172	**1 184**

Note 20 Auditor's remuneration

Amounts received, or due and receivable, by the Australian National Audit Office for:

	1995	1994
	$'000	$'000
Auditing the accounts	274	260
(No other services were provided by the auditors)	====	====

Note 21 Co-operative Research Centres (CRC)

The Co-operative Research Centres Program, launched in May 1990 by the Commonwealth, was established to assist two or more collaborators to carry out research contributing to the development of internationally competitive industry sectors. The Program supports long-term, high-quality research, improved links between research and application, and stimulation of education and training.

At 30 June 1995 CSIRO is a participant in 52 CRCs and CSIRO's interest in each is listed as follows :

Names of Co-operative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
MANUFACTURING TECHNOLOGY	
Materials Welding and Joining	49
Polymer Blends	34
Molecular Engineering and Technology: Diagnostic Technologies	44
Industrial Plant Biopolymers	25
Intelligent Manufacturing Systems and Technologies	30
International Food Manufacture and Packaging Science	14
Alloy and Solidification Technology	50
INFORMATION AND COMMUNICATION TECHNOLOGY	
Intelligent Decision Systems	7
Robust and Adaptive Systems	22
Australian Photonics CRC	2
Advanced Computational Systems	35
Research Data Network CRC	13
MINING AND ENERGY	
Mining Technology and Equipment	73

continued

Names of Co-operative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
G K Williams CRC for Extractive Metallurgy	52
Australian Petroleum CRC	61
A J Parker CRC for Hydrometallurgy	49
Australian Mineral Exploration Technologies	48
New Technologies for Power Generation from Low Rank Coal	10
Australian Geodynamics CRC	35
Landscape Evolution and Mineral Exploration	52
Black Coal Utilisation	6
AGRICULTURE AND RURAL BASED MANUFACTURING	
Plant Science	64
Tropical Pest Management	44
Temperate Hardwood Forestry	49
Legumes in Mediterranean Agriculture	18
Tropical Plant Pathology	29
Hardwood Fibre and Paper Science	54
Viticulture	22
Premium Quality Wool	46
Cattle and Beef Industry (Meat Quality)	30
Aquaculture	10
Sustainable Cotton Production	28
Food Industry Innovation	15
Sustainable Sugar Production	19
Weed Management Systems	27
Quality Wheat Products and Processes	26
ENVIRONMENT	
Waste Management and Pollution Control	9
Soil and Land Management	57
Antarctic and Southern Ocean Environment	14
Catchment Hydrology	25
Biological Control of Vertebrate Populations	67
Freshwater Ecology	14
Southern Hemisphere Meteorology	35
Sustainable Development of Tropical Savannas	10
Tropical Rainforest Ecology and Management	37
Water Quality and Treatment	14

continued

Names of Co-operative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
MEDICAL SCIENCE AND TECHNOLOGY	
Tissue Growth and Repair	35
Cellular Growth Factors	19
Eye Research and Technology	18
Cardiac Technology	22
Vaccine Technology	26
Diagnostic Technologies	19

CSIRO's equity interest is the proportion which CSIRO contributes overall to each of the CRCs.

Note 22 Board Members' remuneration and superannuation benefits

Remuneration and superannuation benefits received or due and receivable by full-time and part-time Board Members were as follows:

	1995 $'000	1994 $'000
Board Members' remuneration	357	383
Payments to superannuation funds for Board Members	76	37
	433	**420**

The number of Board Members whose total remuneration and superannuation benefits fall within the following bands was as follows:

$	1995 Number	1994 Number
Nil - 10 000	3	2
10 001 - 20 000	7	7
30 001 - 40 000	1	1
70 001 - 80 000	1	–
190 001 - 200 000	1	–
230 001 - 240 000	–	1

Note 23 Executives' remuneration

Remuneration received or due and receivable by the Executives whose remuneration was $100 000 or more was as follows:

	1995	1994
	$'000	$'000
	1 761	1 534

The number of Executives whose total remuneration falls within the following bands was as follows:

$	1995 Number	1994 Number
130 001 - 140 000	–	1
150 001 - 160 000	–	2
160 001 - 170 000	1	3
170 001 - 180 000	2	1
180 001 - 190 000	1	1
190 001 - 200 000	3	–
200 001 - 210 000	1	–
230 001 - 240 000	–	1
260 001 - 270 000	1	–

Note 24 Related party information

Board Members - The Board Members of CSIRO during the financial year were:

A E Clarke

J W Stocker (Term completed during 1994–95)

R M Green

J R de Laeter

A K Gregson (Term completed during 1994–95)

Sir Gustav Nossal (Term completed during 1994–95)

S M Richards

D S Shears

N C Stokes

C R Ward-Ambler (Resigned during 1994/95)

E J Woods

S Hollway

K W Davern

Remuneration - Information on remuneration of Board Members is disclosed in Note 22.

Board Members' interests in contracts

Since 1 July 1994 no Board Member of CSIRO has received or become entitled to receive a benefit, other than a benefit included in the aggregate amount of remuneration received or due and receivable shown in Note 22 by reason of a contract made by CSIRO with the Board Member or with a firm of which the Board Member is a member or with a company in which the Board Member has a substantial financial interest.

Other transactions of Board Member-related entities

The Chairman of the Board, Professor A E Clarke, is a Director of Alcoa of Australia Limited, Australian Mutual Provident Fund Society, Woolworths Limited, Biosupplies Pty Ltd and BioPolymers Pty Ltd and a Board Member of a Co-operative Research Centre. These companies and the CRC have a number of contractual relationships with CSIRO in the field of research and development. The contracts are based on normal commercial terms and conditions.

A Board Member and Chief Executive until 5 March 1995, Dr J W Stocker, is a Director of Gene Shears Pty Ltd, was a Director of MFP Development Corporation, and a consultant to AMRAD Corporation Ltd during 1994–95. These companies have a number of contractual relationships with CSIRO in the field of research and development. The contracts are based on normal commercial terms and conditions.

A Board Member, Mr C R Ward-Ambler, is the Chairman of AMRAD Corporation Ltd and the Australian Nuclear Science and Technology Organisation (ANSTO) and a member of the Pratt Group Advisory Committee. These companies have a number of contractual relationships with CSIRO in the field of research and development. The contracts are based on normal commercial terms and conditions.

A Board Member, Professor Sir Gustav Nossal is a Director of the Walter and Eliza Hall Institute of Medical Research, a non-executive Director of CRA Limited and a Chairman of a Co-operative Research Centre. The Institute, company and CRC have a number of contractual relationships with CSIRO in the field of research and development. The contracts are based on normal commercial terms and conditions.

A Board Member, Dr S M Richards is a Chairman and Managing Director of Aberfoyle Limited. Through its subsidiary, Aberfoyle Resources Limited contributes to several research projects for which CSIRO is the sole or joint contractor. The contracts are based on normal commercial terms and conditions.

A Board Member, Dr A K Gregson is a Director of the Grains Research and Development Corporation and a Board Member of ANSTO and Rural Finance Corporation of Victoria. CSIRO receives research and development grants from the Corporation. ANSTO has a

number of contractual relationships with CSIRO in the field of research and development. These grants and contracts are based on normal commercial terms and conditions.

A Board Member, Mr N C Stokes is a Director of Continental Venture Capital Limited and Gene Shears Pty Ltd. Continental Venture Capital Limited or its subsidiaries may have dealings with CSIRO. Gene Shears Pty Ltd is an associated company of CSIRO and it has a substantial contractual relationship with CSIRO. The contracts are based on normal commercial terms and conditions.

A Board Member, Professor J R de Laeter is a Director of Westralian Sands Pty Ltd and a Board Member of two Co-operative Research Centres. These CRCs have a number of contractual relationships with CSIRO in the field of research and development. The contracts are based on normal commercial terms and conditions.

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