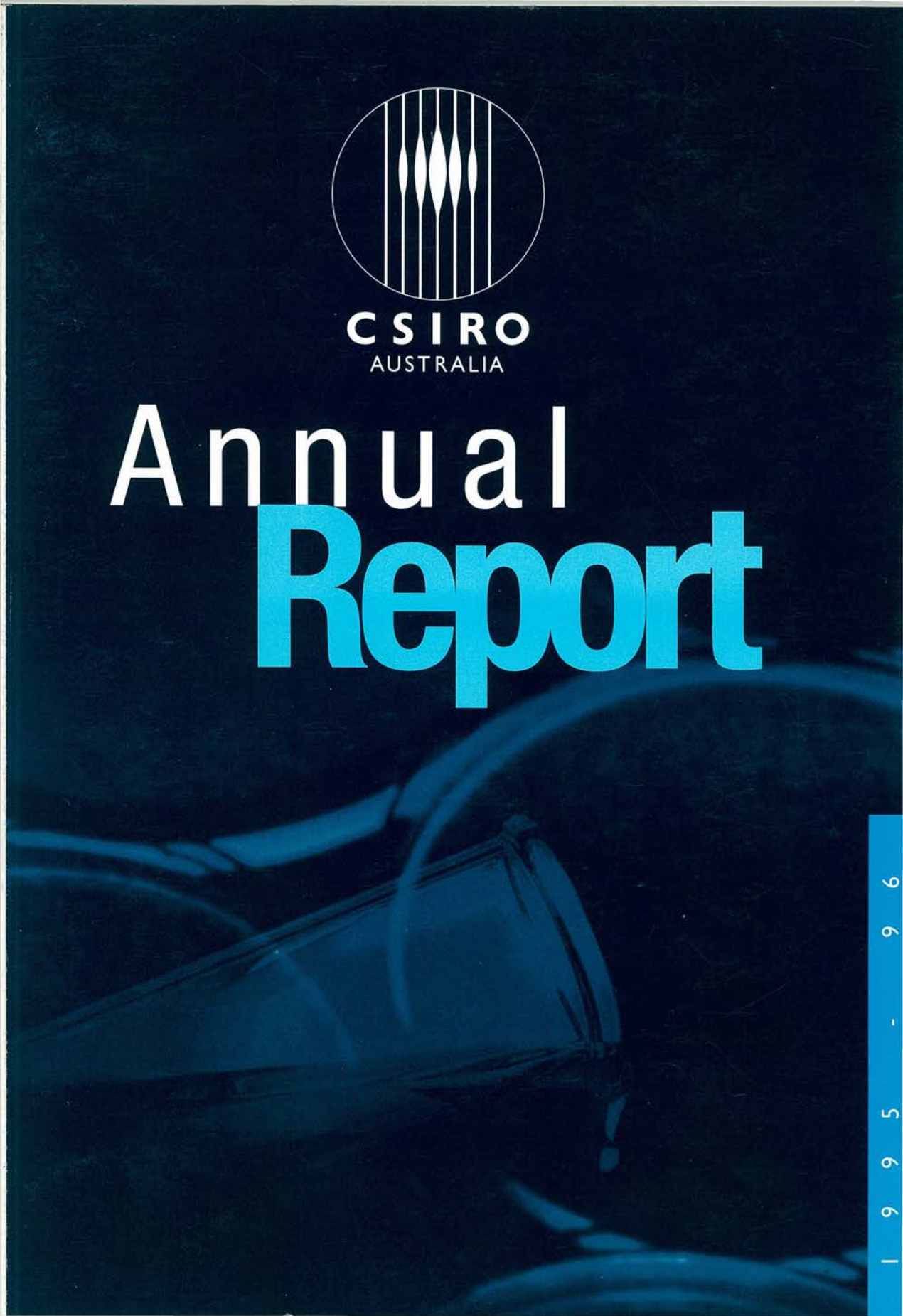
CSIRO
AUSTRALIA

# Annual Report

1995 - 96

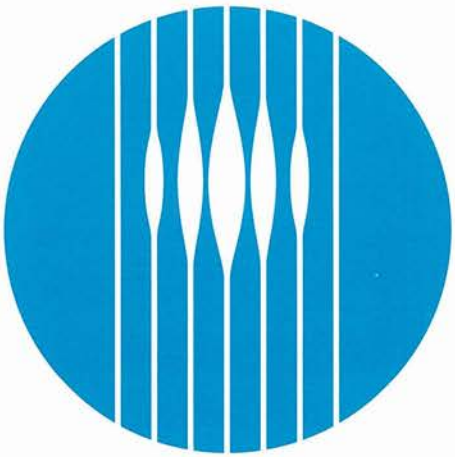


CSIRO — the Commonwealth Scientific and Industrial Research Organisation — is a large and one of the most diverse scientific research institutions in the world. It has a staff of more than 7,000 working in laboratories and field stations throughout Australia.

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.



CSIRO
AUSTRALIA

# Annual Report
# 1995-96

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The Honourable Peter McGauran MP

Minister for Science & Technology

Parliament House

CANBERRA ACT 2600

We have pleasure in submitting to you, for presentation to Parliament, the forty-eighth 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 1996

Malcolm K McIntosh

(Chief Executive)

# Contents

# 1995 - 96 At a glance

- Dr Malcolm McIntosh took up his duties as Chief Executive in February 1996.
- The first phase of CSIRO's restructuring was announced in March 1996.
- CSIRO won a contract to advise the Indonesian research agency LIPI on research management against strong international competition.
- Commercialisation highlights:
  - New block copolymer resins for use as pigment dispersers in inks and toughening agents for automotive coatings have been developed by CSIRO and will be made by Du Pont Australia Ltd.
  - A manufacturing plant is to be set up by Bonlac Foods Ltd to use a CSIRO process for producing a high value protein from whey, a byproduct of cheese-making.
  - CSL Ltd is now marketing a test kit that detects TB in humans, based on CSIRO's test kit for animals.
- Research highlights:
  - new technologies to (a) improve nutrient uptake by various plants and (b) reduce water intake by grapevines, have resulted from research into the basic mechanisms involved.
  - birds and domestic animals have been identified as significant polluters of waterways.
  - developments to increase the life of lead acid batteries have been successful.
  - development of image recognition software, with potential use in security systems.

# Foreword

The most significant event this year has been the completion of the first two stages of the restructuring of CSIRO's management and how CSIRO does business. The outcome so far is a new structure, fewer senior managers, and a more flexible strategic framework to enhance CSIRO's capacity to deliver research outcomes to customers.

The Chief Executive is supported by four Deputy Chief Executives, each of whom is responsible for a set of Sectors of the national economy and its natural resources, a number of Divisions, one or more large sites and one or more corporate management functions.

We now have a much more flexible and responsive arrangement in which Divisions are individually accountable to one of the Deputy Chief Executives, but collaborate with each other in support of work for the 22 Sectors. Sectors are grouped informally into five Alliances to facilitate strategic consideration of the needs of customers, while Divisions retain responsibility for the development and maintenance of CSIRO's scientific skill-base.

This new structure is designed to facilitate the use of resources to tackle complex, multi-disciplinary research problems and address new opportunities. It evolved from an extensive team effort by staff at different levels of CSIRO, working to devise the most effective way to manage a diverse research organisation. We are confident the end result succeeds in matching the stimulation and flexibility needed to conduct excellent science with the high levels of accountability demanded by our stakeholders in the Government, industry and the community at large.

More details of CSIRO's new approach to doing business can be found later in this Report on page 13.

We are confident that the changes will give CSIRO the flexibility to meet new demands and challenges. Our first challenge has been to implement the new structure and, through this process, improve communication with all our stakeholders. We are in a new era in Federal Government and a critically important challenge has been to negotiate a favourable triennium budget for 1997-2000. Finally, throughout all this change, we have sought to maintain and enhance the high quality of our science and keep the research flowing.

Following the March 1996 Federal Election, Mr Sandy Hollway left the Board and was replaced by Mr Greg Taylor, the new Secretary of the Department of Industry, Science and Tourism. Though Mr Hollway was a Board member for only a short time he contributed in many ways to the Board's activities. We all valued Mr Hollway as a colleague and Board member and particularly appreciated his contribution to the structural review. We welcome Mr Taylor.

We also thank Dr Roy Green, former Chief Executive and before that, Director of the Institute of Natural Resources and Environment, who retired from CSIRO in March 1996. Dr Green steered CSIRO most successfully through a difficult period last year while our restructuring

activities and discussions were under way. At times these changes generated a degree of uncertainty both inside and outside the Organisation. The current support for the new arrangements is due in no small part to Dr Green's strong leadership.

This is the first year that we are including performance indicators in the Annual Report. Two years ago CSIRO and other Government science agencies agreed on a set of indicators suited to research performance. After some refinement we now have six key indicators in place. These are reported on page 16 and will serve as a baseline for us to compare and improve our efforts.

During 1995-96, CSIRO scientists have continued to produce outstanding results. We have developed new resins for use in the chemicals and coating industries, improved dragline operations in open-cut coal mining and a new factory is to be built, based on CSIRO technology, to produce a high-value protein from whey. Our work has resulted in a new test for detecting TB in humans and an anti-setting agent for wool fabrics.

Our rural research has developed ways of improving nutrient uptake by various plants and of reducing the amount of water needed by grapevines.
Our environmental research has identified some birds and domestic animals as among the culprits in fouling inland waterways.

One research activity that has caused concern in some areas has been our work with the Rabbit Calicivirus Disease (RCD) and the escape of the virus from its experimental site on an island off South Australia. CSIRO has been conducting tests on this virus on behalf of the Australian Federal and State Governments and the New Zealand Government. At the time of writing the virus had spread sporadically to all mainland States in Australia. The causes of its initial escape and subsequent patchy spread are still unknown, but the weight of evidence points to flying insects aided by strong winds.

The escape was unfortunate for all partners in the project, particularly as it then precluded the detailed public consultation process that had been planned for early 1996. However swift action by State authorities to inform the public prevented widespread concern. Further national tests on the virus have confirmed three years of testing in Australia and experience in other countries, that it only infects the European rabbit and not Australian native animals. We are now working with State authorities to try to maximise the impact of RCD following Federal Government agreement to its official release in the Spring of 1996.

In June 1996, we were pleased to learn that CSIRO has been invited to provide R&D assistance to the Indonesian national research agency, LIPI. CSIRO was selected by the Indonesian Government after a rigorous process of international competitive tendering by the research agencies of several countries. Contracts such as this will greatly help to link Australia to countries in the Asia-Pacific region.

All these activities combine to indicate that CSIRO is emerging from some difficult times reinvigorated and renewed. We are committed to maintaining our contribution to world science as well as to science and technology in support of the Australian economy.

AE Clarke

MK McIntosh

# Corporate Overview

## Vision and purpose

### 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; and
- 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 corporation 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 improve our performance continually.

## 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.

# Charter, functions and powers

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

**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; and
- 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; and
- 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.

## Responsible Minister

From 1 July 1995 to 2 March 1996, the Minister responsible for CSIRO was Senator the Honourable Peter Cook (Minister for Industry, Science and Technology, Minister Assisting the Prime Minister for Science). From 11 March 1996 to 30 June 1996, the Minister responsible for CSIRO was the Honourable Peter McGauran, Minister for Science and Technology.

Under the *Act,* the Minister has the power to:

- direct CSIRO to carry out scientific research for any purpose (sub-paragraph 9(1)(a)(iv));
- provide to the Board in writing, directions and guidelines with respect to the performance of the functions, or the exercise of the powers, of the Board or of the Organisation (section 13 (1)); and
- direct the Board, in the performance of its functions and in the exercise of its powers, to have regard to any relevant policies of the Commonwealth Government.

Neither Minister exercised any of these powers during 1995-96.

## Structure, management and staff

The *Science and Industry Research Amendment Act* 1986 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.

At the start of the year, research was performed in 33 Divisions and research units, grouped into six Institutes. Each Institute had its own management committee, which consisted of the Director and Divisional Chiefs (pages 6-7). The Institute Committee provided 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 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.

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

Central services were provided from a corporate services centre to support managers and staff in the development and implementation of policies, and to provide services such as payrolling that are best performed at the corporate level.

During the year the six Institute structure was abolished and replaced by a matrix management structure that focused on industry and environmental sectors for priority setting and planning, and Divisions with a strong disciplinary focus as semi-autonomous business units for execution. The new structure is described on pages 8 and 9 of this Report.

The new Executive Committee comprises the Chief Executive and four Deputy Chief Executives, and meets more frequently and less formally than its predecessor.

CSIRO staff are employed under Section 32 of the *Science and Industry Research Act* 1949. At 30 June 1996, CSIRO had a total staff of 7,137, which has an equivalent full-time value of 6,758 units. The numbers employed in different job categories are shown in the chart on page 31.

# The Board (as at 30 June 1996)

**Chairman**

Professor Adrienne Clarke
AO BSc PhD FTS FAA

Director, Plant Cell Biology Research Centre

University of Melbourne

5 December 1991
— 4 December 1996

Dr Malcolm McIntosh
BSc PhD FRAeS

Chief Executive of CSIRO

3 January 1996
— 2 January 2001

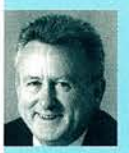
Dr Roy Green BSc PhD FTS

Chief Executive of CSIRO

18 July 1995 — 2 January 1996

Acting Chief Executive of CSIRO

1 July 1995 — 17 July 1995
3 January 1996
— 4 Febuary 1996



Mr Kevin Davern

Joint National Secretary

Finance Sector Union of Australia

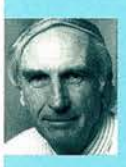
1 September 1994
— 31 August 1997

Mr Sandy Hollway BA(Hons)

Secretary

Department of Industry, Science and Technology

6 December 1994
— 5 December 1997
(Resigned 22 March 1996)



Professor John de Laeter
AO FTS FInstP FAIP

Deputy Vice-Chancellor (Research and Development)

Curtin University of Technology

5 December 1991 —
4 December 1995

Dr Max Richards
BSc PhD FAIMM

Chairman

Aberfoyle Limited

12 December 1995
—11 December 1997
(Reappointment)

Mr Doug Shears

Executive Chairman

ICM Australia Pty Ltd

5 December 1991
— 4 December 1996

Mr Nigel Stokes BEc BA

Company Director

1 September 1994
— 31 August 1996

Dr Eric Tan
AM MBBS FRACS FACS

Managing Director

Medical Corporation Australia Ltd

12 December 1995
— 11 December 1998

Mr Greg Taylor AO BEc(Hons)

Secretary

Department of Industry, Science and Tourism

23 April 1996 —22 April 1999

Dr Beth Woods
OAM BAgrSc PhD

Director

Rural Extension Centre

University of Queensland

9 June 1995 — 8 June 1998

# CSIRO Organisational Chart
# As at 1 July 1995 - 18 March 1996

## THE BOARD

Professor Adrienne Clarke, AO

Mr KW Davern
Mr DA Hollway
Dr MK McIntosh
Dr R Green
Dr SM Richards
Mr DS Shears
Mr NC Stokes
Dr EGC Tan, AM
Dr EJ Woods, OAM
Professor J de Laeter

## INSTITUTE OF INFORMATION SCIENCE & ENGINEERING

Director
Dr RH Frater, AO

### DIVISIONS

Information Technology

Mathematics and Statistics

Radiophysics

Australia Telescope National Facility

## INSTITUTE OF INDUSTRIAL TECHNOLOGIES

Director
Dr CM Adam

### DIVISIONS

Applied Physics

Biomolecular Engineering

Chemicals and Polymers

Manufacturing Technology

Materials Science and Technology

## INSTITUTE OF MINERALS, ENERGY & CONSTRUCTION

Acting Director
Dr BE Hobbs

### DIVISIONS

Building, Construction and Engineering

Coal and Energy Technology

Exploration and Mining

Minerals

Petroleum Resources

## CHIEF EXECUTIVE

Dr RM Green (to 30 Dec)

Dr MK McIntosh (from 1 Jan)

## CORPORATE SERVICES

Director
Mr AW Blewitt

## CORPORATE BUSINESS

Chief General Manager
Dr T Biegler

## INSTITUTE OF ANIMAL PRODUCTION & PROCESSING

Director
Dr CP Mallett

### DIVISIONS

- Animal Health
- Animal Production
- Food Science and Technology
- Human Nutrition
- Tropical Animal Production
- Wool Technology

## INSTITUTE OF PLANT PRODUCTION & PROCESSING

Director
Dr JC Radcliffe, OAM

### DIVISIONS

- Entomology
- Forestry & Forest Products
- Horticulture
- Plant Industry
- Tropical Crops and Pastures
- Soils

## INSTITUTE OF NATURAL RESOURCES & ENVIRONMENT

Acting Director
Dr GI Pearman

### DIVISIONS

- Atmospheric Research
- Fisheries
- Oceanography
- Water Resources
- Wildlife and Ecology
- Centre for Environmental Mechanics
- CSIRO Office of Space Science & Applications

# CSIRO Organisational Chart (From 19 March 1996)

## THE BOARD

Professor Adrienne Clarke, AO (Chairman)

Mr KW Davern
Mr NC Stokes
Mr DS Shears
Dr EJ Woods, OAM
Mr GF Taylor, AO
Dr SM Richards
Dr MK McIntosh
Dr EGC Tan, AM

## CHIEF EXECUTIVE

Dr MK McIntosh

## CORPORATE EXECUTIVE OFFICE

Corporate Secretary
Dr EN Cain

## DEPUTY CHIEF EXECUTIVES

**Dr Colin Adam**

Deputy Chief Executive

**Chair:** Minerals & Energy Alliance

**Alternate Chair:**
Manufacturing Alliance

**Dr Bob Frater, AO**

Deputy Chief Executive

**Chair:** Information Technology, Infrastructure & Services Alliance

**Chair:** Manufacturing Alliance

## CSIRO DIVISIONS AND CORPORATE SUPPORT UNITS

### DIVISIONS

Building, Construction & Engineering

Coal & Energy Technology

Exploration & Mining

Materials Science & Technology

Minerals

Petroleum Resources

ooo

Commercial Group

Corporate Property

Legal Network

### DIVISIONS

Applied Physics

Australia Telescope National Facility

Biomolecular Engineering

Chemicals & Polymers

Information Technology

Manufacturing Technology

Mathematics & Statistics

Radiophysics

ooo

Information Technology Services

Corporate Information Management

CSIRO Publishing

Strategic Planning & Evaluation

## RISK ASSESSMENT & AUDIT

General Manager
Mr P O'Callaghan

**Dr Chris Mallett**

Deputy Chief Executive

Chair: Agribusiness Alliance

**Dr John Radcliffe, OAM**

Deputy Chief Executive

**Chair:** Environment & Natural Resources Alliance

## DIVISIONS

Animal Health

Animal Production

Fisheries

Food Science & Technology

Human Nutrition

Tropical Animal Production

Tropical Crops & Pastures

Wool Technology

ooo

Corporate Finance

## DIVISIONS

Atmospheric Research

COSSA

Entomology

Environmental Mechanics

Forestry & Forest Products

Horticulture

Oceanography

Plant Industry

Soils

Water Resources

Wildlife & Ecology

ooo

Corporate Human Resources

# Senior staff and addresses (as at 30 June 1996)

## CSIRO Corporate Centre - Canberra

Limestone Ave, CAMPBELL, ACT 2601
Tel: (06) 276 6766

## Chief Executive

Dr MK McIntosh

## Deputy Chief Executives

Dr C Adam
Dr RH Frater, AO
Dr C Mallett
Dr JC Radcliffe, OAM

## General Manager

**Risk Assessment and Audit**
Mr PF O'Callagahn

## Corporate Executive Office

Corporate Secretary
Dr EN Cain

Government Business
and International Scientific Liaison
Principal Secretary
Dr TE Heyde

Manager, Ministerial and
Government Business
Ms MJ Keir

Manager
Education Programs
Mr R Kingsland

## Corporate General Managers

Commercial Group
Dr T Biegler

Corporate Finance
Mr RJ Garrett

Corporate Human Resources
Mr B Walker

Corporate Information
Management Services
Ms J de Gooijer (Melbourne)

Corporate Information
Technology Services
Mr J Potter

Corporate Property
Mr GJ Harley

CSIRO Publishing
Mr P Reekie

Strategic Planning and Evaluation
Dr AJ Pik

## Divisions

**Chief, Division of Animal Health**

Dr MD Rickard
Cnr Flemington Road and Park Drive
PARKVILLE VIC 3052
Tel: (03) 9342 9727

**Chief, Division of Animal Production**

Dr O Mayo
Clunies Ross St
PROSPECT NSW 2149
Tel: (02) 9840 2833

**Chief, Division of Applied Physics**

Dr JG Collins
Bradfield Road
LINDFIELD NSW 2070
Tel: (02) 9413 7328

**Chief, Division of**
**Atmospheric Research**

Dr GI Pearman
Station Street
ASPENDALE VIC 3195
Tel: (03) 9239 4650

**Chief, Division of Biomolecular Engineering**

Dr PM Colman
343 Royal Parade
PARKVILLE VIC 3052
Tel: (03) 9342 4211

**Chief, Division of Building, Construction and Engineering**

Mr LR Little
Graham Road
HIGHETT VIC 3190
Tel: (03) 9252 6114

**Chief, Division of Chemicals and Polymers**

Dr TH Spurling
Bayview Avenue
CLAYTON VIC 3169
Tel: (03) 9542 2470

**Chief, Division of Coal and Energy Technology**

Dr JK Wright
51 Delhi Road
NORTH RYDE NSW 2113
Tel: (02) 9887 8666

**Chief, Division of Entomology**

Dr PW Wellings
Clunies Ross Street
BLACK MOUNTAIN ACT 2601
Tel: (06) 246 4025

**Chief, Division of Exploration and Mining**

Dr BE Hobbs
Underwood Ave
FLOREAT PARK WA 6014
Tel: (09) 387 0361

**Chief, Division of Fisheries**

Dr PC Young
Castray Esplanade
HOBART TAS 7001
Tel: (002) 32 5264

**Chief, Division of Food Science and Technology**

Dr M Eyles
Delhi Road
NORTH RYDE NSW 2113
Tel: (02) 9887 8341

**Division of Forestry and Forest Products**

Dr GA Kile
Banks Street
YARRALUMLA ACT 2600
Tel: (06) 281 8314

**Chief, Division of Horticulture**

Dr E Heij
Hartley Grove
URRBRAE SA 5064
Tel: (08) 303 8622

**Chief, Division of Human Nutrition**

Prof RJ Head
Kintore Avenue
ADELAIDE SA 5000
Tel: (08) 303 8865

**Chief, Division of Information Technology**

Dr JF O'Callaghan
North Road
ACTON ACT 2601
Tel: (06) 216 7001

**Chief, Division of Manufacturing Technology**

Dr IR Sare
Cnr Albert & Raglan Streets
PRESTON VIC 3072
Tel: (03) 9662 7718

**Chief, Division of Materials Science and Technology**

Dr MJ Murray
Normanby Road
CLAYTON VIC 3169
Tel: (03) 9542 2787

**Chief, Division of Mathematics and Statistics**

Dr RL Sandland
Macquarie University Campus
NORTH RYDE NSW 2113
Tel: (02) 9325 3203

**Chief, Division of Minerals**

Dr RD La Nauze
Bayview Avenue
CLAYTON VIC 3169
Tel: (03) 9545 8600

**Chief, Division of Oceanography**

Dr CB Fandry
Castray Esplanade
HOBART TAS 7001
Tel: (002) 32 5212

**Chief, Division of Petroleum Resources**

Dr AF Williams
Kinnoull Grove
SYNDAL VIC 3150
Tel: (03) 9881 1289

**Chief, Division of Plant Industry**

Dr WJ Peacock, AC
Clunies Ross Street
BLACK MOUNTAIN ACT 2601
Tel: (06) 246 5250

**Chief, Division of Radiophysics**

Dr DN Cooper
Cnr Vimiera and Pembroke Roads
MARSFIELD NSW 2121
Tel: (02) 372 4200

**Chief, Division of Soils**

Dr RS Swift
Waite Road
URRBRAE SA 5064
Tel: (08) 303 8406

**Chief, Division of Tropical Animal Production**

Dr PA Jennings
120 Meiers Road
INDOOROOPILLY QLD 4068
Tel: (07) 3214 2800

**Chief, Division of Tropical Crops and Pastures**

Dr JA Taylor
306 Carmody Road
ST LUCIA QLD 4067
Tel: (07) 3377 0209

**Chief, Division of Water Resources**

Dr G Pickup
Clunies Ross Street
BLACK MOUNTAIN ACT 2601
Tel: (06) 246 5805

**Chief, Division of Wildlife and Ecology**

Dr BH Walker
Barton Highway
GUNGAHLIN ACT 2912
Tel: (06) 242 1742

**Chief, Division of Wool Technology**

Dr KJ Whiteley
Princes Highway
BELMONT VIC 3216
Tel: (052) 27 5777

## RESEARCH GROUPS

**Director, Australia Telescope National Facility**

Prof RD Ekers
Cnr Vimiera and Pembroke Roads
MARSFIELD NSW 2121
Tel: (02) 9372 4300

**Head, Centre for Environmental Mechanics**

Dr JJ Finnigan
Clunies Ross Street
BLACK MOUNTAIN ACT 2601
Tel: (06) 246 5552

**Head, Centre for Mediterranean Agricultural Research**

Mr ML Poole
Underwood Avenue
FLOREAT WA 6014
Tel: (09) 387 0603

**Head, CSIRO Office of Space Science and Applications**

Dr BJ Embleton
Cnr North and Daley Roads
ACTON ACT 2601
Tel: (06) 216 7230

# Corporate Development

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

## Planning and evaluation

### Corporate restructuring and the planning process

During 1994-95, the CSIRO Board conducted an evaluation of CSIRO's management and structure. The recommendations included discontinuation of the formal Institute structure, and restructuring of the Executive to give greater emphasis to the corporate and strategic role of its members.

In March 1996, CSIRO's new Chief Executive, Dr Malcolm McIntosh, announced the appointment of four Deputy Chief Executives, each having a mix of Sectoral, Divisional and corporate responsibilities (as shown in the chart on pages 8-9). The six Institutes, which were adopted in 1988, ceased to operate formally on 30 June 1996.

Following the restructure, CSIRO's research Divisions remain the core business units of the Organisation. Research planning and prioritisation will be undertaken on a Sectoral basis, where each Sector represents an industry group, market or natural resource of national significance. External advice will be channelled through Sector Advisory Committees. The Chairpersons of Sector Advisory Committees will be appointed by the CSIRO Board.

To recognise the important links that exist between many Sectors, the 22 Sectors are grouped into five Alliances (as shown in Box 1, page 14). Each Alliance is chaired by a Deputy Chief Executive. Alliances are strategic meeting points for Divisions to engage in the planning and conduct of research for related Sectors, not structural elements as were the Institutes. Each Division will contribute relevant skills to a variety of Sectors through one or more Alliances as appropriate.

Taken together, the changes in management and structure are designed to strengthen CSIRO's capacity to assemble multidisciplinary teams to conduct world-class research. They also

ensure that the Organisation's research consists of a balanced portfolio of projects directed to the short, medium and longer term needs of customers and clients in both the private and public sectors.

Considerable progress has been made since March 1996 in reorienting CSIRO's research planning and priority setting processes to this new approach. A Sector-based stocktake of research activity has been compiled and an Outlook for each Sector is being prepared with input from the Sector Advisory Committees. This work will inform CSIRO's assessment of research opportunities across all Sectors and form the basis for development of Sector Plans. The first allocation of resources to research activities on the basis of agreed Sector Plans will be made to coincide with the commencement of the next funding triennium (1997-98 to 1999-2000).

A second significant outcome from the CSIRO Board's Evaluation of Management and Structure was the inaugural CSIRO-Government Workshop held on 20 October 1995. The workshop brought senior officials from 14 Government departments together with senior CSIRO scientists and managers. The result was a valuable dialogue about the key economic, social and environmental issues facing Australia and the potential role of science and technology in general, and the role of CSIRO research in particular, in helping Government address these issues.

Box 1

## CSIRO's ALLIANCES and SECTORS as at June 1996

### Sectors in the Agribusiness Alliance

- Field Crops
- Food Processing
- Forestry, Wood and Paper Industries
- Horticulture
- Meat, Dairy and Aquaculture
- Wool and Textiles

### Sectors in the Environment and Natural Resources Alliance

- Biodiversity
- Climate and Atmosphere
- Land and Water
- Marine

### Sectors in the Information Technology, Infrastructure and Services Alliance

- Information Technology and Telecommunications
- Infrastructure
- Measurement Standards
- Radio Astronomy
- Service

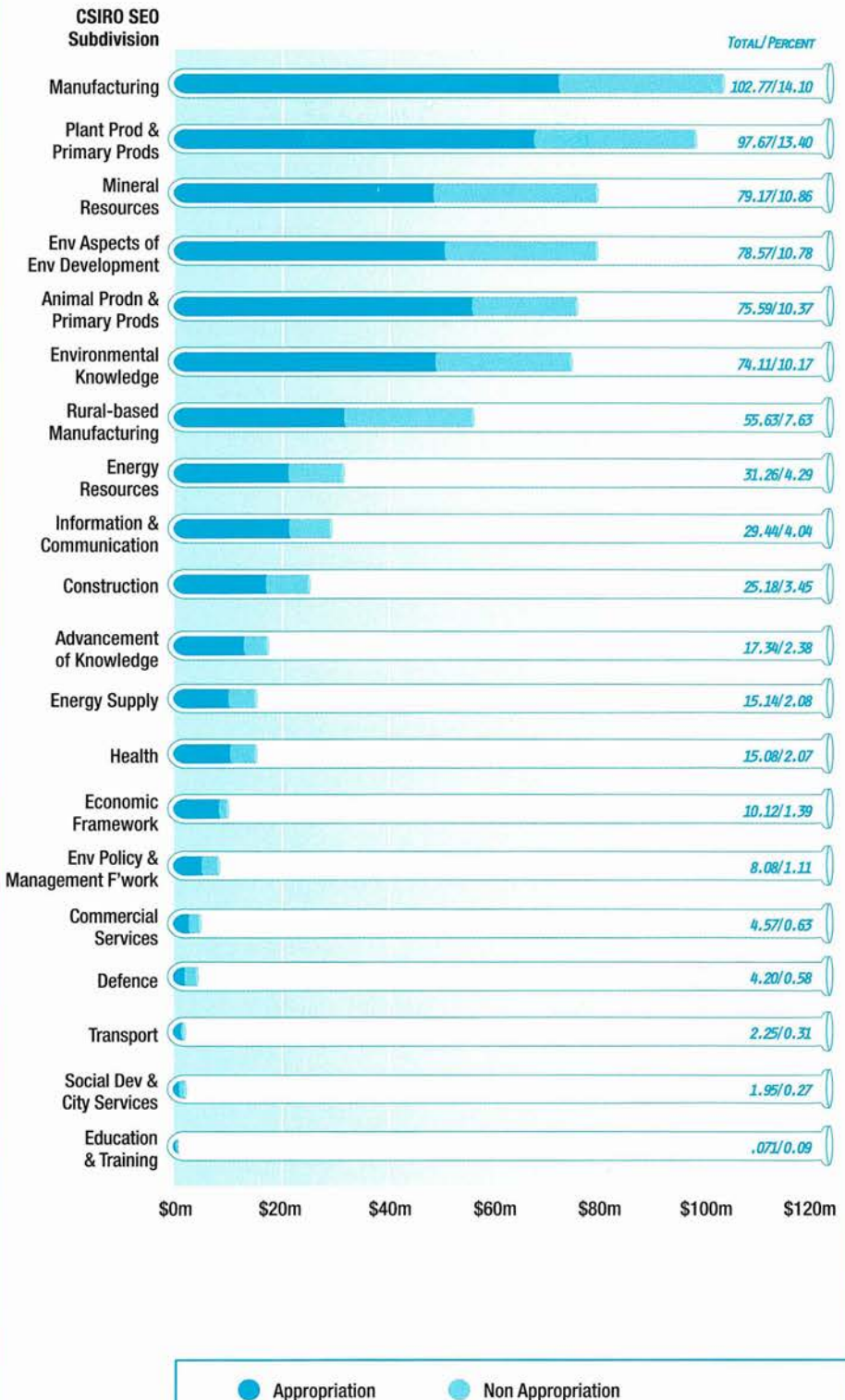
### Sectors in the Manufacturing Alliance

- Chemicals and Plastics
- Integrated Manufactured Products
- Pharmaceuticals and Human Health

### Sectors in the Minerals and Energy Alliance

- Coal and Energy
- Mineral Exploration and Mining
- Mineral Processing and Metal Production
- Petroleum

## Figure 1: Distribution of research effort 1995-96

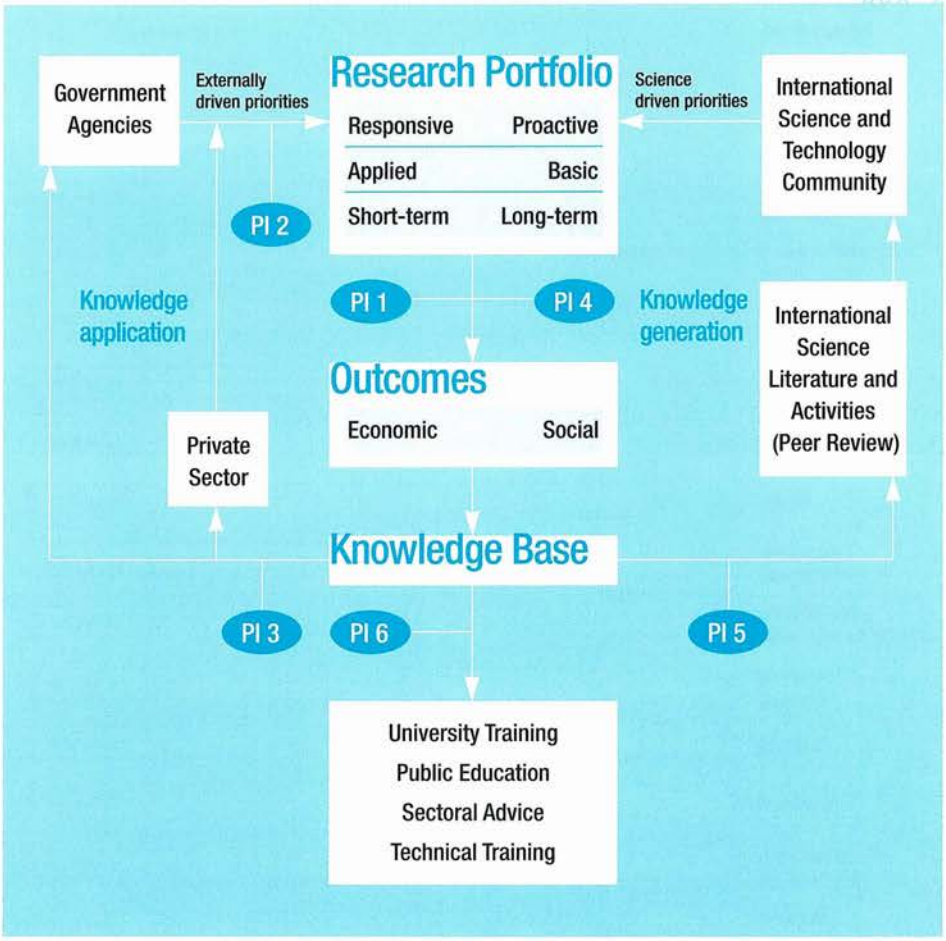


# Performance Indicators

Under a 1995 agreement with the then Ministers of Finance, and Industry, Science and Technology, CSIRO and the other Commonwealth science agencies, agreed to trial six Performance Indicators as a means of demonstrating a commitment to continuous improvement.

The context of the indicators in terms of CSIRO's mission is depicted in Box 2 below.

Box 2




Key:
- PI 1 - Shift of resources in accord with priority decisions
- PI 2 - External earning target
- PI 3 - Customer satisfaction
- PI 4 - Adoption of research results
- PI 5 - Publications, reports and patents
- PI 6 - Training

## Performance indicator 1: shift of resources according to priority decisions

*This indicator measures CSIRO's shift of resources in line with changing priorities as determined in consultation with Government and CSIRO customers in the public and private sectors.*

In conjunction with stakeholders, CSIRO undertakes a major assessment of research priorities on a triennial basis. The assessment coincides with consideration of the Organisation's Triennial Funding by Government, and guides the subsequent allocation of resources between the vast number of research opportunities the Organisation may pursue to serve a range of socio-economic objectives (SEOs).

The Government does not stipulate either the direction or magnitude of resource shifts but, as part of the Triennium Funding Agreement, CSIRO has agreed to report on the change in expenditure in defined priority areas over the full triennium.

The current triennium covers the years 1994-95 to 1996-97 and thus still has one year to run. A final report under the terms of the Agreement will therefore be provided in next year's Annual Report. This Report provides interim information comparing total expenditure by priority SEOs for the first two years of the triennium with expenditure in the final year of the previous triennium.

### The 1993 priority decisions and interim outcomes

The major priority decisions affirmed by the CSIRO Board in December 1993 for the 1994-95 to 1996-97 triennium were that appropriation resources directed to research for Mineral Resources, Manufacturing, and Information and Communications would be increased together with increased external earnings for the latter two.

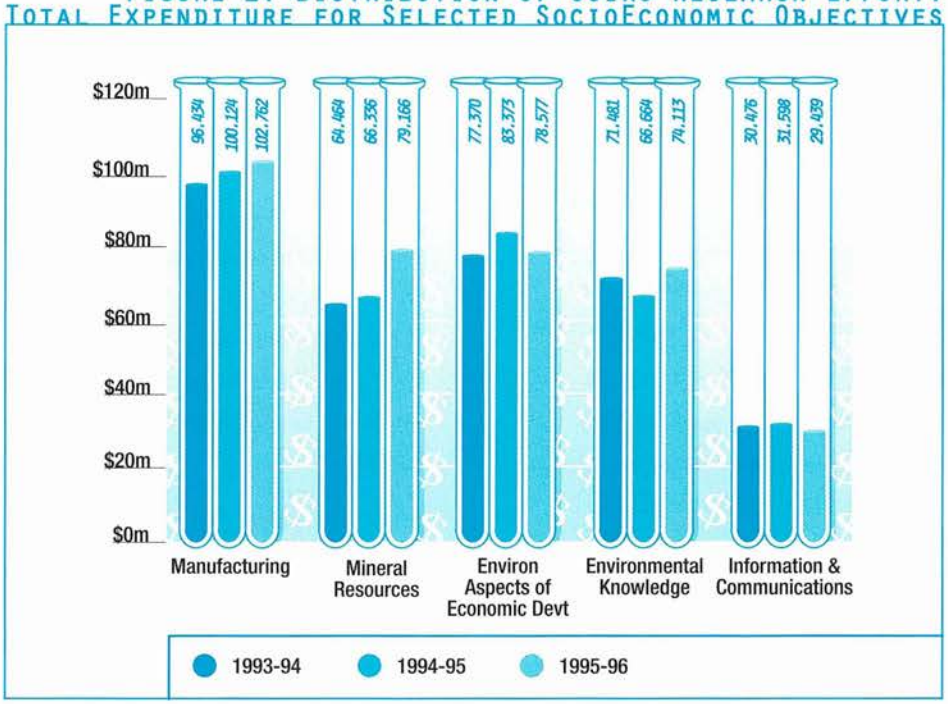
It was also agreed that appropriation funding would be maintained at the existing level for Environmental Aspects of Economic Development and Environmental Knowledge.

The shift in total expenditure for each of these SEOs over the period is shown in Figure 2, page 18. Taken together these five SEOs accounted for 48.3 per cent of total expenditure in 1993-94 and 50 per cent in 1995-96.

With two years of the triennium completed there has been strong growth in the expenditure on research for Manufacturing and Mineral Resources. The two Environmental SEOs have maintained their share of total expenditure in aggregate.

So far, the Information and Communications area has not shown the expected growth. This is due, at least in part, to the expenditure of funds on a major new software initiative being reflected in other SEO classifications which are being served by this particular program.

FIGURE 2: DISTRIBUTION OF CSIRO RESEARCH EFFORT: TOTAL EXPENDITURE FOR SELECTED SOCIOECONOMIC OBJECTIVES




## Performance indicator 2: external earnings

*This indicator is a measure of the demand for CSIRO's research and services consistent with its mission. The agreed target is for external earnings to be 30 per cent of total income derived from the provision of research and technology services or outputs.*

External earnings for 1995-96 were 32.6 per cent of total income, up from 30.5 per cent in 1993-94. Note that these numbers are based on income, not expenditure. Expenditure details are provided elsewhere in the Annual Report.

## Performance indicator 3: customer satisfaction

*This indicator is intended as a measure of CSIRO's responsiveness to customer needs and has been measured primarily for those cases where there is a contractual arrangement. These data therefore tend to exclude, at least at this stage, satisfaction with (for example) the provision of scientific advice to aid Government policy making.*

Formal post-contract surveys on customer satisfaction were conducted by ten CSIRO Divisions in 1996. Of the 281 returns received from customers, high levels of satisfaction were recorded by each of the ten Divisions. The main cause of dissatisfaction was slowness predominantly in report delivery, but also in contract preparation and negotiation.

Another ten Divisions are intending to conduct formal customer satisfaction surveys in 1996-97. The remaining Divisions, as well as those which do conduct formal surveys, use other methods such as repeat business and contract reviews with clients to gauge the level of satisfaction and to take corrective action if needed.

## Performance indicator 4: adoption

*This indicator assesses the significance or impact of the work CSIRO does as opposed to the External Earnings indicator which simply measures CSIRO's ability to generate revenue. The measure looks at examples of CSIRO-developed practices, instruments or products, and processes adopted by users in industry, Government and the community, or changes in user practice in response to policy advice provided by CSIRO.*

This is a difficult indicator to quantify and measure. A listing of significant achievements has been compiled and several are described in the Research Highlights section of this Annual Report. The following is a *selective* list of items for this indicator.

### Practices

- an expert system for building code compliance winning five national awards plus a CSIRO Medal and adopted also in Malaysia and Indonesia;
- adoption of prawn selective breeding increasing the company's turnover by 20 per cent;
- creation and establishment of two new cropping enterprises (feed wheat and linola);
- utilisation of rapid biodiversity assessment techniques in the Forest Comprehensive Regional Assessment process and in Papua New Guinea;
- sub-surface irrigation for vineyards realising a saving in water costs of $200 per hectare per year and contract cultivation costs of $400 per hectare per year;
- protocols for controlling enterrohaemorragic *E.coli* in fermented meat products have been developed for the Australian food processing industry; and
- establishment of sustainable catch levels for Southern Bluefin Tuna in Australian waters.

### Instruments and products

- adoption by one of the national carriers for mobile communications of a new class of power amplifier for cellular base stations, which has higher performance and lower cost than conventional systems;
- commercial coding equipment and process technology to extend the working life of precision coining dyes by as much as five to ten times have been commissioned at the Royal Australian Mint;
- release of cultivars of mungbean, soybean, cowpea and cotton achieving up to 95 per cent of market share in the past six years;
- new milk powder technology opening up a $34 million per annum export market;
- an airborne multi-spectral scanner for environmental monitoring and mineral exploration has been developed and commercialised;
- commissioning and first industrial trials of a mobile magnesium melting/dosing furnace;
- a Very High Speed Card which more than doubles the output of conventional worsted card technology while maintaining the quality of the woollen product (net present value assessed at $220 million).

## Processes

- expertise in polymer surface engineering for painting and adhesion has been a significant factor in the decision by an overseas firm to invest in Australia to support its activities in the Asia-Pacific region;
- assistance in the discovery of major new gold deposits in the Yilgarn region of Western Australia (in particular Plutonic and Bronzewing) with the deposits having an estimated value of $4.5 billion;
- successful commissioning of CSIRO's Synthetic Rutile Enhancement Process at Narngula;
- provision of scientific basis for new Commonwealth Environmental Guidelines for Pulp Mills;
- management guidelines established to minimise algal blooms by controlled water flow releases from weir pools;
- cellular manufacturing facility designed and implemented in Boeing's Wichita (USA) plant.

# Performance indicator 5: publications, reports and patents

*This indicator is used primarily to assess CSIRO's contribution to, and hence ability to access, the world's knowledge base. Australia produces only some 2 per cent of the world's science and technology and hence the ability to access the other 98 per cent and evaluate it for local use is crucial. Quantity is measured and reported annually; the quality of publications, via citation analysis, is assessed and reported triennially and hence will be reported next year.*

## Publications

Total publication output has been relatively steady over the last ten years at approximately 3,500 per annum as

FIGURE 3: CSIRO PUBLICATIONS BY DOCUMENT TYPE 1985 TO 1995

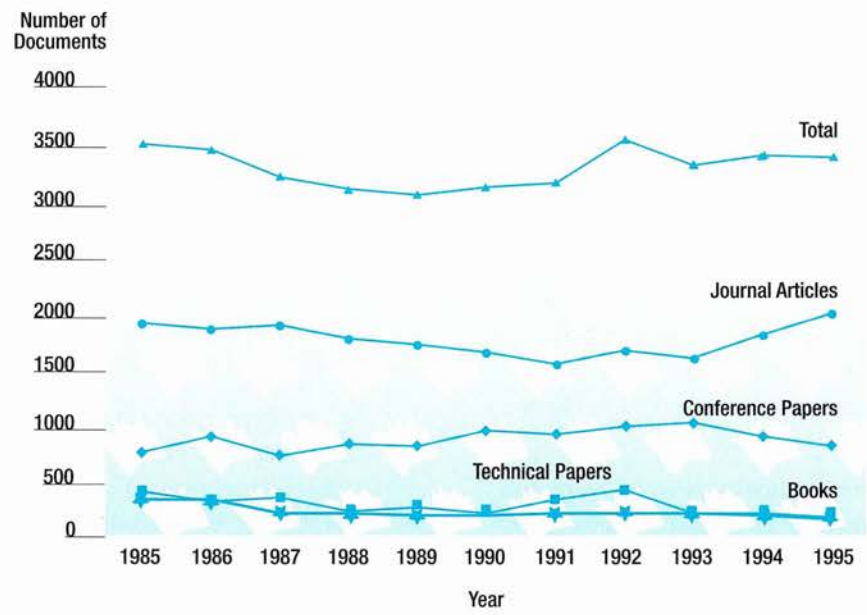
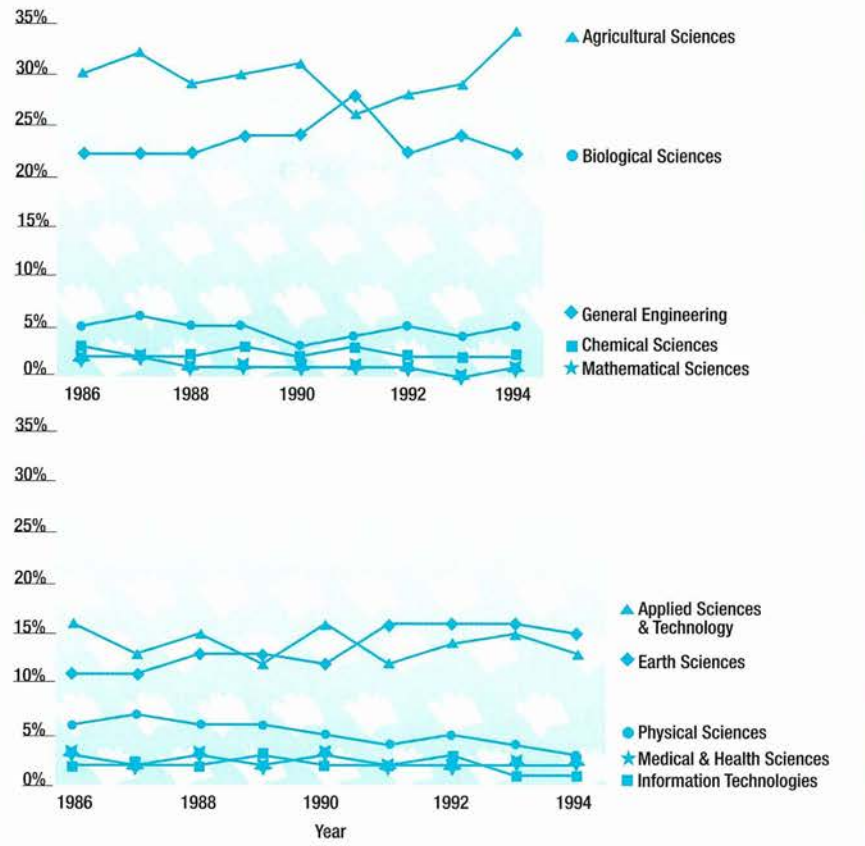


FIGURE 4: CSIRO PUBLICATIONS BY FIELD OF RESEARCH 1986 TO 1994




reported through the CSIRO Index. Numbers of scientific research articles are steady. General science articles have increased slightly; technical reports have decreased since 1992 (Figure 3).

CSIRO continues to produce a majority of its articles in the agricultural and biological sciences. The proportion of articles in earth sciences has increased since 1990 (Figure 4).

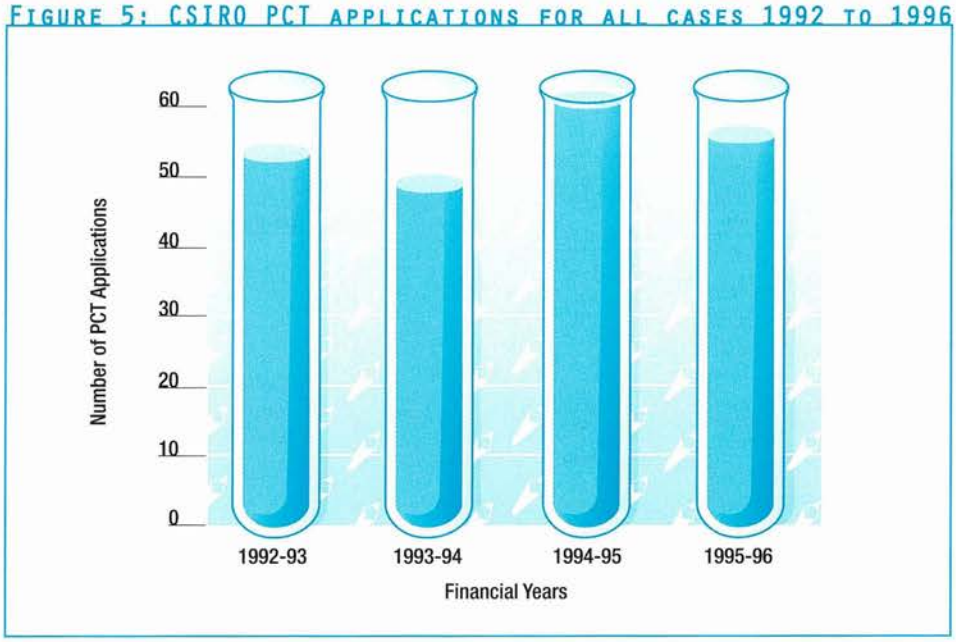
## Client reports

CSIRO produced a total of 4,760 client reports for 1995-96. This was the first year such information has been collected and as such it may not be complete. There are wide variations within CSIRO. The majority of the client reports (2,745) were produced by just two Divisions reflecting the service (testing) nature of part of their operations. A further 690 client reports were produced by two other Divisions. There are another four Divisions which produced over 100 reports each. The remaining 28 Divisions and Units produced less than 100 client reports. Of these, half produced less than 20 client reports.

## Patents

CSIRO patents data have been collected for the last four years by IPM Pty Ltd, CSIRO's intellectual property data base managers. Owing to the complex nature of families of patent

FIGURE 5: CSIRO PCT APPLICATIONS FOR ALL CASES 1992 TO 1996




applications, an indicator of Patents activity is used. The indicator used here is patent applications under the Patent Cooperation Treaty (PCT). Publication occurs within six months of a patent application under the PCT.

International patent applications filed by CSIRO are relatively steady over the last four years (Figure 5). As expected, some of these applications are allowed to lapse over time. The decision to maintain a patent takes into account legal advice, market conditions and identification of and wishes of commercial partners. However, once they are published, patent applications remain as published documents.

## Performance indicator 6: training

*This indicator is a measure of the number of students jointly supervised by CSIRO and university staff and the number of students fully or partially sponsored by CSIRO (not including CSIRO employees). It is a measure of CSIRO's contribution to developing the skill base in Australia.*

In collaboration with universities throughout Australia, CSIRO in 1996 jointly supervised a total of 902 postgraduate students, including 703 PhD students and 199 Masters or Honours students. Over one third of these students were supervised through the Organisation's involvement in the Cooperative Research Centre program (up 73 per cent from 1994). The corresponding figures for 1995 were 509 PhD students and 183 Masters or Honours students.

In 1996 CSIRO provided full scholarships to 31 PhD and seven Masters or Honours students, and partial scholarships to a further 91 PhD and 17 Masters or Honours students. These numbers are essentially unchanged from 1994.

In addition, CSIRO is also involved in student lectures and seminars, undergraduate and TAFE courses, short courses, summer schools, apprenticeships and vacation student programs.

# Corporate Development

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

## Risk assessment and audit

During 1995-96, risk assessments were completed for nine Divisions within CSIRO. The risk assessment process provided the basis for identifying and analysing high and significant risks, and the process for examining risk treatment options.

Sixteen Divisional and Departmental audits were completed during the year, and specialist Organisation-wide reviews of commercial practices (six Divisions), capital budgeting and asset management (eight Divisions) and financial management including accrual accounting (eight Divisions) were undertaken.

Additionally, regular meetings were held with the Australian National Audit Office to ensure that synergies between internal and external audits were optimised.

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

## Finance systems

1995-96 was a year of consolidation in the finance area. The Organisation continued the thrust towards full accrual budgeting and improved financial management. Several financial management reports were enhanced to provide better information, and much effort went into improving the quality of information held in the finance systems. The systems themselves underwent a series of enhancements to improve their functionality and user interface.

During 1995-96 the Executive Committee agreed that the Organisation should adopt a more rigorous approach to managing its activities on a project basis. Significant progress was made in implementing this decision. For example, there was increasing Divisional interest in, and use of, computer-based project management and timesheeting tools. To cater for this increasing interest, and

to ensure a reasonably uniform project management environment, specific products were adopted by the Executive Committee as Organisational standards.

Work continued on the proposed project information and management system. Following a program of workshops held around Australia, the Executive Committee decided that implementation should focus initially on the provision of a project ledger and a reporting database. A broadly-based working group considered and made recommendations on the accounting principles and practices that should accompany the introduction of a project ledger. Another group provided input into the information elements that should be captured in a reporting database. The Executive Committee agreed that further functionality would be built into the system once a demonstrated need existed.

The trial of proposed new travel arrangements was completed, and a report prepared on the outcomes. The report is to be considered by staff associations and management before final decisions are taken on its recommendations.

## Information technology services

The CSIRO Information Management and Technology Committee (IMTC) was formed out of the former Information Technology Steering Committee (ITSC) in March 1996 to reflect a wider charter encompassing oversight of both information management and the implementation of technology.

The committee reviews and advises on major developments such as the TRIM Records Management Project; the Discussions, Negotiations and Agreements System; the Project Management and Reporting System (formerly PIMS); major enhancements in the Human Resource Systems (eg on-line staff services, Leave System); and World Wide Web system enhancements. The IMTC also advises on issues of policy and standards for matters such as e-mail, security, and standard desktop platforms. In the forthcoming year the committee will focus on refining the system owner process, examining the funding of IT projects and investment in IT infrastructure, and revising the IT strategic plan.

Major changes have occurred in telecommunications systems over the past 12 months following the sale of AARNet to Telstra. As a result of this, CSIRO and universities throughout Australia are involved in joint projects in every State, called Regional Network Organisations. These provide very high speed data links between the organisations and subsequent access to the Internet. The networks are constructed using microwave technology and state-of-the-art communications protocol - Asynchronous Transfer Mode (ATM).

Under the PABX replacement program, seven more PABXs were installed to provide high quality digital telephony.

ITS Operations continue to plan and maintain the operating environments for the major Corporate applications. Several security enhancements, including rigorous encryption and authentication schemes, have been developed and implemented. Comprehensive IT security procedures have been incorporated into the

CSIRO Security Manual and an IT security awareness program has begun across all of CSIRO.

A focus for 1996-97 will be to upgrade the current computing infrastructure by replacing some ageing equipment, introducing better tools for managing the various data sets and enhancing the overall IT security of the systems.

The ITS Helpdesk continues to support CSIRO staff in the use of corporate applications.

## Information management

In August 1995 the Executive Committee decided to introduce new management arrangements for CSIRO Information Services by dividing the functions between two units: an information management unit and a publishing unit. As the role of the former is related to corporate development needs, its work is reported in this section. The work of the publishing unit is reported in the Communication section of this Report.

One major consequence of this split was the relocation of both units — information management to Clayton and publishing to Collingwood. The Information Services' East Melbourne site has been sold.

The Corporate Information Management Unit's main activities are to:

- coordinate strategic planning and development of information management processes and systems;
- assist the implementation of organisational information policies and guidelines;
- support and advise users of networked information resources;
- provide quality assurance and control of the information available on CSIRO's library and information delivery systems; and
- manage information supply processes - where economies of scale in the purchase of information can be realised.

The activities of the unit fall into three main areas.

*Information Delivery Mechanisms* supports the maintenance of implemented systems. Major achievements in 1995-96 were:

- implementation and support for the Voyager library management system across CSIRO (March 1996);
- further enhancement of the SIM information retrieval system that delivers information to the desktops of all CSIRO staff. This involved working closely with Information Technology Services staff and Divisional staff and investigations into further databases;
- development of a new corporate style for presentation of CSIRO information through the World Wide Web; and
- devolution of former central library collections to Divisions and the Australian library community.

*Networks Facilitation* supports the development of corporate information and knowledge networks. During 1995-96, the following outcomes were achieved:

- coordination of conferences, training and workshops for CSIRO librarians and records managers;

- launch of the CSIRO Records Management and Archives Manual (November 1995);
- tender project for CSIRO's purchasing of 10,000 serials valued in excess of $6.5 million;
- continued quality control of CSIRO's shared library catalogue (400,000 + records);
- coordination of CSIRO's network of publications officers including contributions for the CSIRO Index (80,000 records); and
- refocus of processes for the CSIRO Index including outsourcing of indexing work.

*Organisational Development* investigates and develops new and existing tools, systems, processes and resources. Outcomes in 1995-96 were:

- ongoing system owner responsibilities including facilitation of user consultation processes;
- participation in Ernst and Young's international research program on Knowledge Management;
- development of an information management strategy for CSIRO; and
- investigation and advice on the use of copyrighted works to and on behalf of CSIRO.

# Property

## Project administration

Work carried out under the Property Management and Capital Investment Plans is running within budget and on time.

Major works completed during the year include:

- completion of 'The Village', the Hydraulics and Facade Building, and the Fire Technology facilities at the Division of Building, Construction and Engineering at North Ryde, New South Wales, as part of the Site Redevelopment project;
- refurbishment of the Division of Entomology buildings at the Black Mountain site, Australian Capital Territory;
- completion of laboratory extensions and refurbishment at the Division of Horticulture, Glen Osmond, South Australia;
- extensions to Tropical Crops and Pastures' Davies Laboratory, Townsville, Queensland to accommodate new laboratories, offices, and seminar facilities;
- refurbishment of the Engineering Bay at the Division of Manufacturing Technology, Woodville, South Australia;
- refurbishment and alterations to laboratories at the Division of Plant Industry, Black Mountain, Australian Capital Territory; and
- extensions and alterations for the Divisions of Plant Industry and Wildlife and Ecology, Atherton,Queensland.

Major works presently in progress include those at:

- the Division of Biomolecular Engineering, Parkville,Victoria;

- the Division of Manufacturing Technology, Woodville, South Australia;
- the Division of Wildlife and Ecology, Gungahlin, Australian Capital Territory;
- the Division of Building, Construction and Engineering, North Ryde, New South Wales;
- the Division of Minerals, Clayton, Victoria;
- the Division of Fisheries, Marmion, Western Australia;
- the Division of Animal Health, Geelong and Werribee, Victoria;
- the Division of Human Nutrition, Adelaide, South Australia;
- the Division of Forestry, Yarralumla, Australian Capital Territory; and
- the Division of Wildlife and Ecology, Darwin, Northern Territory.

## Property acquisition/disposal

During 1995-96 five properties were disposed of and there were no major acquisitions. One of the properties sold was the East Melbourne site of the original headquarters of (then) CSIR, continuously occupied by CSIR/CSIRO since 1926.

## Security

During 1995 a taskforce was established by the Executive Committee to examine CSIRO's security practices. A Security Policy and Security Manual was subsequently developed outlining Baseline and Best Practice Security Standards for implementation throughout the Organisation. A Security Awareness and Education Implementation Program is currently underway to introduce improved security practices across CSIRO.

# Human Resources Development

**Provide leadership in the development and implementation of strategic plans that allow staff to be willing and capable of achieving CSIRO's vision and corporate objectives.**

## Human resources review

The review completed in September 1994 and implemented beginning August 1995 is continuing.

Former corporate activities have been devolved to Divisions and a smaller more strategically focussed core corporate group provides leadership in remuneration planning, employee relations, and training and development. A Human Resources Service Group provides central pay resource, information systems, Occupational Health and Safety, and customer focussed activities such as surveys and policy review.

As a result of the Organisational restructure begun in March 1996, the training and development function was taken out of the Human Resources reporting structure. However the Performance Management and Equal Employment Opportunity functions remain. Some of the Legal Affairs group transferred from Corporate Business to Corporate Human Resources and from 1 July 1996, the Occupational Health and Safety advisors will report through Corporate Human Resources.

## Employee relations

A new Enterprise Agreement was certified in December 1995 that delivered an 8.5 per cent salary increase, paid in three instalments, over a period of 18 months. This Agreement addressed a number of operational issues and is current until 30 June 1997.

A Working Party has been examining improvements to the practice of Industrial Participation with the underlying principle being to maximise the participation of all staff.

## Occupational Health and Safety

A five year Strategic Plan has been prepared with the twin aims of further reducing both the incidence and subsequent cost of workplace accidents.

## Customer focus

A range of Human Resources Performance Indicators have been identified and are being measured through data analysis and by customised surveys.

## Information systems

A review of the existing Human Resources information system has confirmed that it is advanced in terms of automation of Human Resources and pay processing activities but lacks up-to-date interface features.

Alternative commercial packages will not provide the functionality required and CSIRO will therefore maintain its in-house system.

## Development and Leadership Programs

The Leadership Development Program (LDP) is CSIRO's premier executive development program. It is an individually tailored two year program, focussed on staff who are considered to have potential to be future leaders in CSIRO. Since its inception in 1990, a total of 80 senior managers have participated in the four intakes of LDP.

CSIRO has continued to run the Research Management Program (RMP) during 1995-96. It has been a successful and high profile program, since its inception in 1988 with 355 individuals having completed the program.

The RMP moved from being corporately funded to a "user pay" system in this reporting year.

The Business Higher Education Round Table and CSIRO jointly developed a pilot program for project leaders/managers in the Australian Research and Development field.

## Equal Employment Opportunity (EEO)

From 1 January 1996, EEO contact officers were supported and resourced by Human Resources managers in Divisions and Business Units.

Human Resources managers and Business Unit managers were involved in "rollout workshops" during the latter part of 1995, which outlined the arrangements for transfer of responsibility for grievances and appeals, redeployment and redundancy, and EEO.

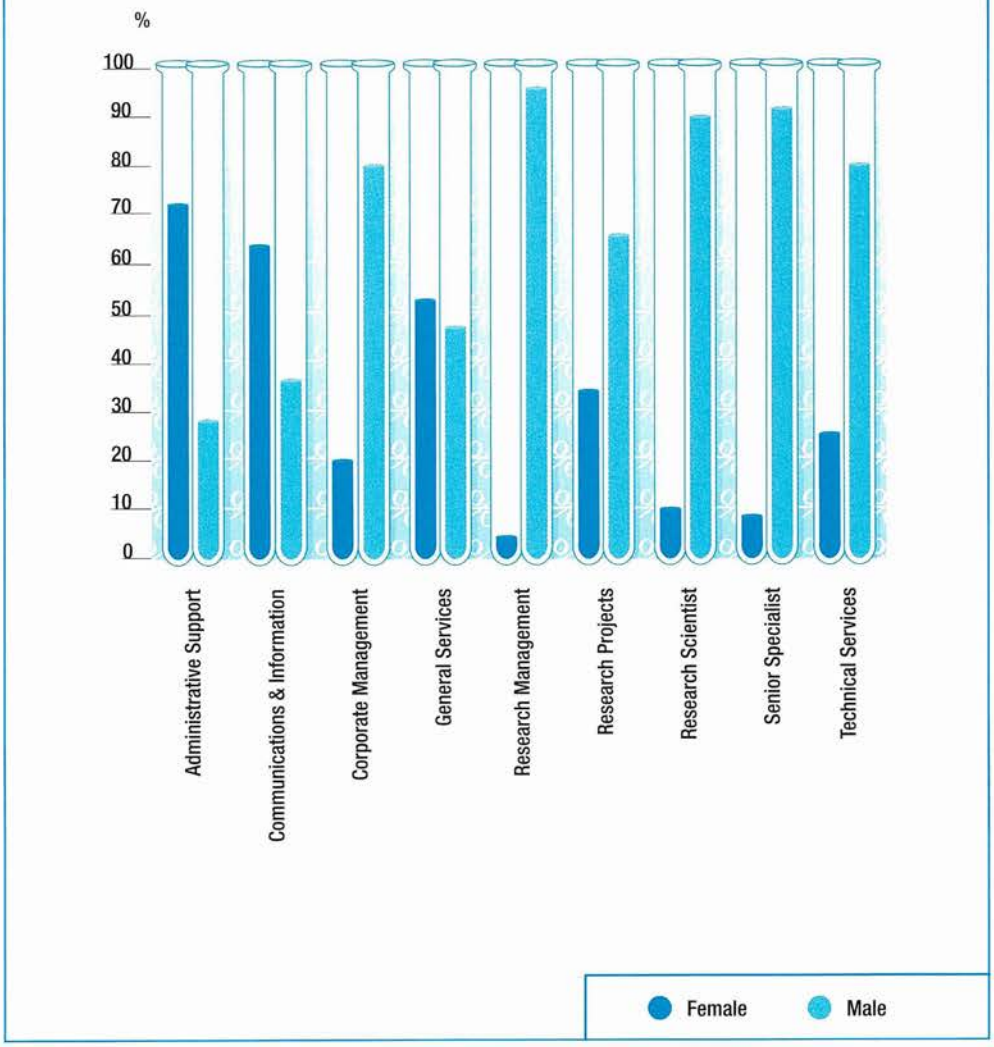
CSIRO won the major award - Winner of the Open Category - for the Public Service Commission's Equality Awards in October 1995.

## Performance management

Job profiles for the major roles in CSIRO are now available on World Wide Web as an input to performance appraisal. The requirement to set competency objectives has been removed and performance appraisal accountabilities changed to make it easier to use in a team setting.

A Performance and Development framework, which identifies the capabilities that are most valuable in the Organisation, has been developed and each of the roles contoured against these. These along with job profiles provide an input into recruitment.

FIGURE 6: PERCENTAGE OF STAFF BY GENDER AND PRINCIPAL FUNCTIONAL AREA: 30 JUNE 1996



# Research

## Research highlights

This is the last year that planning and reporting of CSIRO research followed a 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 selected sub-divisions that are relevant to science and technology and re-organised them into a form more meaningful to CSIRO. The result was 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 radio astronomy is classified separately under 'advancement of knowledge'.

Purely for ease of reading in this section of the Report, the 16 research purposes and radio astronomy have been grouped into the following six related sections.

### 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 industry:* 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; Radio astronomy.*

The selection of achievements and developments described in this section demonstrates how CSIRO is achieving its corporate goals and research objectives. A complete report of the year's activities in all 1,000-plus projects in more than 200 Programs would quadruple the size of this Report. However, a list of Program titles is contained in Appendix 6 of this Report. The list includes the titles of the 28 Multi-Divisional Programs (MDPs) operating this year.

# Contents of research highlights

## Rural Industries

### Achievements



### Developments



## Minerals and Energy Industries

### Achievements



### Developments



## Information and Communications

### Achievements



### Developments

## Manufacturing Industries

### Achievements



### Developments



## Environment

### Achievements



### Developments



## Infrastructure, Services, Advancement of Knowledge

### Achievements



### Developments

## Improve the international competitiveness and sustainability of rural production systems.

### Achievements

**Improving grapevine water use efficiency**

Water availability has been identified as the major constraint to the vineyard expansion needed to sustain Australia's growing wine exports.

The Division of Horticulture in collaboration with the University of Adelaide, and with funding from the Grape and Wine Research and Development Corporation, has demonstrated that significantly reducing the water requirements of grapevines is achievable.

The introduction of a partial root drying regime has the benefit of reducing vine vigour to give a more open canopy with better bunch exposure. The technique takes advantage of hormonal changes within vines, induced by partial root drying, and applies the results of strategic research by the Division, which describes the physiology controlling a vine's response to water stress.

Experiments on field-grown vines showed that water usage could be reduced by as much as one third to one half, but crop yield was not reduced in comparison with normally irrigated vines. The quality of the fruit was also shown to be significantly improved, and the more open canopy resulted in better control of fungal diseases.

The next phase of the research is to turn current experimental procedures into commercially viable management systems.

**New weapon in the fight against Tuberculosis**

Tuberculosis (TB) has re-emerged as one of the world's most significant infectious diseases. According to a World Health Organisation (WHO) estimate, one third of the world's population is infected with TB and three million people die from it annually. The emergence of multi-drug resistant TB strains compounds the problem in the developed world.

In collaboration with industry and commercial partners, the Division of Animal Health developed and patented technology that was subsequently used as the basis for a bovine TB blood test in cattle. The new test, BOVIGAM, is sold by CSL Ltd in over 16 countries.

The BOVIGAM test for cattle attracted significant medical interest because of the limitations of the human TB skin test, known as the Mantoux test. As a result, the Division established that the technology worked in humans. CSL Ltd scientists then modified the bovine test to produce a human TB test kit, called QuantiFERON-TB, which is now commercially available.

Extensive trials within Australia and overseas demonstrated that QuantiFERON-TB is a rapid and sensitive test for latent TB infection. It provides more clinical information and is easier to perform than the skin test. There is also potential for the CSIRO technology to be adapted to other diseases and immune conditions including Hansen's disease, milk allergy and autoimmunity.

**Superovulation in juvenile heifers**

In response to increased international market pressures, the beef cattle industry worldwide is entering a period of accelerated genetic improvement. Increasing genetic information for individual animals, breeds, and breed combinations is becoming available through traditional genetic evaluation schemes as well as molecular genetics.

Any technology that reduces the generation interval in cattle has a significant impact on the use of this genetic information, and hence the rate of genetic gain in cattle.

The collection of oocytes (egg cells) from heifers before they reach puberty, and *in vitro* fertilisation of these oocytes to produce embryos, is a technology that can sigificantly increase rates of genetic gain in beef cattle. A multi-institutional team led by CSIRO has made major improvements in the efficiency of superovulation and oocyte collection from juvenile heifers.

Using a novel superovulation protocol, the team has doubled the number of oocytes collected from juvenile heifers. This in turn resulted in a doubling of the number of potentially transferable embryos after *in vitro* fertilisation and culture.

The results have major implications for genetic improvement and several commercial agents have expressed interest in evaluating the superovulation protocol under industry conditions. The research team will continue to evaluate other novel protocols to further enhance responses to superovulation and embryo production from juvenile heifers.

The Meat Research Corporation has shown industry leadership by supporting this work with project funds and a postgraduate studentship. The work is also supported by the Livestock Improvement Program of the Division of Tropical Animal Production. Collaborators include Primary Industries South Australia and James Cook University.

**Better plant nutrition**

Many of Australia's agricultural soils are derived from highly weathered material, and so are poor in nutrients. As a result, agricultural production is dependent upon phosphatic fertilisers, which are often inefficiently used by crop and pasture plants.

With the sustainability of some agricultural systems now in question and environmental contamination an important issue, scientists at the Division of Tropical Crops and Pastures have determined how plants can make better use of nutrients.

Apart from reducing the impact of chemical fertilisers on the environment, the technology opens up exciting possibilities for improving human and animal health by raising levels of mineral nutrients that are often deficient in plant-based diets.

Plants take up mineral nutrients from the soil by means of transporter proteins embedded in the membranes of root cells.

In pioneering research, scientists at the Division cloned the genes that encode transporters involved in phosphate and sulfate uptake into plant roots. These clones provide powerful tools for improving the efficiency of nutrient uptake by plants.

Nutrient transporter proteins are also involved in the remobilisation of nutrients within plants. Genes encoding for some of these proteins have also been cloned by the Division's scientists.

Manipulation of the expression of such genes provides a capacity to change the distribution of nutrients in plants, particularly the content in edible seeds.

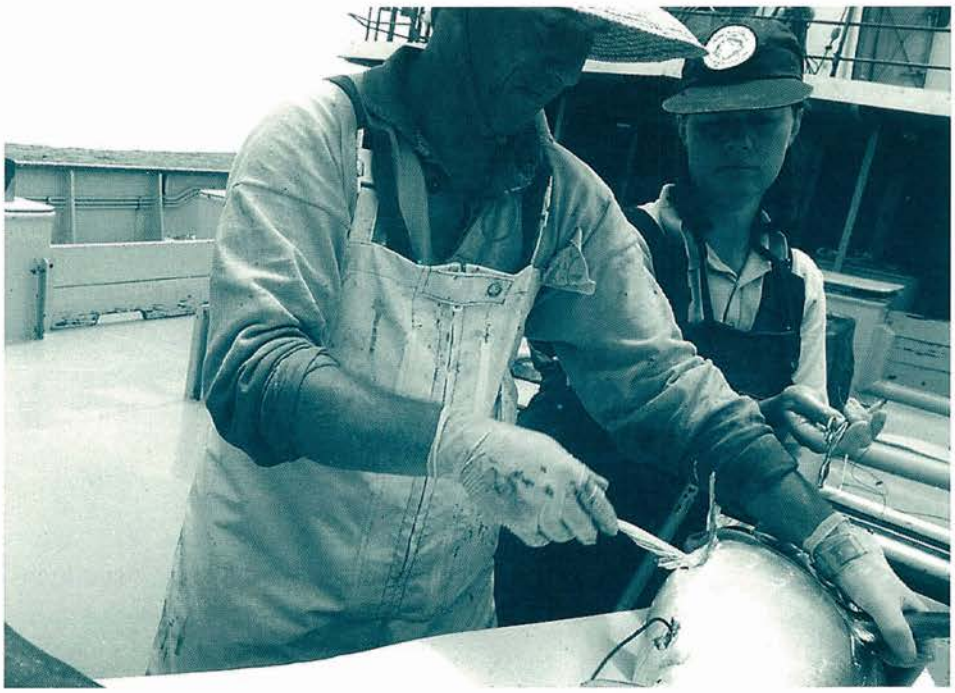
**Tagging Southern Bluefin Tuna**

Collaborative research and development by the Division of Fisheries and its industry partner Zelcon Technic Pty Ltd has produced the archival tag for studying fish movement, physiology and behaviour.

## Tagging Southern Bluefin Tuna

**Within 30 seconds, Dr John Gunn and Naomi Clear insert an archival tag into a Southern Bluefin Tuna. The tag will record the life patterns of the fish for up to nine years.**

Photo Peter Whyte.



A miniature computer and data logger, the archival tag is capable of collecting and storing, for over nine years, up to one megabyte of data on a fish's depth, the temperature of its body and the surrounding water and light levels. Using this information, scientists can calculate the global position of individual fish.

The archival tag is being used to study the Southern Bluefin Tuna (SBT) which is the most valuable fin fishery in Australia, generating around $100 million per year. In January 1994 and March 1995, archival tags were implanted in 300 SBT in the Great Australian Bight. Nineteen of these fish have been recaptured.

The project is a key component of a program monitoring trends in the recruitment of juvenile SBT into Australian waters. The Division of Fisheries plays a central role in the assessment of SBT stocks, which are at historically low levels, and the integration of science into international management protocols.

The data contained within the tags is providing insights into the vast migrations, behavioural peculiarities, such as sunbaking in summer, and physiology of the species.

A highlight has been the discovery that fluctuations in the body temperature of SBT are related to feeding, so for the first time, scientists can examine the frequency, depth and location of feeding of a fish in the open ocean over periods of months or years.

The Division of Fisheries has received two grants to apply archival tagging technology to sharks: a Fisheries Research and Development Corporation grant for school sharks and a National Ecotourism award to study whale sharks.

**New wheat for Australia's industry**

The Division of Plant Industry released a new winter wheat variety "Lawson", following the signing of an agreement with the Australian Wheat Board.

Lawson is a high yielding, dual purpose red-grained winter wheat for the Australian industry that has been specially bred for high rainfall zones. It provides graziers in this zone of southern and south-eastern Australia with an alternative source of income.

As a long season winter wheat, Lawson responds well to grazing and grain recovery, providing a valuable source of winter fodder and then recovering to produce a high yielding wheat crop. It allows farmers who had previously depended on grazing industries to diversify into cropping, no longer having to rely on wool and meat production.

Lawson set a new Australian record in March 1996, when a paddock near Ballarat in Victoria yielded 9.55 tonnes per hectare.

Lawson is susceptible to stem rust so its use is restricted by the Australian Wheat Board. However, following extensive research and field trials, Plant Industry scientists have developed a second winter wheat variety, "Paterson", that is stem rust resistant, and is being grown for the first time in New South Wales in 1996.

**Microbes help stock digest tropical pastures**

Australia's grazing and wool industries would gain $180 million if cattle and sheep improved their digestion by 5 per cent.

A CSIRO project team made up of the Divisions of Animal Production, Tropical Animal Production and Tropical Crops and Pastures has made significant advances in using rumen bacteria and anaerobic fungi to enable this increase in digestion.

The two approaches are quite different. The rumen bacteria are genetically engineered to contain additional genes for fibre metabolism, while the rumen anaerobic fungi technique relies on oral administration of different strains of fibre-digesting anaerobic fungi from a variety of ruminant species.

In the next phase of the project, scientists are aiming to enhance the performance of the modified bacteria so as to achieve a 5 per cent increase in fibre digestion. This work will also involve an evaluation of the stability of the modified bacteria and its impact on the ecology of the rumen.

The anaerobic fungi technique is expected to be commercialised next year, and it is anticipated that the techniques will be combined to produce a synergistic effect.

Supported by the Meat Research Corporation and the International Wool Secretariat, the research is conducted in partnership with the University of New England.

## Developments

**Test detects resistant worms**

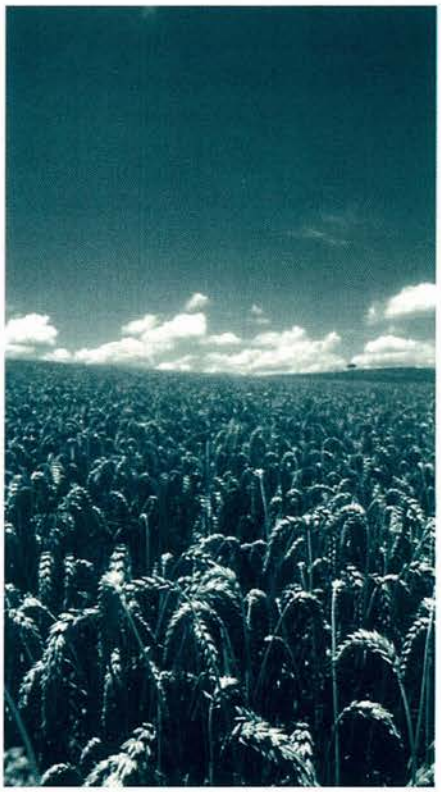
A new test to detect drench resistant parasitic worms has been released to help farmers wage war on worms.

CSIRO's McMaster Laboratory, Division of Animal Production, has been developing the test, DrenchRite™ for the last seven years, and it is now available from Horizon Technology Pty Ltd.

## New wheat for Australia's industry

**The winter wheat variety, Lawson, has been specially bred for high rainfall zones, providing graziers with an alternative source of income.**

Photo Visual Resources Unit, Division of Plant Industry.



DrenchRite quickly and accurately gauges drench effectiveness on individual farms, enabling farmers to target worm problems using the right drench and the right dosage. The test will help slow the development of resistant worms and result in financial savings as drenches will be used more effectively.

The research leading to the development of DrenchRite builds on the Division's ongoing research into parasite control (Annual Report 1992-93).

### CSIRO-Itochu deal helps Australian firms into Asia

A Letter of Intent to formalise closer ties between CSIRO and the Japanese trading giant, Itochu, and to ease access by Australian companies, particularly agri-food companies, into Asia was signed in October 1995 at Itochu's Tokyo office.

As part of the agreement, a CSIRO representative will work in Itochu's Tokyo office to gain understanding of how Japanese firms, and Itochu in particular, conduct their business operations.

Itochu will also assist in commercialising CSIRO technologies in Japan and eventually in other countries in Asia. In return, Itochu and CSIRO will share some of the financial rewards resulting from these commercial ventures.

### Horticulture's new facilities

A $2.7 million conference centre and laboratory at the Division of Horticulture's Merbein research station were completed in time for celebrations held to commemorate 75 years at this site.

The development is strategic to the Division's commitment to Riverlink — the historic new initiative in regional R&D. Riverlink integrates the horticultural interest and capabilities of NSW Agriculture (Dareton), Agriculture Victoria (Irymple), South Australia Research and Development Institute, Primary Industries South Australia (Loxton) and CSIRO.

The Division's Adelaide laboratory received a new wing and existing facilities were refurbished at a cost of $1.7 million.

### Patent a step closer to blowfly vaccine

In May 1996, scientists at the Division of Tropical Animal Production were granted an Australian patent for a protein that protects sheep against blowfly strike.

Blowfly strike costs the industry an estimated $250 million annually, as well as causing great distress to affected sheep.

Research is now focused on trying to increase the strength of the vaccine, but a commercial vaccine is still some way off.

As well as support from Australian wool growers through the International Wool Secretariat, the research was made possible through a bequest from the late Mr Les Bett, a successful grazier, who wanted to make a contribution to the Australian sheep industry.

### World first super sub-clover

Scientists at the Division of Plant Industry this year planted a world-first field trial of genetically modified subterranean clover with in-built herbicide tolerance.

The genetically improved sub-clover will enable farmers to control pasture weeds earlier in the growing season when lower rates of herbicide are sufficient to kill broad leaf weeds.

Its in-built herbicide tolerance means that the young sub-clover plants will not be affected by the chemicals.

This will result in reduced herbicide use and a more cost-effective pasture system. Laboratory and glasshouse tests have shown that the new sub-clover variety has a greatly increased level of tolerance to the herbicide bromoxynil.

**Davies Laboratory extended**

Mr Ted Lindsay, Parliamentary Secretary to the then Minister of Industry Science and Technology and then member for Herbert, opened the $2.1 million extensions to the CSIRO Davies Laboratory in Townsville on November 7, 1995.

The extensions increase the floor area by about 950m$^2$ and include a new conference room and improved laboratory, office and service accommodation in support of research on sugar, soybeans, and the management of both tropical savannas and the coastal zone.

**entomoLOGIC cottons on**

The Division of Plant Industry released its 1995 version of entomoLOGIC in October. entomoLOGIC is a decision support system to assist the cotton industry in implementing sustainable insect management practices.

The 1995 version rated highly in the sustainable section of the annual Namoi Valley Crop Competition having been used to manage cotton crops placed first, third and sixth in the competition.

entomoLOGIC allows growers and consultants to input data on insect pressures, crop inputs, pesticide applications and field operations, providing graphs and status reports.

entomoLOGIC also contains a costing system which allows users to enter data on dollars spent on each field operation or chemical application.

**Process cleans up wool wash**

During the wool washing process, a single wool scouring machine can produce sewage water equivalent in pollution to a city of 30,000 people.

The Division of Wool Technology has developed a process called Sirolan CF, a chemical treatment that removes at least 95 per cent of the dirt and wool wax from the dirtiest waste stream.

When combined with other weaker waste streams, the final effluent contains a significantly lower pollution load.

Sirolan CF has been licensed to ICI Watercare for use in Australia and New Zealand. The team is evaluating its use for wool scouring plants overseas, in conjunction with the International Wool Secretariat.

**Resource centre opened**

The Herbert Resource Information Centre in Queensland was officially opened by the then Minister for Housing and Regional Development, the Honourable Brian Howe on February 12, 1996.

The Centre will provide essential resource information to assist in the decision making activities of key stakeholders in the Herbert River Catchment.

It is funded by cash contributions from the Commonwealth, CSR, Hinchinbrook Shire Council and the Herbert Cane Protection and Productivity Board, as well as significant in-kind contributions from CSIRO and Queensland Department of Primary Industries.

When fully operational, the centre will have a full time staff of two and an annual budget of $150,000.

Approximately $350,000 will be spent in establishing the centre in the first year.

**Abattoir effluent process**

Scientists at the Division of Chemicals and Polymers have developed technology to reduce nitrogen and phosphorus levels in abattoir waste water that is simple and cheap to install and operate, and requires minimal supervision and maintenance.

Combining anaerobic and aerobic methods, the Green Raper process will save Australian abattoirs millions of dollars each year when compared to chemical treatment, while protecting waterways and lands. The process can be used to treat many other types of effluent, with purified water from the process used to enhance pasture production.

The first commercial installation is operating at Poowong Meat Packing Pty Ltd in Victoria. It was designed and installed by Australian Meat Technology (AMT) under licence to CSIRO.

AMT is a wholly owned subsidiary of the Meat Research Corporation, and formerly part of CSIRO.

## Minerals and Energy Industries

**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

**Effective coal dewatering**

Moisture reduction is a key issue in the coal industry potentially offering significant financial benefits from even modest reductions. Currently a large proportion of Australian coals are dewatered in centrifuges, but some of the moisture is held so strongly, it is difficult to remove by conventional centrifuging.

The Division of Coal and Energy Technology has developed a technique that provides an extra edge to centrifuging. It involves the introduction of a turbulent air stream to the process — the air stream 'blowing' water from the spaces between particles. The effectiveness of the technology has been demonstrated using a bench-scale centrifuge with moisture reductions of 1-2 weight per cent achieved.

Substantial industry support has been given to fast-track the project, scaling it up to a plant which will handle four-tonnes of coal per hour, and enable testing of the process at an operating coal preparation site with full scale centrifuges.

**Monitoring petrol temperatures across Australia**

The Division of Mathematics and Statistics completed a $2 million study for the Australian Institute of Petroleum (AIP) to determine the average national temperatures of petrol delivered to and dispensed from petrol stations.

AIP wanted to determine values for average national petrol temperature to a specified accuracy, which correctly accounted for variations in petrol temperatures in places with widely different climates. Temperature variations may be important because they cause variations in volumes. Petrol, which is sold by volume, expands by about 1 per cent for every 8 degree increase in its temperature.

Scientists designed a sophisticated methodology for data collection, audited and monitored the collection process, analysed the data and modelled the sales at service stations. The Division of Applied Physics approved and calibrated the instruments used for data collection, which was then sub-contracted to Email Electronics.

The research team organised seven rigs, each fitted with special instrumentation, to travel to over 120 service stations nationwide. At each service station, the rigs met petrol tankers twice every season to measure the temperatures and volumes of a random sample of deliveries.

The study also involved monitoring petrol sales 24 hours a day for 12 months at eight service stations. Stations were carefully selected to provide a range of seasonal temperatures. Three of these service stations were also equipped to constantly measure petrol temperatures at a number of points in the station's underground tank and pipe network.

The completed CSIRO study has provided AIP with reliable values for national average petrol temperatures. It will form part of a package which could save industry, and ultimately consumers, over $300 million.

**Long life lead-acid battery**

The Division of Minerals is patenting a simple change in the construction of lead-acid batteries that could significantly lengthen their service life and make them a more attractive power source for electric vehicles.

Initial tests by the Division's Novel Battery Technologies group indicate that under tough conditions, which simulate use in electric cars, maintenance-free (valve regulated) batteries made to the new design have about double the endurance of standard lead-acid batteries.

The longer life is made possible by putting the battery electrodes, or plates, under strong pressure. Such compression overcomes a problem known as premature capacity loss which is characteristic of the newer, maintenance-free lead-acid batteries.

The group is also working on improving the service life of rechargeable lead-acid batteries. Rechargeable batteries can be damaged by the high currents needed to recharge them quickly. Research by the group has shown that these batteries can be redesigned to minimise the generation of heat and to rid themselves of heat more efficiently.

Another feature of this research has been the discovery that if the high current is delivered in pulses, then battery damage can be minimised. Early work has demonstrated that battery life may even be extended. Already the team can recharge an electric vehicle's lead-acid battery from 80 per cent flat to full charge in less than ten minutes.

**Lasers monitor fluoride in aluminium smelters**

An instrument that measures hydrogen fluoride levels rapidly and accurately could change the way aluminium smelter operators control their plants.

Developed by the Division of Minerals, the device uses lasers to achieve in seconds what has taken several days using traditional techniques of air sampling and chemical analysis. Its speed of measurement should allow smelter managers to detect problems as they occur, and make running adjustments to minimise the emission of hydrogen fluoride into the atmosphere.

Hydrogen fluoride is a gaseous by-product of aluminium smelting. Even at concentrations as low as a few parts per billion, it can cause significant damage to vegetation because it reacts with chlorophyll and interferes with the biochemical processes of plants. For this reason, Australian Environmental Protection Authorities closely monitor and license the emission of hydrogen fluoride from aluminium production facilities.

The shift from air sampling to optical technology provides cheaper and more comprehensive monitoring.

As well as speed and accuracy, laser measurement can unambiguously cover the whole potroom, not just a point here and there. Operators can also use it to keep a record over time, allowing them to determine when peak emissions occur and to analyse their cause.

The Division of Minerals has licensed the Sydney laser applications company, Dynamic Light Ltd, to package, market and sell the technology.

## Lasers monitor fluoride in aluminium smelters

**View down aluminium smelter pot room catwalk showing location of hydrogen fluoride monitor. The monitor uses lasers to achieve in seconds what has taken days using traditional techniques.**

Photo David Death, Division of Minerals.

## Safe mining beneath water storages

Safe and economic extraction of good quality hard coking coal worth more than $600 million from beneath major water reservoirs in the southern coalfields of New South Wales requires accurate deformation monitoring.

Without this information, managers of water resources and mines need to design excessively conservative extraction sequences to guarantee the integrity of the water storages.

Using high-precision strain monitoring systems initially developed for measurement of tectonic deformations in Australia and California, scientists from the Division of Exploration and Mining have monitored mine-induced strain variations associated with longwall mining beneath the Cataract Reservoir.

The success of the Cataract experiment has led to requests for CSIRO to set up similar demonstration projects in coal mines in China.

Installed to confirm the predictions of safety margins in the mine's design, the monitoring system provides direct and real time measurement of the deformations induced by rock caving during long wall extraction sequences beneath the water.

The system is so sensitive that the response to mining is easily monitored from hundreds of metres away without interfering with the mining process.

Research shows that it can also be used in hard rock mining operations where direct estimates of the effects of blasts on pillar loading can be measured, as can the subsequent induced creep and slump processes.

## Specialist laboratory assists petroleum industry

The Division of Petroleum Resources has developed a specialist testing facility to enable the modelling of rock mechanics problems relevant to the petroleum industry.

Rock mechanics is the study of the behaviour of rock masses under changing stress conditions. It has become an important consideration in the petroleum industry over the last 15 years, corresponding to the introduction of aggressive drilling practices, and efforts to increase the amount of recoverable oil and gas through hydraulic fracturing.

The equipment developed at the Division comprises unique in-house designs built in cooperation with Australian manufacturers.

Each piece of equipment has specific functions. The Pressure Penetration Cell monitors and measures the flow of a pressure front inside a rock sample, as well as permeability changes resulting from chemico-mechanical interaction with a penetrating fluid.

The High Pressure Triaxial Cell can be used to scale processes occurring in a borehole at depths three times greater than now encountered in Australian basins. The Autonomous Triaxial Cell performs high quality tests for measuring mechanical properties.

The high pressure testing equipment enhances CSIRO's state-of-the-art testing capability, enables the Organisation to service the petroleum industry's needs for innovative research, and provides Australia and South East Asia with a world class testing facility.

### Concealed orebodies detected

Discovery of concealed mineral deposits is vital to the continuing success of Australia's mineral industry. By combining isotopic analysis of groundwaters with conventional groundwater geochemistry, scientists at the Divisions of Exploration and Mining and Petroleum Resources have developed a highly effective method for detecting concealed mineralisation.

The technique is based on the sampling capability of groundwaters, which pass through large volumes of rock below the surface, and the ability to recognise ore signatures in isotopic data. Even at very low elemental concentrations, lead, sulfur and strontium isotope compositions in groundwaters can be sensitive indicators of hidden mineralisation.

In a three-year study funded through the Australian Mineral Industries Research Association Ltd (AMIRA), researchers assessed the potential of this method over a number of concealed mineral deposits and prospects across Australia.

During the course of the project, the group developed robust field-based techniques for sampling groundwaters and preconcentrating the elements of interest for isotopic analysis.

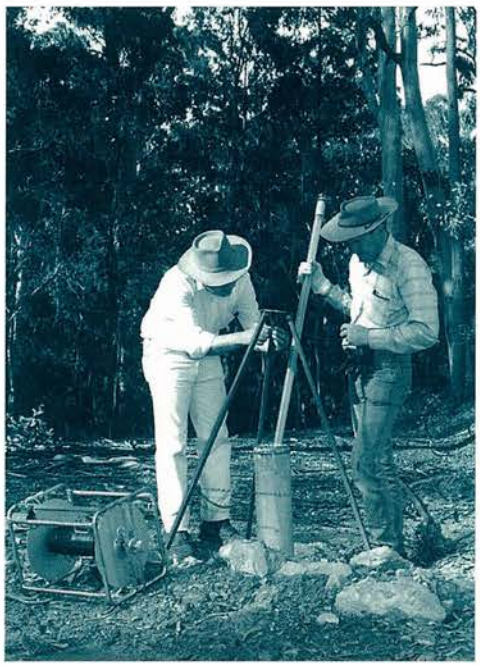
The isotopic data, which complement conventional groundwater geochemical exploration methods, were successful in detecting ore and providing an enlarged target for exploration.

The next stage in the process is to refine the method and test it in "real time" so that exploration companies can add isotopic analysis to their conventional groundwater surveys.

## Concealed ore-bodies detected

**Scientists have developed a highly effective method for detecting concealed mineralisation by analysing groundwaters. Pictured (left to right) are Dr David Whitford and Dr Graham Carr sampling groundwater for analysis.**

Photo Chris Taylor, Division of Exploration and Mining.



## Developments

### Pioneering process treats industrial waste

ICI Australia and Queensland Metals Corporation are to construct a $3-million pilot plant to produce a magnesium hydroxide slurry (MHS). The slurry will be manufactured using technology developed by the Division of Minerals.

MHS is a liquid form of magnesium oxide, or magnesia, used for treating industrial effluents containing acid or metal compounds. The plant will be built at ICI's complex in Melbourne, and is expected to be operating by the end of 1996 with the capacity to produce 25,000 tonnes of MHS a year.

Initially MHS will be sold locally, but as Australia has the world's largest known deposit of the mineral magnesite, it is expected the venture will capture a significant share of an international market estimated at more than a million tonnes a year.

### Minerals study helps sell zinc

A study by the Division of Minerals into the roasting of zinc concentrate from Queensland's Gulf Country, has provided CRA Limited with the boundary conditions within which it can prepare the concentrate for shipping.

Output from the mine, which will be the world's largest producer of zinc, will represent 27 per cent of Australia's and 8 per cent of the world's zinc production.

Scientists at the Division determined the conditions needed to produce filter cake, which when processed in a fluidised bed roaster, breaks down to form particles of optimum size for roasting without generating excessive dust. This will enable the company to produce filter cake for export which has the optimum porosity and moisture content for roasting.

### Oil exploration improved

The 1991-92 Annual Report highlighted a discovery by scientists at the Division of Petroleum Resources that petroleum generation in sediments could be assessed based on laser-induced fluorescence characteristics.

Back then, twelve companies supported demonstration trials for exploration wells in the Northwest Shelf area. The technique has now been successfully applied to a variety of sedimentary sequences worldwide, and is established as a commercial service to the petroleum exploration industry. The method is also employed in a number of research areas where tight control on oil generation parameters is required.

### Diamond giants take on technology

Technology to rapidly and cheaply assess prospective diamond areas and exploration targets is now being used for area selection by major companies working in Siberia, Canada, Southern Africa, China and Australia.

First described in the 1990-91 Annual Report, the technique involves the analysis of trace nickel and other elements in garnets separated either from rocks that may contain diamond, or from stream sediment and soil samples collected during exploration programs.

Developed by the Division of Exploration and Mining, it distinguishes between prospective and barren areas and also gives a semi quantitative estimate of potential diamond grade.

**Ore-grade analysis**

The Division of Information Technology, as part of the CRC for Advanced Computational Systems, has developed an interactive system to compute and analyse the geostatistics used in analysis of ore grade distribution.

The system's interactive visualisation techniques improve the ability of consultants to understand and analyse ore-grade data. It also assists in communicating results to mining industry clients.

Industrial collaborator for the development project is mining industry consultant, Snowden Associates. Snowden Associates has installed the system for operational use, and proposals are now in place to commercialise the work.

**Organic-rich shale exposed**

A major collaborative study between the Division of Oceanography, the Australian Geological Survey Organisation and the University of Tasmania has produced, for the first time, a fully integrated geological and geochemical characterisation of the organic-rich tasmanite oil-shale.

The novel use of carbon isotopic fractionation data has shown that the oil shale was probably deposited under sea ice during the Permian Age when Tasmania had a palaeolatitude of about 80°South.

The oil shale occurs at sites in the north and east of the state, and at some locations appears to be within the oil window where petroleum is formed. In conjunction with the Tasmanian State Government Industry, Safety and Mines Division, work continued through 1995 to further assess Tasmania's onshore petroleum potential.

**Australian satellite project**

CSIRO is a major player in a consortium formed to build, launch and operate the Australian Resource Information and Environment Satellite (ARIES-1). The ARIES-1 hyperspectral infrared spectrometer will produce a new generation of mineralogical and environmental maps for use in mineral exploration, resource mapping and environmental monitoring.

A full-scale feasibility study will start in the second half of 1996, with the satellite launch proposed for late 1999. The study is supported by the Australian Government, consortium members and end-users of the information. It is being brokered by the Australian Mineral Industries Research Association Ltd.

The consortium includes CSIRO, Auspace Pty Ltd, the Australian Centre for Remote Sensing, Earth Resource Mapping Pty Ltd, GEOIMAGE Pty Ltd and Technical and Field Surveys Pty Ltd.

**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 communication industries.**

## Achievements

### Expert systems

The Division of Information Technology has developed the expert module component of the Spares Assessing Expert System (SAES) project.

SAES is aimed at reducing surplus inventory costs by encouraging a standardised approach to provisioning and spares assessment.

The Division conducted the research and development for Integrated Systems Solutions Corporation Australia Ltd (ISSC), the prime systems integrator to the Department of Defence (Navy).

Phase One of the CSIRO SAES project delivered a user requirements specification, product evaluation and high level design for the expert module component of the system.

CSIRO's contribution involved modelling provisioning and spares assessment tasks in the Navy, the integration of the expert module with other components of the SAES system developed by ISSC, and detailed analysis of the spares assessment operators' work practices and requirements.

Senior Navy and Defence Department staff participated in interviews to define correct rules and procedures that the expert module would implement. A unique feature of this project was the adoption of advanced human computer interaction (HCI) modelling techniques both for requirements analysis, and as a complement to more conventional rule-based approaches in knowledge acquisition.

The Division received a letter of commendation from ISSC following phase one, and has been contracted to undertake phase two which includes software implementation for the expert module. Phase two was due for completion by mid 1996.

### Electronic directories

The Division of Information Technology, with BHP and Telstra, completed a major study to examine the implementation strategy and benefits of electronic directories within the BHP world-wide organisation.

Information Technology's contribution included technical consulting during the development of the tender, technical overview and performance testing for the pilot study, and the development of software components

to demonstrate connectivity with existing data sources.

This work built on knowledge gained from an earlier Government Industry Research and Development (GIRD) funded project between the Division, Datacraft Technologies Pty Ltd and CiTR to develop tools for large scale electronic directory implementation. Datacraft Technologies are now internationally marketing an electronic directory product based, in part, on this work.

**Quick image search**

The Division of Radiophysics has developed the System for Quick Image Search or SQIS™, a recognition software system that efficiently stores and retrieves information in large databases.

The market for content and knowledge based imaging is vast with applications for this technology in access control, law enforcement, traffic control, generic image archiving and search, and border control.

SQIS has the potential to improve security and be sold overseas generating valuable export dollars for Australia.

One area where the technology can be applied is face recognition. Face recognition — SQIS is a real time, image search system that finds database images closest to a live video image. Operating on a PC platform, the system can run automatically or be operator assisted. It is ideally suited for access control, mugshot browsing and identikit database application.

The Division is working with the Australian SME company CPS Systems Pty Ltd to develop a passport verification system for Australian Customs. In early 1996, CPS Systems signed an agreement with the Department of Immigration and Ethnic Affairs and the Australian Customs Service to conduct a pilot face recognition trial at a major Australian airport to assist with border control. CPS Systems will use CSIRO's face recognition technology for this trial.

**Acoustic vision**

The Division of Radiophysics and Thomson Marconi Sonar Pty Ltd have developed a technology for seeing beneath the ocean waves using sound waves.

Existing sonar technology is effective in detecting underwater mines but it cannot identify the type and condition of the mine. It is often possible to determine the exact type of mine from its surface detail, and from any settings of screws, plugs or indicators visible on the casing.

Obtaining this information is difficult. Current options are to send divers down, which is dangerous, or to use remotely operated vehicles equipped with high intensity lights and video cameras, which may not be effective. Often water conditions, especially the murky waters around Australia, do not allow the use of either cameras or divers.

The new system, which will eventually be carried on a remotely controlled subsea vehicle, will be able to detect surface features of 1 millimetre x 1 millimetre in size from a distance of 1 metre. Although the system has been developed to detect mines it can be used to detect anything in turbid waters including objects or bodies in rivers. The technology could also have

important industrial applications, for instance examining subsea structures such as oil rigs.

The technology evolved from CSIRO's work on medical imaging married to Thomson Marconi Sonar's experience with military and sonar systems.

**Microwave circuits**

The Division of Radiophysics in collaboration with Microwave Networks Australia (MNA), a local subsidiary of a mid-sized American communications company, has developed several 38 GHz monolithic microwave integrated circuits for the telecommunications market.

The low cost, high performance circuits are to be incorporated into subsystems for microwave radio products sold worldwide by MNA's parent company generating high export dollars for Australia.

The 38 GHz microwave digital radio interconnects telecommunication base stations to central exchanges, and will be used primarily by cellular telephone operators and private networks. The radio allows for efficient passing of telecommunication information from point A to point B without cables.

MNA and the Division of Radiophysics are now working on miniaturising this technology to improve performance and reduce costs further.

The subsystems are intended to be manufactured in Australia and shipped to the US for integration into MNA's parent company's digital radio products, creating a multi-million dollar export market for this Australian company.

## Developments

**International contract signed**

The CSIRO developed Spatial Database Manager (SDM) is to be installed in a large US telecommunications company.

Used to manage the network assets of utilities in the telecommunications, water, electricity and sewerage sectors, SDM resulted from the Division of Information Technology's research on Geographic Information Systems. It is licensed to ARC Systems, who have licensed it to the Convergent Group Asia Pacific (CGAP).

In January 1996, CGAP signed an agreement to fund CSIRO R&D in this area for three years.

Another result of this research is the Land Information Systems Architecture (LISA) system (see 1993-94 Annual Report). The Division collaborated in the early development of LISA, and the South Australian Department of Environment and Natural Resources, which instituted a production form of LISA, received a Gold Government Productivity Award for the system in March 1996.

**CAD conferencing**

The 1992-93 Annual Report described a joint project between the Division of Building, Construction and Engineering and Telecom Research Laboratories, to develop a prototype electronic conferencing system that enables participants to share Computer Aided Design (CAD) text and graphics simultaneously.

Networking CAD between geographically dispersed members of a project can reduce the time for some operations by up to 40 per cent, while generating savings of up to 10 per cent.

The construction of Melbourne's Greensborough Shopping Plaza, completed in October 1995, provided an opportunity to demonstrate its effectiveness for Sydney based designers, Lend Lease, and Melbourne based Civil and Civic.

A CAD conferencing link is now planned between Melbourne and Jakarta to demonstrate its value to industry in an international environment.

**On-line multimedia search for notable Australians**

The Division of Information Technology has developed a demonstration on-line interactive system for film and television researchers that will allow them to access and compile biographical information on notable Australians from film and video archives.

The system can be accessed remotely and users can navigate through biographical data in multiple media forms. The work is a collaborative effort with Film Australia and the Research Data Networks CRC Partners.

One demonstration system is to be placed in several film institutions around Australia and will be used to trial Telstra's Experimental Broadband Network.

**MobileSat™ antenna technology**

The Division of Radiophysics and Mitec Ltd, with some financial support from the Australian Space Office, developed an electronically steered low profile antenna for users of mobile satellite communications services. The antenna, described in the 1990-91 and 1991-92 Annual Reports, is suitable for use by cars and trucks as well as larger vehicles. It remains locked to the satellite even when turning or travelling over varying terrain.

Optus Networks Pty Ltd is now using this technology in its MobileSat™ Communications service, which provides mobile satellite communications services over the entire Australian continent and up to 200 kilometres to sea.

# Manufacturing Industries

**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

### Conducting rubber

In the USA in 1988, it was observed that rubber, one of the best insulators known, could be turned into a conductor of electricity by doping it with iodine. Why this phenomenon occurred remained unclear until 1990, when scientists at the Division of Chemicals and Polymers established the reasons behind it.

Further research at Chemicals and Polymers has led to a number of achievements including the development of microlithographic technology for the formation of conducting patterns at micron scale in thin rubber films, and the successful introduction of Buckminster fullerenes (bucky balls) into the structure of rubber. The molecular structure of bucky balls bestows photonic, conducting, magnetic and various physicochemical properties into rubber-like materials.

The microlithographic technique and the introduction of bucky balls are considered key prerequisites for the successful application of the technology to electroluminescent displays, integrated circuits, microelectronics, and electronic and photonic labels.

Research into conducting rubber and its applications will continue under a collaborative arrangement with two commercial partners.

### Anti-setting agent gains international market

Permanent setting of animal fibres is a well known process. People have their hair permed and most of us have worn woollen clothing with permanently set creases.

But permanent setting is not always desirable. When wool is being dyed, permanent setting can occur inadvertently, leading to unwanted results in many steps of the wool processing chain.

Scientists at the Division of Wool Technology, with support from the International Wool Secretariat (IWS), have developed a specific chemical agent to prevent permanent setting.

Commercialised as the BASF process "Basolan AS", the use of anti-setting agents is gaining wide acceptance in

wool dyeing companies around the world. So far, leading wool textile mills in fifteen countries are now using the CSIRO technology routinely.

Wool dyed using the CSIRO process is generally stronger, and performs better in carding and spinning. It knits and weaves better, and garment appearance is improved. The process brightens the colours obtained from dyes, and produces slightly better light fastness. Fabrics treated with Basolan AS also feel and handle better than untreated fabrics dyed in the normal manner.

**Block copolymers now commercially viable**

Research at the Division of Chemicals and Polymers has led to the development of a world-first technique in the synthesis of engineered resins.

This technique, the most recent breakthrough in research spanning ten years, allows control of the size and shape of polymers, producing fewer waste materials and opening up a whole range of commercially viable processes.

The work was awarded the Royal Australian Chemical Institute's 1996 Applied Research Medal.

Properties of polymers depend on size, shape and chemical composition and controlling these has, up until now, been very difficult. With this new process a wide range of narrow polydispersity block copolymers can be economically synthesised from inexpensive monomers.

Block copolymers are formed by linking together, end to end, two or more sets of polymers of different composition. By controlling the size, shape and end group functionality, polymer structures can be made which have specific properties and applications.

Block copolymers have applications in the preparation of pigment dispersants for ink coatings and formulations, toughening agents for automotive coatings, and as agents to facilitate the production of polymer blends having new spectra of properties.

Product development is being pursued with Du Pont Australia Ltd. Du Pont is licensee to CSIRO's world wide patents for this technology.

**High value product from cheese whey goes commercial**

Bonlac Foods Ltd, a large Australian dairy cooperative, plans to establish a manufacturing facility to extract a high value minor protein component from whey, a byproduct of cheese manufacture.

The new manufacturing facility will use technology arising from process development and scale-up work at the Division of Food Science and Technology, based on a separation process first established at the Cooperative Research Centre for Tissue Growth and Repair (CRC).

The extracted component, known as Whey Growth Factor Extract and marketed under the trade name Accel *gF*, has applications in a number of lucrative biotechnological, biomedical and specialist food areas. These include: wound healing and the prophylactic and therapeutic treatment of some gut diseases; organ culture such as the growth of skin for burn victims; and mammalian cell culture for the production of hormones, vaccines and other fine biochemicals. Each application commands a very large potential export market.

The process development work formed part of a collaborative project between CSIRO, the CRC and the Queensland Department of Primary Industries (Centre for Food Technology). It received financial support from the Dairy Research and Development Corporation. Bonlac has established a subsidiary company, Bonlac Biosciences International Pty Ltd, to manufacture and market the new product worldwide.

**Gene Shears more efficient**

Scientists at the Division of Biomolecular Engineering have developed synthetic "Gene Shears" that promise to provide more effective pharmaceuticals than their naturally occurring counterpart.

"Gene Shears" molecules, known as ribozymes, have the ability to cleave specific messenger RNA molecules disrupting the information flow within cells. Ribozymes are also composed of RNA. They are produced in the cell and form a part of the larger RNA which they cleave.

Because of their ability to excise unwanted genetic material, there are many agricultural, veterinary and medical situations where ribozymes will be useful. The construction of disease-resistant plants, or pharmaceuticals for the treatment of cancers and viral infections are two examples.

To use ribozymes as pharmaceuticals, they must be delivered into specific target cells where they must find and cleave a single RNA molecule among the many thousands present in the cell.

Recognising that naturally occurring ribozymes may not be suited to this role, scientists at the Division developed several alternative versions which may be more effective as pharmaceuticals.

## High value product from cheese whey goes commercial

**Whey Growth Factor Extract, a high value minor protein component from cheese whey, is marketed under the trade name Accel *gF*. It has applications in a number of lucrative biotechnological, biomedical and specialist food areas.**

Photo David Loram, DDL Photographics.

The Division's synthetic ribozymes are smaller and have some of their RNA replaced by DNA. This substitution makes them easier to produce, easier to deliver into cells and increases their stability.

These smaller ribozymes are also able to cleave long messenger RNA molecules more efficiently than do natural ribozymes, at least in the test tube. Scientists at the Division are currently testing two varieties of these minizymes and mini-ribozymes for activity in living cells.

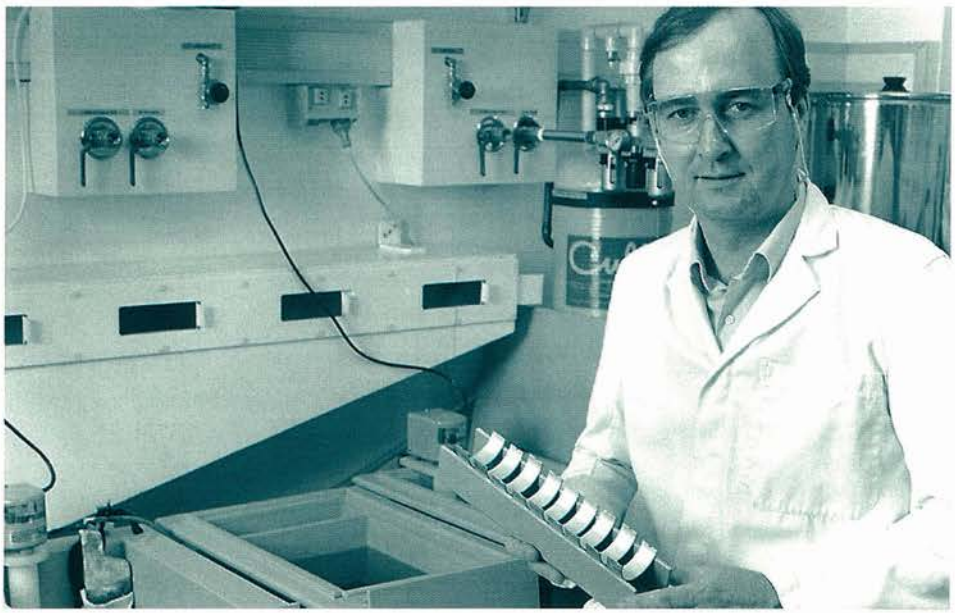
**High performance electroplated alloys**

In response to a collaborative R&D request from Tasmania's ACL Bearing Company, the Division of Materials Science and Technology, through its Electrochemical Technology project, developed several electroplated alloys for use in high performance and domestic engine markets.

## High performance electroplated alloys

**Dr Brett Sexton with a batch of high performance lead alloy automotive bearings produced at the Division of Materials Science and Technology for ACL Bearing Company.**

Photo Mark Fergus, Division of Materials Science and Technology.



ACL Bearing Company is Australia's main manufacturer of crankshaft bearings for locally produced cars. It supplies bearings for much of the local car production, and an expanding overseas market.

The company contacted the Division through CSIRO's Small to Medium Enterprises (SME) Program.

The Division had not worked with lead alloy electrodeposition before, but produced the first test bearings within four months of starting the project. ACL encouraged one of its staff to regularly visit CSIRO, and to actively participate in the development program.

The CSIRO research team also developed a method for examining the microstructure of these soft alloys — microtoming the bearings with a diamond blade — allowing unprecedented views of the crystal structure and composition of the overlay itself.

This technique was subsequently used to analyse all of the main competitors' bearings, revealing information not available through patents or publications.

Fatigue and live engine tests on two products have been successful, with one to be used in high performance racing engines such as NASCAR engines.

ACL plan to begin manufacturing the products when the new production line is completed.

**Dragline automation for open-cut coal mines**

Researchers from the Divisions of Exploration and Mining and Manufacturing Technology have developed technology to maximise the performance of draglines in open-cut coal mines.

Dragline productivity is a vital factor in determining the overall economic performance of a mine because draglines are key components in the removal of overburden, which represents a large proportion of a mine's operating costs.

Working within the Centre for Mining Technology and Equipment (CMTE) and with funding from the Australian Coal Association Research Program (ACARP), the CSIRO team developed a method for automatically controlling the dragline during the swing and dump phases of its operating cycle.

The novel contribution of the project has been the development of a sensor that can measure the swinging motion of the dragline bucket as it is suspended freely from the hoist and drag ropes. Tests on a one-tenth scale model dragline have shown that automatic control of bucket position on a full-sized dragline operating at full speed is possible.

The technology is expected to generate savings of $3 million per year for a typical Australian open-cut mine and potential savings of $50 million per year for the industry as a whole. The system will also lower maintenance costs and make the operator's job easier.

Industry, through ACARP and with direct funding from BHP Australia Coal Pty Ltd and CRA Ltd, has now supported a $1 million project over two years to implement the control system on a full-scale dragline. The project also aims to measure the productivity gains available through automatic control.

## Developments

### R&D centre helps industry compete

CSIRO launched a revamped Refractories Centre Australia in November 1995 to give greater assistance to industry and suppliers.

Centralising refractory research and development in Melbourne enables CSIRO to provide a better service that will save time and money. It also gives companies access to CSIRO's network of R&D alliances, both internationally and within Australia.

The Refractories Centre Australia is able to address a number of industrial problems, as well as the needs of small to medium size enterprises that may not have resources to engage in medium to long-term R&D.

The Refractories Centre Australia is located in new premises at the Division of Materials Science and Technology on the Clayton CSIRO site.

### SICOR partnership

The Division of Building, Construction and Engineering, Venture Industries Australia and the Royal Melbourne Institute of Technology are working to develop a commercial version of SICOR, a revolutionary and environmentally friendly technology that will improve the adhesion of paints and car body mouldings, while reducing operating costs to the automotive industry.

Venture is one of the largest producers of motor vehicle components in the US, and has recently set up headquarters at Broadmeadows in Victoria.

SICOR's commercial development is driven by the Montreal Protocol that calls for the ban of ozone-depleting substances. These substances are currently used in the pretreatment of polymers for painting in the auto industry, so with the increasing use of advanced plastics and composite materials in motor vehicles, the potential applications of SICOR are immense.

### Safe-T-Cam™ a winner

Safe-T-Cam™, a road safety device described in the 1991-92 Annual Report, won the prestigious Rolls Royce/Qantas Award for Engineering Excellence from the Warren Centre for Advanced Engineering at the University of Sydney in October 1995.

The result of collaborative Australian research and commercial development between Telstra, the Roads and Traffic Authority of NSW, and the Division of Manufacturing Technology, Safe-T-Cam™ is a unique digital imaging system that automatically detects and classifies moving vehicles, identifying large vehicles and reading their number plates.

The system is being installed at 20 locations on NSW roads.

### Antioxidant test

The cytokinesis-block micronucleus technique is recognised internationally as a key technique for assessing the chromosome damaging potential of chemicals, radiation and reactive oxygen metabolites. The method is increasingly used instead of conventional chromosome analysis in metaphase.

Developed by scientists at the Division of Human Nutrition, the method is also being used to assess the *in vivo* antioxidant potential of food components, and the relation between spontaneous genetic damage and diet.

EEC countries have adopted the cytokinesis-block micronucleus technique as a tool to assess genetic damage rates in human populations. Since 1991 it has been used to assess levels of chromosome-damage in children living in regions with highest levels of radionuclide contamination from the Chernobyl accident.

**Industrial liaison managers**

The Institute of Industrial Technologies' network of Industry Liaison Managers (ILMs) is fully operational at key CSIRO sites across Australia.

ILMs provide an effective interface between the technology needs of companies, and the extensive technical skills and resources available within CSIRO.

Application of their own specialist expertise and networking with other service providers, for example universities, Cooperative Research Centres and State and Federal Government organisations such as AusIndustry, has enabled ILMs to provide valuable assistance to hundreds of companies.

As a result of the success of this initial ILM program, a decision has been taken to expand the industry liaison network to encompass additional CSIRO Divisions.

**Resin technology agreement signed**

CSIRO's Matrix Resins Group at the Division of Chemicals and Polymers and TWR Australia (Holden Racing Team) signed a collaborative agreement in August 1995 to build the lightest and toughest automotive body parts ever produced in Australia.

The venture springs from the Division's breakthrough work in epoxy resins which 'cure' at low temperatures. Described in the 1994-95 Annual Report, the technology has several advantages over traditional production methods, including time and saving costs.

Since February 1996, composite body parts have been produced for 80 commercial Holden Special Vehicles. The resin technology can be applied in boating, defence and other industries, and staff are already working on projects for other companies.

# Environment

**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

### Reducing pollution problems at Port Pirie

The Division of Atmospheric Research has completed a major environmental consultancy project at Port Pirie's Pasminco-BHAS lead smelter. The month-long project involved detailed measurements designed to discover what meteorological conditions cause elevated sulfur dioxide concentrations near the smelter.

Pasminco was keen to receive this information so it could prepare for any future tightening of air emission regulations. The company will use the results from the study to investigate technologies to reduce emission problems from its smelter.

The $250,000 study in South Australia involved a research aircraft, weather balloons and a lidar, which fired powerful laser beams to collect data on the behaviour of the smelter's smoke plume.

Pasminco's pollution problems typically occur during hot summer days with onshore breezes. This suggested that the plume was being brought down to ground level by a process known as shoreline fumigation, due to strong convective mixing in the lower atmosphere. To confirm this, CSIRO needed to monitor meteorological conditions during pollution episodes, and gather detailed emissions data from the smelter.

Sixteen scientists worked for four weeks during January and February. They used daily weather forecasts to estimate the likelihood of northerly winds, during which sulfur dioxide pollution could be a problem in the township. The team made detailed meteorological, pollution and plume measurements on 12 days, six of which turned out to be days of elevated sulfur dioxide concentrations in Port Pirie. In order to see the plume, the team injected into the 205 metre high stack fly ash from the nearby Port Augusta Power Station.

CSIRO collaborated on the Port Pirie study with Flinders University and Pasminco-BHAS.

## Wagga Wagga effluent plantation project

Discharge of sewage effluent into Australia's inland rivers causes eutrophication and subsequent blooms of unwanted algae.

An alternative to river discharge is to use effluent to irrigate tree plantations, turning waste into a resource.

The number of effluent-irrigated plantations has increased, but there is inadequate scientific data on the fate of added water, nutrients and salt. This information will ensure that the design and management of these land treatment systems protects soil and water resources from degradation.

In 1991, the Divisions of Forestry and Forest Products and Soils started the Wagga Wagga Effluent Plantation Project, a six year study of the potential productivity and sustainability of effluent irrigated plantations.

In October, the project was awarded the 1995 BHP State Landcare Research

## Wagga Wagga effluent plantation project

**The Wagga Wagga Effluent Plantation Project is a six year study of the potential productivity and sustainability of effluent irrigated plantations.**

Photo Brian Myers, Division of Forestry & Forest Products.

Award for New South Wales, and in June 1996, received the Australian Banksia Environmental Award for Land Management.

The research team has studied the processes involved in the cycling of water, nutrients and salt in plantations of different tree species (eucalypts and pines) irrigated with varying amounts of effluent or fresh water. Using this information, the team developed a model to extrapolate results from Wagga Wagga to other sites and climates.

Based on the results of their research, the team is preparing national guidelines for sustainable management of effluent-irrigated plantations. The guidelines will assist local governments, rural industries, environmental regulators and planners design and manage their plantations. In 1995, the team published *Effluent - Irrigated Plantations: Design and Management* with 10,000 copies distributed nationally.

The work has been supported by Land and Water Resources R&D Corporation, Murray Darling Basin Commission, NSW Department of Land and Water Conservation (formerly Public Works), Wagga Wagga City Council, Tahara Pastoral Pty Ltd and the Department of Primary Industries and Energy.

**Predicting salinity problems on farmland**

Salinity is one of Australian agriculture's worst problems, costing farmers an estimated $243 million in lost production every year. The Remote Sensing Group of the Division of Mathematics and Statistics has developed an expert system, called 'salt spread', to monitor the spread of salinity and map areas most at risk in the future.

Developed in collaboration with Agriculture WA and the Land and Water Resources Research and Development Corporation, the expert system allows land condition to be predicted on the basis of existing data. A unique feature of the system is that errors and uncertainty in the data can be accommodated in the prediction.

The system focussed on the spread of salinity in the Upper Kent River Catchment in Western Australia. With digital elevation maps of the catchment and satellite data from 1977, 1988 and 1994, scientists derived four land attributes identified as the most useful and cost-effective for predicting salinity within the study area.

When tested, the system generated detailed salt spread maps, with the predicted 1988 and 1994 data closely matching the actual data for those years. It showed that while 9 per cent of the catchment was affected by salinity in 1977, 14 per cent in 1988 and 20 per cent in 1994, this could rise to an estimated 27 per cent in 2004 unless remedial action is taken.

Agriculture WA has announced plans to see the system applied throughout the State's south-west, and local farmers and Landcare groups will be able to use the predictive salt-spread maps to concentrate their efforts where they will be most effective.

## Tracing the polluters of our waterways

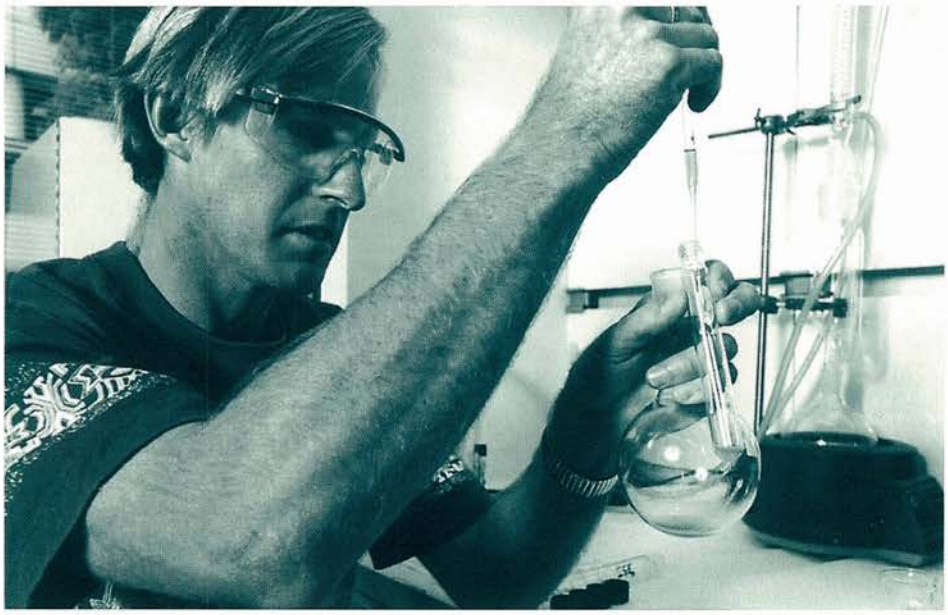
Birds, wildlife and domestic animals are contributing to the contamination of Australia's waterways at previously unrecognised levels, preliminary studies by the Division of Oceanography have revealed.

The preliminary studies were carried out in New South Wales and Tasmania as part of a broader program that is monitoring Australia's marine environment. They involved new techniques developed at the Division, which use organic compounds called faecal sterol biomarkers. These chemical biomarkers provide scientists with a 'fingerprint' to trace the sources and amounts of faecal pollution in waterways.

Oceanography research scientists undertook the biomarker studies in collaboration with the Division of Water Resources and Australian Water Technologies Pty Ltd in Sydney.

## Tracing the polluters of our waterways

**Studies by the Division of Oceanography are revealing the polluters of our waterways. Rhys Leeming analyses water samples to establish faecal sources.**



The New South Wales study, at Lake Tuggerah, was the first time the technique had been applied where there was a likelihood of pollution from multiple sources in both urban and rural catchments. It found that in Lake Tuggerah as much as 80 per cent of faecal pollution after rains was from sea birds. The second highest contributor was domestic animals at about 15 per cent. Rural catchments contributed the remainder of the faecal contamination, which came from sheep, cows and horses and native animals such as kangaroos. In this study, human faecal contamination was either negligible or below detection.

The technique is soon to be applied to Melbourne's Yarra River in a collaborative study with the Victorian Environment Protection Authority, and a major study for the Water Services Association Australia started in July this year.

**Control strategies for algal blooms**

Understanding the physical processes at work behind thermal stratification in riverine weir pools has led to the development of strategies to control blooms of cyanobacteria, or blue-green algae.

Scientists from the Centre for Environmental Mechanics and the Division of Water Resources investigated the effects of water discharge on thermal stratification and mixing within weir pools, and the resulting effects on phytoplankton population growth.

Strategies for the control of blue-green algae were devised based on knowledge of the physical factors influencing the growth and spatial distributions of algal populations. In Maude Weir on the Murrumbidgee River, water discharge rate was found to be the key regulating factor in the establishment of algal blooms.

The research team evaluated four different strategies to prevent algal blooms developing. These were: manipulating the physical conditions within the weir pool by maintaining an elevated discharge through the weir; pulsing the weir discharge; releasing water over the weir wall rather than under it; and artificial destratification.

Each strategy disrupted the development of thermal strata within the water column of the weir pools, potentially stopping blue-green algae blooms. All four strategies offer possible benefits for managing algal blooms. The research team also observed that drawing water for human consumption at deep levels of the weir pool reduced the concentration of algae in the water supply.

**Describing a patchwork landscape**

The *Observations At Several Interacting Scales*, or OASIS, project is enabling scientists to better depict land-air interactions in global and regional climate models. These interactions are essential for predicting global climate change and regional climate variability. OASIS will also help to make better sense of the many small-scale measurements made around the world every day, and how these measurements can be related to changes in the climate and biology of the planet.

The information generated by OASIS has revealed how the mixing of energy flows, water vapour and greenhouse gases occurs as air crosses the landscape, and shows the influence crops, forests and other landscapes have on this

process. In particular, OASIS has investigated how the patchiness, or heterogeneity, of the landscape affects interactions between land and air.

In October 1994 and 1995, two ambitious field campaigns were undertaken by researchers from the Centre for Environmental Mechanics in the mixed farming country around Wagga Wagga, New South Wales. The work was performed in collaboration with scientists from the CSIRO Earth Observation Centre, and the Divisions of Atmospheric Research, Plant Industry and Water Resources. Five Australian universities and two New Zealand organisations were also involved.

The researchers measured land-air exchanges of energy, water, trace gases and stable isotopes in this patchwork landscape, at scales ranging from individual leaves up to whole continents. These measurements required a diversity of equipment from kites to satellites, as well as instruments on the ground.

**Exotic woody weeds under fire**

Exotic weeds are a threat to both the ecological and economic sustainability of Australian tropical rangelands. Every major industry advisory body has identified the woody weed invasion as a major threat to the continued viability of the pastoral industry.

The Division of Tropical Crops and Pastures is studying ways to manage woody weeds such as Rubbervine, Chinee apple, Prickly acacia and Mesquite, including the effects of fire as a means of controlling invasions.

Controlled burning experiments at Lansdowne in Queensland, show that fire is a promising tool for managing Rubbervine. Results indicate mortality was greatest, at over 95 per cent, in small plants, with over 80 per cent of medium-sized plants and 50 per cent of large plants failing to recover.

Dense stands of exotic woody weeds result in declines in forage production with serious implications for beef producers. The use of fire as a management tool will not only have positive implications for the beef industry, but will also be an important tool for conserving native vegetation and maintaining biodiversity.

## Developments

**CSIRO leads world space body**

International space organisations chose CSIRO in October 1995 to lead cooperative efforts in observing the Earth's environment by satellites.

CSIRO will take over from the Canadian Space Agency as Head of the Committee of Earth Observation Satellites (CEOS) for 1996, with Dr Brian Embleton, Head of the CSIRO Office of Space Science and Applications (COSSA) as Chair.

As well as the space agencies from North America, Europe and Japan, the coordinating body also includes satellite management organisations from Russia, Ukraine and China as well as space and research organisations from India, Brazil and Australia. International scientific and technical bodies, such as the World Meteorological Organization and the International Council of Scientific Unions are also included.

**New soils found in oldest continent**

Scientists from the Division of Soils defined a number of new soils in Australia.

The soils have been documented as part of a catalogue of Australian Soils called the *Australian Soil Classification,* based on examination of 14,000 soil profiles and 30 years of national soil survey work by State and Federal agencies.

Some of the newly-catalogued soils are the high-rainfall tropical soils. These are subject to more than 2,000 millimetres of rain each year, are generally severely weathered and hold few nutrients. Knowing that fragile soils exist means that their high-risk properties can be identified, so they can be managed appropriately to maintain their stability and productivity.

**Fungal control of black cricket**

The Division of Entomology completed successful field trials using *Metarhizium* fungus as a means of biological control of the black cricket.

The black field cricket is a major pest of pastures in south-eastern Australia, particularly in western Victoria, and causes up to $20 million damage annually.

*Metarhizium* fungus is a natural enemy of crickets that penetrates its skin and takes over the body cavity.

Until now, the only method of control of crickets available to farmers was the application of chemical insecticides, usually malathion in cereal baits. Using a biological alternative will avoid the adverse effects of chemical pesticides.

The field trials have been a collaborative effort between CSIRO, Agriculture Victoria and Alcoa Landcare.

**Atherton building opening**

Veteran ecologist Professor Len Webb opened the new $1 million extension of the Tropical Forest Research Centre at Atherton on September 5, 1995.

The building, which includes a new library, service herbarium and extensions to the main herbarium, will cater for the expansion of tropical rainforest research.

The Centre provides facilities for 50 research scientists and support staff from the Divisions of Wildlife and Ecology, Entomology, Soils, Plant Industry, and others working on projects in the CRC for Tropical Rainforest Ecology and Management.

**Ausaid contract impacts global change**

The Global Change and Terrestrial Ecosystems (GCTE) Core Project of the International Geosphere-Biosphere Program (IGBP), based at the Division of Wildlife and Ecology, signed a $2.6 million contract with Ausaid to establish a key global change impact centre in Bogor, Indonesia.

Hosted by the Southeast Asian Regional Centre for Tropical Biology (SEAMEO-BIOTROP), the Impacts Centre was opened on May 7, 1996.

The Division of Wildlife and Ecology is providing infrastructure and project management experience, and is joining with other scientific institutions in Australia and overseas, to provide scientific expertise for the first three years of the Centre.

GCTE is playing a lead role in linking the international research programs with the new Impacts Centre.

## Earth Observation Centre established.

An external review in 1994 of CSIRO Earth observation infrastructure and activities led to the formation of the CSIRO Earth Observation Centre (EOC) in July 1995.

EOC will provide leadership in Earth observation science for Australia. It will promote a coordinated and collaborative approach in CSIRO to generic research and interactions in Earth observation from satellites and aircraft platforms.

Co-located with the CSIRO Office of Space Science and Applications (COSSA), EOC has established its Program Office, Science Plan and initial collaborative tasks. It has focus areas in applications support, measurement models, data systems and sensor systems.

## CSIRO — Department of Defence MOU

For 25 years the Division of Water Resources has provided management advice to the Department of Defence to allow it to better manage Defence training areas.

Under a Memorandum of Understanding (MOU), the Department has approved a three year project to develop a hydrogeological database and groundwater vulnerability assessment using geographical Information Systems and integrated modelling, for Garden Island in Western Australia.

The $400,000 project is associated with the expanded use of the Garden Island facility by the Navy.

## Infrastructure, Services, Advancement of Knowledge

**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

**Cheap effective sewage effluent treatment**

Sewage effluent managers in City Councils report that treating effluent by applying it to land for cropping and forestry is often less economical than other treatment techniques.

This is mainly due to the cost of effluent storage during wet and winter periods. Waterlogging and salinisation of heavy clay soil of eastern Australia can reduce crop yields and nutrient removal, and hence the long-term sustainability of such sites used for effluent disposal.

To overcome these problems, the Division of Water Resources, in collaboration with Griffith City Council and State/Commonwealth regulatory bodies, developed a technique called FILTER — Filtration and Irrigated cropping for Land Treatment and Effluent Reuse.

The FILTER technique provides effluent treatment throughout the year by combining nutrient-rich effluent for intensive cropping, with filtration through the soil to a sub-surface drainage system during periods of low cropping activity and heavy rainfall.

Field evaluation of the performance of the FILTER system on one-hectare plots has exceeded expectations for reducing phosphorus and nitrogen well below Environmental Protection Authority limits of 1.0 and 10 milligrams per litre, respectively, while maintaining high flow rates and hydraulic loading.

Other benefits observed during the two-year trial are reductions in algae, suspended solids and pH, increased nitrogen : phosphorus ratio and the potential use of the technique to reclaim saline and sodic soils. Crop yields and crop nutrient removal rates indicate that the FILTER system is potentially economically viable and sustainable.

The FILTER system has other possible applications including the treatment of industrial and commercial effluent, runoff from farms which may contain pesticides, and effluent from feedlots, piggeries and dairies.

## Setting the frequency standard

As part of its role as the national standards laboratory for Australia, the National Measurement Laboratory (NML) located within the Division of Applied Physics, conducts research into selected areas of standards development.

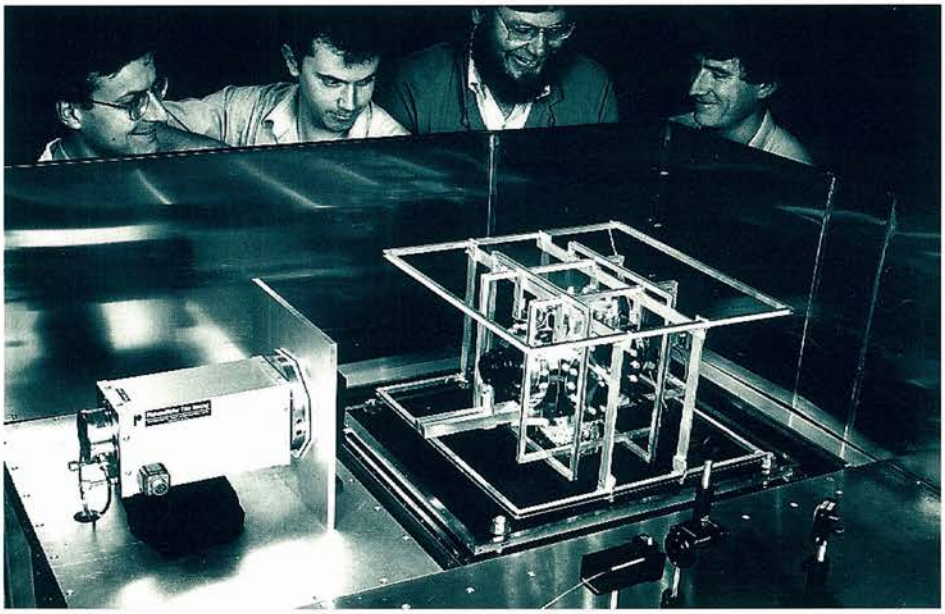
One of these is frequency standards. It is now recognised internationally that the stability and accuracy of existing time and frequency standards, based on hydrogen masers and caesium beam devices, will soon be unable to satisfy the requirements of some advanced navigation, communication, timekeeping, surveying and other applications.

The NML project has developed a new frequency standard by locking an ultra-low phase noise microwave source to a microwave absorption resonance in a cloud of electromagnetically trapped ytterbium ions. The ultra-low phase noise microwave source is based on a cryogenic resonator loaned by the University of Western Australia under a collaborative agreement.

## Setting the frequency standard

**Part of the National Measurement Laboratory's ytterbium frequency standard. The ytterbium ions are confined electromagnetically in a vacuum chamber, which is surrounded by an array of electrical coils for magnetic field control. Scientists involved in the project are (left to right) Malcolm Lawn, Matthew Sellars, Colin Coles and Peter Fisk.**

Photo: Ibrahim Mehmet, Division of Applied Physics.



The short-term stability of the trapped ytterbium standard is currently superior by a factor of three to any passive atomic frequency standard yet demonstrated. The NML team is presently upgrading its two ytterbium standards to allow continuous operation, so that their long-term stability may be investigated.

Results demonstrating that this technique offers a viable approach to a new, more stable, frequency standard were presented as an invited paper at a major international meeting on frequency standards and metrology in 1995.

**Parkes Telescope upgrade supports Galileo mission**

In 1995 CSIRO's Parkes Telescope received a major upgrade to prepare it for tracking NASA's Galileo spacecraft.

Supporting Galileo is the largest project in the Telescope's 35 year history, and the upgrade for the mission is the greatest change made to the Telescope since it was built.

Galileo, launched in 1989, is now orbiting Jupiter. From mid 1996 to November 1997 it will be taking pictures of the planet and its moons. NASA will use the Parkes Telescope to track Galileo for nine to ten hours a day for 13 months from November 1996.

So that the tracking can be worked in with normal astronomy, NASA funded a replacement of the Telescope's 'focus cabin'. This cabin holds the equipment that does the first processing of the signals coming into the Telescope. The new cabin's design makes it possible to switch quickly between the different sets of equipment needed for tracking Galileo and for normal astronomy.

**First 3-D images of Jupiter's radiation belts**

Astronomers have made the first 3-D images of Jupiter's radiation belts using data collected by CSIRO's Australia Telescope.

Jupiter is a strong natural source of radio waves. Much of this radio emission comes from its 'radiation belts' — regions of strong magnetic field that ring the planet. The radio waves come from high-energy electrons trapped in the belts.

Jupiter rotates once every ten hours. The 3-D images are tomographic reconstructions, built up from views taken at different angles as the planet turns.

The new Australia Telescope data have added a lot to our picture of Jupiter's magnetic field. It tells us about the properties of the field close to the planet where spacecraft have been unable to measure it directly.

## Developments

**Traffic planning for the future**

As part of the CRC for Advanced Computational Systems, the Division of Information Technology has developed a high-performance traffic and road network simulation package for use in the design and operation of the next generation of traffic management systems. First demonstrated to industry representatives in August 1995, the system has since undergone further development and validation tests in collaboration with the NSW Roads and Traffic Authority. It is now being applied to traffic congestion analysis.

### Asia-Pacific Telescope workshop

In December 1995 the Australia Telescope National Facility hosted the 3rd Workshop of the Asia-Pacific Telescope (APT). This workshop, funded by the then Department of Industry, Science and Technology, brought together 60 delegates from ten countries.

Coordinated by Australia, APT is an informal consortium of radio telescopes in the Asia-Pacific region that conducts experiments in very long baseline interferometry (VLBI).

VLBI is a technique that involves linking widely separated radio telescopes, and has applications in astronomical imaging, astrometry and geodesy.

Six days of APT experiments are planned for 1996, with the first scheduled on October 17 - 19, 1996. One set of observations will be processed in Australia by CSIRO's Australia Telescope National Facility using equipment formally opened at the December workshop. In the past, data had to be sent to the USA for processing.

### Decision support system for urban water supply

The Division of Information Technology, in collaboration with the Division of Water Resources, has developed a decision support system for Sydney Water as part of the CSIRO multi-Divisional Program on Urban Water Systems. The system, called Hydra, applies multiple hydrological models to provide information for engineers planning new water supplies and improvements to existing ones.

## First 3-D images of Jupiter's radiation belts

**The first 3-D images of Jupiter's radiation belts, made with CSIRO's Australia Telescope. True 3-D objects, they can be rotated and viewed from all angles.**

Photo Dr Robert Sault, Australia Telescope National Facility.

**Protecting telecommunications services**

The 1991-92 Annual Report described work by scientists in the Division of Soils that helped AOTC (formerly Telecom Australia) identify soils that could damage optical fibre cables when laid through them.

Continuing research developed a model to predict the combined influences of soils, vegetation and climate on these types of cables.

CSIRO presented a final report to Telstra in 1995, which included a *Soil Assessment Manual* to help determine the best cable route and optical fibre type for any particular route across the continent. Procedures described in the manual have been incorporated into future planning of all of Telstra's optical fibre cable networks. The procedures will save Telstra and the community millions of dollars while improving the performance of Australia's telecommunications network.

Negotiations for sale of the product to potential clients are underway.

# 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. Total commitments to the Program by participating organisations over the initial contract period amount to $1,950 million. The Commonwealth CRC Program is to provide an additional $854 million.

CSIRO is involved in 52 of the 62 CRCs already established under the CRC Program (Box 3). CSIRO senior management evaluated the Organisation's participation in each of these 52 CRCs during 1996 as a basis for considering its future involvement in the program. For CSIRO to be a participant in a CRC, its objectives must be consistent with the priorities determined by CSIRO in its response to national research needs.

CSIRO's contribution, valued at more than $417.3 million or 21.4 per cent of the participants' total, is mainly through the provision of research staff, (approximately 700 person years each year) 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 takes advantage of Australia's considerable investment in public research infrastructure and creates opportunities for research students to gain experience in a commercial research environment. CSIRO staff now jointly supervise over 327 additional PhD and other post-graduate students as a result of the Organisation's participation in the Program; the total number of post-graduate students supervised by CSIRO is over 900. CSIRO staff are also involved in undergraduate lectures, summer schools, seminars for industry and similar extension and training activities through the Program.

The CRCs and CSIRO's Multi-Divisional Programs focus the Organisation's multidisciplinary 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.

CSIRO is involved in a number of new proposals for the 1996 selection round of CRCs, and in proposals seeking renewal of funding for first round (1991) CRCs. These will be decided in late 1996.

# Cooperative Research Centres in which CSIRO is a participant

## Manufacturing Technology

- Alloy and Solidification Technology
- Industrial Plant Biopolymers
- Intelligent Manufacturing Systems and Technologies
- International Food Manufacturing and Packaging Science
- Materials Welding and Joining
- Molecular Engineering and Technology: Sensing and Diagnostic Technologies
- Polymer Blends

## Information and Communications Technology

- Advanced Computational Systems
- Australian Photonics
- Intelligent Decision Systems
- Research Data Network
- Robust and Adaptive Systems

## Mining and Energy

- AJ Parker CRC for Hydrometallurgy
- Australian Geodynamics
- Australian Mineral Exploration Technologies
- Australian Petroleum
- Black Coal Utilisation
- GK Williams CRC for Extractive Metallurgy
- Landscape Evolution and Mineral Exploration
- Mining Technology and Equipment
- New Technologies for Power Generation from Low Rank Coal

## Agriculture and Rural Based Manufacturing

- Aquaculture
- Cattle and Beef Industry (Meat Quality)
- Food Industry Innovation
- Hardwood Fibre and Paper Science
- Legumes in Mediterranean Agriculture
- Plant Science
- Premium Quality Wool
- Quality Wheat Products and Processes
- Sustainable Cotton Production
- Sustainable Sugar Production
- Temperate Hardwood Forestry
- Tropical Pest Management
- Tropical Plant Pathology
- Viticulture

## Environment

- Antarctic and Southern Ocean Environment
- Biological Control of Vertebrate Pest Populations
- Catchment Hydrology
- Freshwater Ecology
- Soil and Land Management
- Southern Hemisphere Meteorology
- Sustainable Development of Tropical Savannas
- Tropical Rainforest Ecology and Management
- Waste Management and Pollution Control
- Water Quality and Treatment
- Weed Management Systems

## Medical Science and Technology

- Cardiac Technology
- Cellular Growth Factors
- Diagnostic Technologies
- Eye Research and Technology
- Tissue Growth and Repair
- Vaccine Technology

# Awards and fellowships

## The 1996 Australia Prize

The 1996 Australia Prize was shared by Dr Peter Colman of the Division of Biomolecular Engineering, Professor Graeme Laver, from the Australian National University and Professor Mark von Izstein from Monash University for their work towards a drug to combat influenza. Dr Paul Janssen, Chairman of the Janssen Research Foundation Worldwide was the international winner for his excellence in pharmaceutical design.

## The Chairman's Medal

The 1995 Chairman's Medal and CSIRO Medals were presented on 21 November, 1995 by Professor Adrienne Clarke AO, Chairman of the Board.

The winners of the Chairman's Medal were Dr Keith Murray, Dr Alex Hyatt, Dr Allan Gould, Dr Peter Hooper, Mr Paul Selleck, Dr Harvey Westbury and Dr Laurence Gleeson from the Division of Animal Health, for the discovery of a previously unknown equine morbillivirus.

## CSIRO Medals

The CSIRO Medals for 1995 were awarded to:

Dr Barry Harrowfield, Mr Gary Robinson and Mr Ken Atkinson of the Division of Wool Technology, for the invention, development and commercialisation of the Very High Speed Carding Process;

Dr Nicholas Stokes, Dr Chin-Hsien Li, Dr Xiao-Lin Luo, Dr John Mooney,

## The 1996 Australia Prize

Pictured with former Science, Industry and Technology Minister, Senator Peter Cook (centre) are the 1996 Australia Prize winners, CSIRO's Dr Peter Colman (left) with (clockwise) Monash University's Professor Mark von Itzstein, the Australian National University's Professor Graeme Laver and Chairman of the Janssen Research Foundation Worldwide, Dr Paul Janssen.

Photo Snappy Pics.

## The Chairman's Medal

Winners of the 1995 Chairman's Medal were (clockwise from left) Dr Laurence Gleeson, Dr Allan Gould, Dr Peter Hooper, Dr Alex Hyatt, Dr Peter Westbury, Mr Paul Selleck, Dr Keith Murray pictured with CSIRO Board Member, Professor John de Laeter.

Photo Mark Fergus, Division of Materials Science and Technology.

Dr Noel Barton, and Dr Zili Zhu of the Division of Mathematics and Statistics, for their work in developing a computational fluid dynamics program called *Fastflo*;

Dr Geoffrey Syme of the Division of Water Resources, for his research focusing on designing methodologies to measure community risk-benefit trade-offs, defining "fairness" in water allocation and advancing economic psychological theory;

The CSIRO External Medal was won by Professor Allan W Snyder and Professor John Mitchell from the Australian National University for work on light guiding light, a major conceptual breakthrough in which linear and non-linear optics are unified.

## 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 1995 Award was presented on 24 October, 1995 by the Honourable Phillip Gude, MP, Victorian Minister for Industry and Employment and Minister for Regional Development. The winner was Dr Bruce Thomas of the Division of Radiophysics/Australia Telescope National Facility for his contribution to the development of antenna technology in Australia.

## CSIRO Medals

**CSIRO Medal winners in 1995 included (back row from left to right) Dr Barry Harrowfield, Dr Geoffrey Syme, Dr Nicholas Stokes, Professor John Mitchell, and Professor Allan Snyder pictured with (front row from left to right) Professor John de Laeter and former Chief Executive, Dr Roy Green.**

Photo Mark Fergus, Division of Materials Science and Technology.

## Sir Ian McLennan Award

**Winner of the 1995 Sir Ian McLennan Award, Dr Bruce Thomas (centre) of the Division of Radiophysics/Australia Telescope National Facility, with the Honourable Phillip Gude, MP (left) and Sir Peter Derham.**

Photo Mark Fergus, Division of Materials Science and Technology.

## Other awards

The CSIRO Wagga Wagga Effluent Plantation Project was awarded the 1996 Banksia Environmental Award for Land Management in June.

Dr Mike Austin of the Division of Wildlife and Ecology won the prestigious Ecological Society of Australia (ESA) Gold Medal for his outstanding contribution to the study of ecology in Australia.

Dr Ian Common of the Division of Entomology won the Karl Jordan Medal for his excellent work with moths and butterflies.

Dr Dharma Shukla and Dr Colin Ward of the Division of Biomolecular Engineering won the Australian Medal for Agricultural Science for the way plant viruses worldwide are detected and controlled.

The Division of Oceanography received an Engineering Excellence Award from the Institution of Engineers, Australia for its work into jarosite dumping at sea and the associated development of AusProbe.

Dr Ezio Rizzardo of the Division of Chemicals and Polymers was awarded the Royal Australian Chemical Institute's 1996 Applied Research Medal for his work leading to the development of a world-first technique in the synthesis of engineered resins.

## CSIRO-DSTO Research Fellowship Scheme

In 1989, the Defence Science and Technology Organisation (DSTO) and CSIRO signed a Memorandum of Understanding to provide for collaboration between the two organisations. In April 1995 it was agreed to introduce an exchange Research Fellowship Scheme involving up to four scientists for a period of one year. Two scientists, one from each organisation, were selected for 1996.

Dr Ralph Leslie of DSTO has been working with the Division of Chemicals and Polymers in the area of biosensors.

Dr Maurice Craig of the Division of Exploration and Mining has been working in DSTO's Microwave Radar Division on improvements to detect buried landmines.

# Technology Transfer

## Selected highlights

In October 1995 CSIRO and Japanese company Itochu signed an agreement to formalise closer ties, particularly in the agrifood business (see page 42).

CSIRO and the International Wool Secretariat are marketing a new anti-setting agent for wool (see page 56).

New block copolymer resins for use as pigment dispersers in inks and toughening agents for automotive coatings have been developed by CSIRO and will be made by Du Pont Australia Ltd (see page 57).

A manufacturing plant is to be set up by Bonlac Foods Ltd to use a CSIRO process for producing a high value protein from whey, a byproduct of cheese-making (see page 57).

CSL Ltd is now marketing a test kit that detects TB in humans, based on CSIRO's test kit for animals (see page 37).

Dynamic Light Ltd has been licensed to produce a CSIRO instrument that quickly measures hydrogen fluoride levels in aluminium smelters (see page 46).

ACL Bearing Company is to manufacture new crankshaft bearings coated with various electroplated alloys developed by CSIRO to improve performance (see page 59).

## Corporate business

In 1993 Mr Peter Bradfield was engaged as Director Corporate Business, heading up a new Department of Corporate Business in Melbourne.

In two years in this role Mr Bradfield made valuable contributions to enhancing the management of CSIRO's corporate business and commercialisation functions.

With this phase complete, arrangements were put in place in July 1995 to allow Mr Bradfield to focus his services to CSIRO entirely on providing high level advice and representation.

Mr Bradfield took up a new role as Principal Advisor (Business Development) and Dr Tom Biegler was appointed as Chief General Manager responsible for the Corporate Business Department.

Following the first stage of CSIRO's restructuring, begun in March 1996, the Corporate Business Department has been gradually wound down and its functions transferred to Dr Colin Adam, Deputy Chief Executive responsible for marketing.

## Intellectual property

Arrangements to review the management of intellectual property were begun following the restructure of CSIRO in March, 1996.

Important objectives of the review will be to reduce further the costs of portfolio management and to achieve closer integration of portfolio management at the business unit level.

The Intellectual Property Standing Committee, established in 1995 to assist with intellectual property management, has endorsed proposals to enhance CSIRO's professional representation overseas through the use of panels of carefully selected patent attorney firms in all important regions. Targeted training programs for all CSIRO staff are being continued.

## Legal services

In July 1995 CSIRO issued invitations to all major Australian law firms and to some other firms that had previously serviced CSIRO, to tender for the supply of legal services to the Organisation. A number of firms were selected on the basis of legal and geographical coverage and pricing to form a CSIRO Legal Panel for an initial period of two years. The firms, and their areas of specialty relevant to CSIRO, are listed in Box 4.

In parallel with the decision to abolish the Corporate Business Department, it was decided to terminate formal arrangements under which a small team of lawyers in the Corporate Legal Service provided commercial legal advice and services to Divisions and other units. Divisions will in future acquire these services through a

Box 4

### CSIRO Legal Panel

| General Panel | Areas of Specialty |
|---|---|
| Australian Government Solicitor | All matters |
| Freehill Hollingdale & Page | All matters |
| Corrs Chambers Westgarth | All matters |
| **Specialist Panel** | |
| Minter Ellison | Intellectual property; technology agreements |
| Blake Dawson Waldron | Government and administrative law; intellectual property; defamation |
| Hunt and Hunt | Technology agreements; computer software |

combination of Divisional solicitors, secondees and access to the CSIRO Legal Panel. Divisions will be encouraged to share legal resources between them where practical.

A CSIRO Legal Network was formed to provide a professional support group for lawyers in CSIRO. The Network is chaired by Deputy Chief Executive, Dr Colin Adam.

CSIRO has been notified of a number of potential legal claims relating to the spread of Rabbit Calicivirus Disease. At this stage there is insufficient information to assess CSIRO's potential financial exposure, if any, to such claims.

## Small to Medium-sized Enterprises (SMEs)

The CSIRO Information Network continues to provide an enhanced enquiry service for SMEs and to monitor the Organisation's response to their enquiries. Details of the type, and size of business, problem requiring advice or assistance, and feedback from the client are compiled fortnightly and distributed to key CSIRO business liaison staff for information.

A range of options has been developed for future directions in assisting SMEs. A brochure "WORKING WITH CSIRO - A Guide For Small and Medium Enterprises" was produced to outline ways in which SMEs can tap into CSIRO's expertise and services. It has been distributed to Divisional Industry Liaison staff and non-CSIRO providers of services to SMEs (eg business enterprise centres).

The Information Network's SME officer assisted in organising CSIRO participation in the successful New South Wales 500 Summit Conference organised by Business Sydney newspaper. Through the Information Network, CSIRO was an associate sponsor of the conference which was held at Leura from 9-11 May 1996.

## International scientific liaison

CSIRO has continued to maintain its extensive international connections and to initiate many new ones. During the past year, there has been a significant increase in interest in initiating and developing linkages with counterparts in South East Asian countries, especially Indonesia, where CSIRO is involved in a number of collaborative projects.

The largest of these is a so-called 'twinning' project with the Indonesian Institute of Sciences (LIPI) to assist its research management. CSIRO was selected for this role in June 1996 by the Indonesian Government, after a process of international competitive tendering by international research agencies.

In 1996-97, CSIRO plans to open a project office in LIPI, Jakarta, Indondesia, to facilitate CSIRO input into the 'twinning' project.

CSIRO is maintaining its regular quota of exchange visits with the Chinese Academy of Sciences (CAS) under a joint collaboration agreement. This year the exchange visits included a group of CSIRO scientists, which

visited counterpart CAS institutes and field sites in China to help prepare a preliminary joint research proposal for the management of soil and water resources. In November 1995, a CSIRO delegation visited CAS Institutes and field sites to explore possibilities for minesite rehabilitation in China. This entailed valuable discussions with a number of Chinese mining companies.

The Minister for Science and Technology, the Honourable Peter McGauran MP, and the Minister for Foreign Trade in the Government of The Netherlands, Ms Anneke van Dok-van Weele, were present at the signing by the CSIRO Chief Executive of two agreements between CSIRO and The Netherlands Organisation for Applied Scientific Research (TNO) to facilitate research cooperation. Although subject areas have yet to be identified, there is initial interest in the manufacturing and horticultural areas with posssible links to South East Asia.

CSIRO is continuing its interactions with the National Research Council (CNR) of Italy under the Arrangement established in 1991. Established research collaboration in areas such as physical standards and grain proteins has been extended to the newly selected areas of forestry and soil science.

The International Scientific Liaison Group arranged a successful short course in Sydney on research and development management for the benefit of 27 participants from developing countries in Asia. The high demand for places, which reflected the success of previous courses, has led to the planning of a similar course in Indonesia next year.

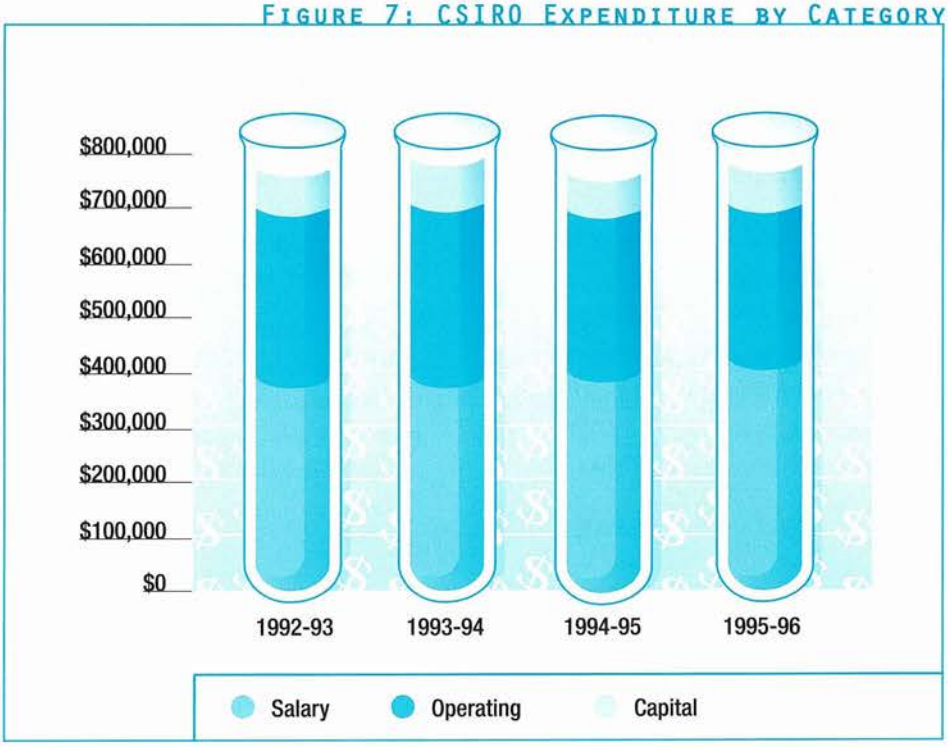
# Funding

CSIRO's 1995-96 appropriation of $417.6 million appears to be a reduction from 1994-95, but this is due to CSIRO bringing $20 million forward from 1995-96 to 1994-95 and then paying it back in 1995-96. The only other major changes are the completion of funding for the Magnesium project, efficiency dividend and inflation adjustments.

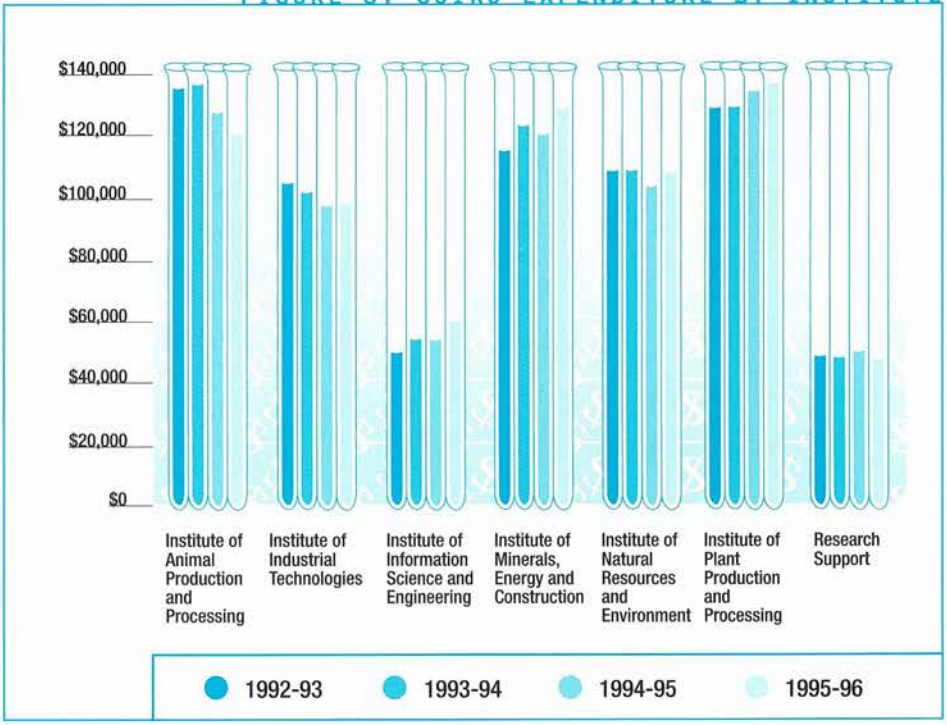
The Organisation's revenue from independent sources was $241.9 million which represented 36.7 per cent of its total revenue. Income by source of funds is shown in the table below.

| | 1995-96 | |
|---|---|---|
| | **$M** | **Percent** |
| Revenue from research activities and user charges | | |
| Private sector | 65.5 | 9.93 |
| Rural R&D Corporations | 41.0 | 6.22 |
| Commonwealth Government | 38.7 | 5.87 |
| Cooperative Research Centres | 30.9 | 4.69 |
| State Governments | 11.4 | 1.73 |
| Overseas | 8.9 | 1.35 |
| Other competitve granting schemes | 7.8 | 1.18 |
| Other sources | 6.3 | 0.96 |
| | 210.5 | 31.93 |
| Other revenue | 31.4 | 4.76 |
| Total operating revenues from independent sources | 241.9 | 36.69 |
| Parliamentary Appropriation received | 417.6 | 63.31 |
| **Total revenue** | **659.5** | **100.0** |

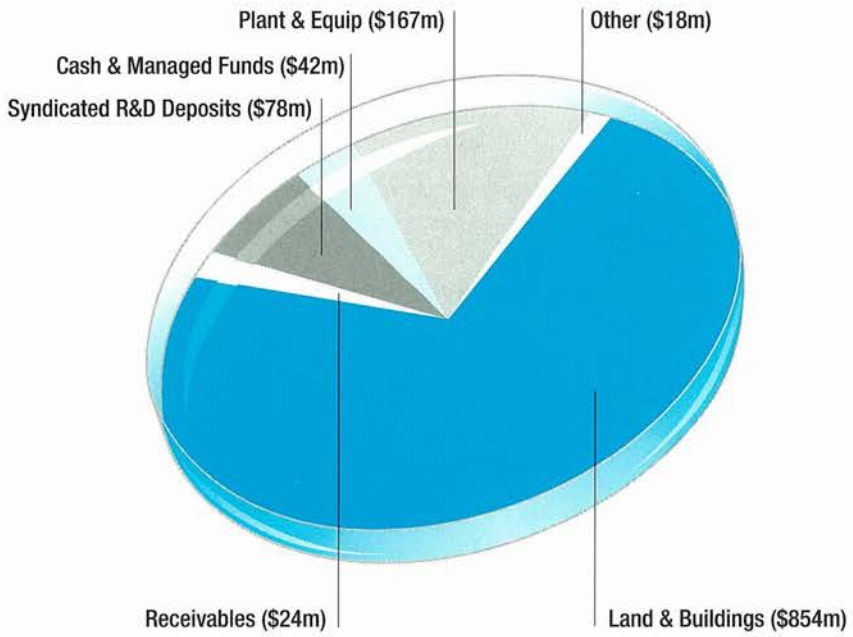
## Figure 7: CSIRO Expenditure by Category



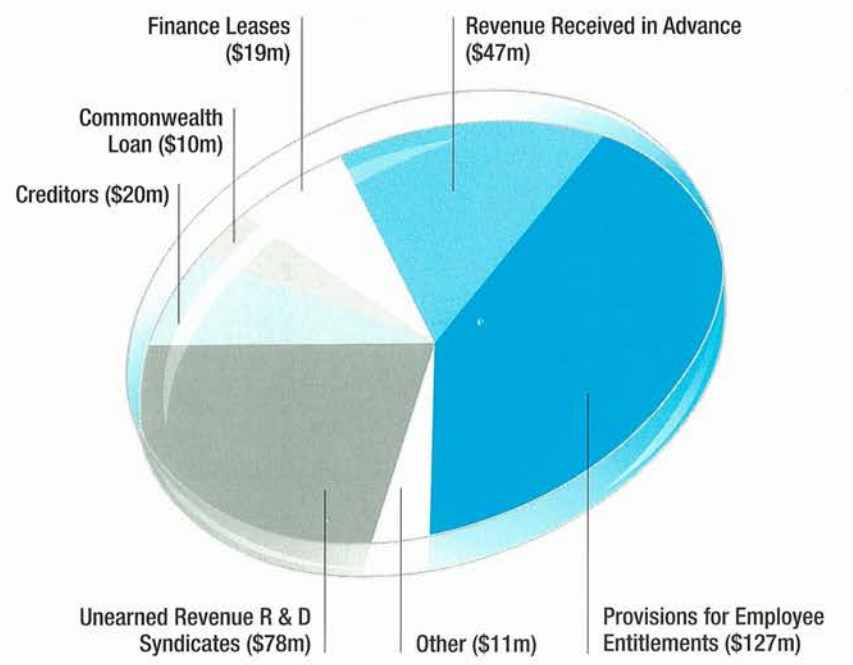

## Figure 8: CSIRO Expenditure by Institute



## Figure 9: Asset Composition as at 30 June 1996




## Figure 10: Liability Composition as at 30 June 1996



# Communication

**Increase recognition by Government, industry and the general public of CSIRO's contributions to the nation.**

## Major communication activities

CSIRO continued to bring science issues and developments in technology before the general community through a variety of public events. In February, a number of CSIRO Divisions participated in "Victoria on Show" at the new Melbourne Exhibition Centre. In addition to a large display, CSIRO research staff gave talks to invited guests about industrial applications of their research.

A part of the "Victoria on Show" CSIRO display was mounted in Belgium during March-June 1996 to accompany a major exhibition on Aboriginal Art staged by the Australian Government.

The Organisation was represented at the Australian Science Festival held annually in Canberra. CSIRO's Double Helix Club played a prominent role offering a "Tinkering with Technology" display. The display appealed greatly to the younger visitors who were able to "tinker with toys" to learn something of the science that underlies them. The Division of Entomology opened its doors to school groups and the general public as part of the Festival. Visitors were able to see exhibits relating to the Division's research on biodiversity, environmental management, clean food and pests.

Queensland's new Skyrail cableway opened in August together with the "Rainforest Interpretation Centre" an interactive education centre which features CSIRO's work on tropical rainforests. The Centre was produced by CSIRO Publishing in partnership with the Tropical Forest Research Centre in Atherton.

CSIRO's travelling exhibition "eatSmart" completed its national tour, finishing in Perth. This interactive display on food was designed to help consumers understand more about healthy and safe eating. It will remain in Perth as a semi-permanent exhibit at the science museum, Scitech.

The Organisation continued to maintain a strong presence at agricultural shows including the Henty Field Days and the Orange National Field Days in NSW, and in Wagin in Western Australia. New ventures

# Major communication activities

The Division of Water Resources' exhibit, "Partners in Research", at the 23rd Hydrology and Water Resources Symposium held in Hobart in May 1996.


included Agquip at Gunnedah, NSW and Lucindale in South Australia.

The Division of Animal Production and four other Divisions participated in a Wool Expo in Armidale in May. The Expo provided an opportunity to showcase some of the Organisation's latest research for the rural industry.

The Division of Water Resources coordinated a major display at the 23rd Hydrology and Water Resources Symposium held in Hobart in May. The exhibit called "Partners in Research" explained the research programs of four major national players in water research.

A major display was organised by the Division of Exploration and Mining at "Expomin '96" in Santiago, Chile.

This communications strategy promoted CSIRO's international research capabilities in the minerals industry. Further communication activities are planned for South America and Indonesia.

## Public information services

The CSIRO Information Network provides a front line enquiry service for the Organisation, with offices in Adelaide, Brisbane, Darwin, Melbourne and Perth.

As part of a goal to continually improve the service to the Australian community, the Network has this year:

- combined the Melbourne and Sydney offices, which have similar enquirer profiles. This has allowed better servicing of specific enquirer groups and more cost effective administration of the unit;
- investigated the adoption of a national 1300 enquiry number. This will provide a local fee service, particularly for rural callers, no matter which office is accessed; and
- sought to establish better links with Divisions to ensure currency of information provided to the public.

The Network fields questions relating to all areas of CSIRO's research. This year's hot issue was the escape of rabbit calicivirus from Wardang Island to the mainland. With briefing from the Australian Animal Health Laboratory, Network staff answered hundreds of enquiries, referring media and legal questions to the appropriate contacts.

## CSIRO Publishing

In August 1995 the Executive Committee decided to introduce new management arrangements for CSIRO Information Services by dividing the functions between two units: an information management unit and a publishing unit. The work of the former unit is reported in the Corporate Development section.

CSIRO Publishing was created to provide a publishing service in science and technology for clients in CSIRO and other related organisations. Its main activities are to:

- publish the Australian Journals of Scientific Research in association with the Australian Academy of Science;
- publish other scientific journals in association with other sponsoring organisations;

- publish books, magazines, CDs and other products in association with or on behalf of sponsors in CSIRO business units or other sponsors with products in related fields;
- provide a multimedia production capability; and
- provide other related publishing services.

CSIRO Publishing operates on a commercial basis.

Key outcomes for 1995-96 included:

- $5.3 million revenue from sales of scientific journals, books, magazines and CD-ROM products; and
- re-location from the antiquated premises at 314 Albert Street, East Melbourne to more modern and efficient offices in Collingwood, with a 15 per cent reduction in staff numbers and 35 per cent reduction in overheads.

## External clients

Approximately 80 per cent of revenue comes from customers external to CSIRO. This includes export earnings of $2 million, mainly from the sale of the Australian Journals of Scientific Research. As Australia's premier publisher of science, CSIRO Publishing aims to increase its reputation as an international science publisher.

## Books

The book publishing program has had one of the busiest years on record with more than 40 new titles including:

- *Carcasson's African Butterflies*, published in collaboration with the Natural History Museum of London;
- ten books published for the Australian Biological Resources Survey. ABRS will continue to play an important role in the program in 1996-97;
- major CSIRO-authored books such as *Australian Soil Classification, Wine Grape Varieties of Australia, Clays: Controlling the Environment, Modern Techniques in Water and Wastewater Treatment,* and *Checklist of the Lepidoptera of Australia;*
- major titles from external authors such as *Nutrition of Eucalypts*, from Melbourne University and *Wheat Rusts*, from Sydney University; and
- *Australia: State of the Environment 1996* published on behalf of the Department of the Environment, Sport and Territories.

## Magazines

The two CSIRO magazines, *Ecos and Rural Research*, maintain a wide readership and are being re-focused to reflect the new sector-based arrangements within CSIRO. *Rural Research* subscriptions have continued to grow significantly for the third year in succession.

## CD-ROM products

Sales of CD-ROM products increased to nearly $300,000 with the major contributor being SAGE – an index to Australia's most popular science and geography magazines. Two new multimedia products, *Ecotrekker* and *The Dynamic Rainforest* were released during the year. Both are being distributed throughout Australia and are available from educational suppliers and some retail outlets.

A major deal with ACER Computers, in which three CSIRO multimedia CD-ROMs were made available to buyers of the new range of its computers, has resulted in a huge increase in the number of CDs sold.

## Education Programs

The Education Programs group was appointed as national coordinator of the Global Learning and Observations to Benefit the Environment (GLOBE) project. GLOBE involves primary and secondary school students in an international environmental monitoring program. Environmental data are collected using clear protocols and the information entered through the Internet to the US. Colourful visualisations of data from all over the world are then available to the students. GLOBE also provides schools with a great deal of curriculum support materials.

Thirty GLOBE Lead Teachers were trained and are now implementing GLOBE in their schools. Sixty Affiliated GLOBE Schools were identified in May and are becoming involved. GLOBE is being undertaken for the Department of the Environment, Sport and Territories and the Department of Employment, Education, Training and Youth Affairs.

The Creativity in Science and Technology (CREST) project continued development into its second year. A further year's national funding was received from the Department of Employment, Education, Training and Youth Affairs while State Education Departments in Queensland, New South Wales, Victoria and Tasmania also supported CREST with funding or staff. The secondary school materials were developed in 1995 and Primary CREST materials are being prepared in 1996. Corporate support is being sought for the continued operation of the project. In 1995, 56 schools registered with CREST, nine teacher workshops were held and 223 awards were made.

CSIRO's Double Helix Science Club finished its national experiment on Dung Beetles, distributing beetles from areas of abundance to areas with no beetles. Appropriate seeding of these populations was ensured by using a CLIMEX model to predict which were the most appropriate species for each area. The 1996 Double Helix national experiment is the Termite Tally. Data on termite abundance will be gathered for the Division of Forestry and Forest Products.

BHP increased its sponsorship of Double Helix to $160,000 for 1996-97. The Double Helix catalogue operation continued to grow and created its own line of science activities — Kool and Original Science (KAOS) Kits. These have proved to be popular. Double Helix membership declined by almost 2,000 to 22,000 largely as a result of an increase in the membership fee.

The number of students provided with interactive science experiences by the national network of nine CSIRO Science Education Centres (CSIROSECs) rose to 150,000 in 1995. However, in 1996, the CSIROSECs' travel to regional centres in each State was curtailed when previous funding from the Science and Technology Awareness Program of the then Department of Science, Industry and Technology was renewed in Tasmania only. Funding from the

Visions of Australia program (Department of Communications and the Arts) was gained for the Darwin CSIROSEC to travel to Western Australia and within the Northern Territory.

The CSIRO Student Research Scheme involved 395 senior secondary students under the supervision of practising scientists from 40 research institutions. The Scheme was again assisted by the Institution of Engineers, Australia.

The BHP Science Awards, jointly operated by CSIRO and BHP, continued to operate successfully.

CSIRO Education Programs gained over 80 per cent of its budget from its own earnings and sponsorship, but continued to rely heavily on CSIRO funds to achieve this result.

## Contribution to public policy

CSIRO provides information both to the Minister for Science and Technology on matters related to his portfolio, and to relevant Departments.

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 related to its expertise. 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. 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, Technology and Engineering Council (ASTEC), and the Standing Committee on Agriculture and Resource Management, as well as a range of advisory panels and interdepartmental working groups.

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

- Senate Environment, Recreation, Communications and the Arts References Committee Inquiry into Marine Pollution (a joint submission with the Australian Institute of Marine Science);
- Industry Commission inquiries into the Pharmaceutical Industry, and into the Medical and Scientific Equipment Industry, and its research project into the Pig Farming, Pigmeat and Processing Pigmeat Industry;
- Joint Bureau of Industry Economics/Australian Bureau of Agricultural and Resource Economics—Evaluation of the Agri-Food Strategy;
- Bureau of Industry Economics—Review of the Multi-Function Polis (MFP) 1995;
- Australian Quarantine Review Committee—Review of Australia's Animal and Plant Quarantine Policies and Programs; and
- National Food Authority Consultancy—Review of the National Food Authority.

# 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 vii-viii,1-2, 13-22 and 81-94);
- any determinations made by the Minister under sub-paragraph 9(1)(a)(iv) of the *Act* during the year (see below);
- any directions or guidelines given by the Minister under section 13 of the *Act* during the year (see below);
- any policies notified by the Minister under section 14 of the *Act* during the year (see below);
- financial statements for the reporting year in a form approved by the Minister for Finance (see pages 109-138); and
- the Auditor-General's report on these statements (see page 110).

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

## 2. Index of compliance with reporting guidelines

Enabling legislation: page 2

Responsible Minister: page 3

Powers, functions and objects: pages 2-3 and 95-97

Membership and staff: pages 3-12

Financial statements: pages 109-138

Activities and reports: pages 33-94

Operational problems: pages 13-32 and 89-94

Subsidiaries: pages 123-124

## 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 cooperate 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 cooperate 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

(i) 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 to 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. Freedom of information

The *Freedom of Information Act* 1982 (the Act) provides the public with a general right of access to documents held by CSIRO and Commonwealth Agencies. This right is limited only by exceptions needed to protect essential public interests or the privacy and business affairs of those who give information to the Commonwealth.

In the year to 30 June 1996, CSIRO received 19 requests under the Act.

## Section 8 Statement

Section 8 of the Act requires agencies to publish certain information concerning their functions and documents.

The following information is presented by CSIRO in accordance with the requirements of that section.

## CSIRO's function and powers

Refer Appendix 3 of this Annual Report.

## Consultative procedures

Valuable input from industry and other users and stakeholders into the identification of strategic research needs and the formulation of policy and administration is obtained through formal advisory and consultative committees as well through receipt of representations from industry, scientific and employee groups.

## Categories of documents

CSIRO holds the following categories of documents:

(1) Corporate records: containing information of corporate and residual value such as financial management and administration, buildings and property, personnel and industrial relations and scientific and industrial research;

(2) Work group records: these are records generated within a work group such as research records and materials created in the course of scientific and technical investigations including:

- raw data;
- project databases;
- observational and experimental data; and
- field and laboratory notebooks.

(3) Personal records: the following CSIRO documents are customarily made available to the public free of charge: policy circulars; information circulars; staff circulars; *CoResearch* (staff newspaper); film catalogues; 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; and school project material.

The following CSIRO documents are available for purchase by the public by contacting CSIRO, Limestone Avenue, Campbell, ACT 2602: Scientific and technical publications including magazines, journals and books as well as CSIRO administrative manuals. A list of these manuals is available from the Freedom of Information (FOI) Coordinator.

## 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 Freedom of Information (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.

## FOI procedures and initial contact points

A central Freedom of Information (FOI) 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:

The FOI Coordinator
CSIRO
Limestone Avenue
CAMPBELL ACT 2601

or

PO Box 225
DICKSON ACT 2602
Tel: (06) 276 6123

In accordance with the *Freedom of Information Act* 1982, 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; and
- 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 1995-96 the Privacy Commissioner did not undertake any investigations under s.36 of the *Privacy Act* 1988 in relation to CSIRO.

In October 1995, the Privacy Commissioner undertook an audit of personal information maintained in Canberra for the purpose of determining whether CSIRO records are maintained according to the Information Privacy Principles. This audit was conducted pursuant to Section 27 (1) of the *Privacy Act.*

The audit focused on the creation, holding, use and disposal of records, held by CSIRO Limestone Avenue as well as the Divisions of Plant Industry and Information Technology. The auditors reported that CSIRO has, within this category of files, instituted policy and procedures that should ensure compliance with most of the Information Privacy Principles. CSIRO's level of compliance was found to be satisfactory. Training to increase awareness of the provisions of the *Privacy Act* was strongly recommended.

## Privacy procedures and initial contact points

A central Privacy Coordinator manages CSIRO's privacy responsibilities.

Initial enquiries should be made to:

The Privacy Coordinator
CSIRO
Limestone Avenue
CAMPBELL ACT 2601

or

PO Box 225
DICKSON ACT 2602
Tel: (06) 276 6123

# 5. Trust funds

## Science and Industry Endowment Fund

The Fund was established under the *Science and Industry Endowment Act* 1926. The Trustee of the Fund is the Chief Executive. During the year, he approved grants totalling $13,577 to support scientific research and education activities.

## FD McMaster Bequest Trust Fund

From this fund, six Fellowships were awarded in 1995-96, totalling $162,500. They were given to support eminent overseas scientists selected to work for a period in CSIRO Divisions.

Four Research Fellowships and three Visiting Fellowships 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 New South Wales 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 Award for Industry 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 and/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 79.

## The Ken and Yasuko Myer Plant Science Research Fund

In June 1994, the Division of Plant Industry received a gift of $1 million from the estate of the late Kenneth Myer to establish a trust fund for plant science research. The Board of Trustees includes representatives from the Myer family, industry and CSIRO. Both Mr Myer and his wife Yasuko were strong supporters of the work done by CSIRO through the Division of Plant Industry. The first project supported by this bequest will develop a recent discovery in the study of flowering, which could lead to new ways of understanding and managing flowering.

# 6. Research programs 1995-96

## List of Multi-Divisional Programs 1995-96*

### Plant Production and Primary Products

Gene Shears

Novel Management Techniques for Plant and Plant Products Pests

Tropical Agricultural Exports

Rejuvenating the Murray-Darling Basin with Forest Products Industries

Strengthening Infrastructure for Mediterranean Agricultural Industry Opportunities

### Animal Production and Primary Products

Fibre Utilisation

CSIRO Aquaculture Initiative (CAI)

### Mineral Resources

Alumina Production

Heavy Mineral Processing

Integrated Geological, Geophysical, Mine Design Visualisation

Iron Ore Processing

Magnesium Alloys

Magnesium Production

Processing of Nickel Ores

### Manufacturing

Biomaterials and Medical Devices

Process and Maintenance Optimisation in Manufacturing

Biosensors

Smart Manufacturing

### Commercial Services

Urban Water Systems

### Environment Knowledge

Climate Change

Conserving Biodiversity for Australia's Future

Climate Variability and Impacts

### Environmental Aspects of Economic Development

Coastal Zone Program

Management of Marine Living Resources

Minesite Rehabilitation

Air Quality

Management of Eucalypt Forests for Timber Production and Conservation: Spatial Prediction of Forest Productivity

Dryland Farming Systems for Catchment Care

*The MDPs are grouped according to their major research purpose (Socio-economic Objective classification).

## Divisional Programs

### Animal Health

Control of Infectious Diseases

Plant Associated Toxins

Effective Vaccine Development

Diagnosis, Pathogenesis and Epidemiology of Infectious Diseases

Molecular Virology and Vaccine Development

## Animal Production

Intensive Animal Production

Wool Quality Enhancement

Livestock Improvement

Extensive Grazing Production

Control of Parasites

## Applied Physics

Electrotechnology

Thermal and
Electromagnetic Technologies

Acoustics and Surface Mechanics

Optical Technology

## Atmospheric Research

Atmospheric Pollution

Atmospheric Processes

Global Atmospheric Change

Climate Modelling

## Australia Telescope National Facility

National Facility Operation

Astrophysics

Instrumentation

Computing Support

Astronomy Education Centres

## 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.

## Building, Construction and Engineering

Designers and Planners

Material Manufacturers

Contractors

Building Owners,
Managers and Facilities Engineers

## Centre for Environmental Mechanics

Atmospheric and Terrestrial Processes

Aquatic Processes

## Chemicals and Polymers

Chemical Discovery

Biomaterials and Chemical Devices

Polymer Production and Processing

Specialty Chemicals and
Environmental Technologies

## Coal and Energy Technology

Coal Preparation

Coal Utilisation

Gas Utilisation

Environmental Management

## CSIRO Office of Space Science and Applications (COSSA)/Earth Observation Centre (EOC)

Access to Research Aircraft Facilities

Environmental Multispectral Imaging

Data Acquisition and Utilisation

Earth Observation Centre

## Entomology

Stored Products and Structural Pests

Weed Management

Pest Management

Natural Resources and Biodiversity

Biotechnology

## Exploration and Mining

Exploration Concepts

Exploration Techniques

Orebody Delineation

Minerals Mining

Coal Mining

## Fisheries

Tropical Fisheries Resources

Pelagic Fisheries Resources

Aquaculture

Temperate and Deepwater Fisheries Resources

Marine Environment

## Food Science and Technology

Food Safety and Quality

Food Ingredients

Meat Technology

Cheese and Cultured Foods

Food Process Engineering and Manufacturing

Food Packaging and Distribution

## Forestry and Forest Products (Divisions amalgamated during 1995-96)

Softwood Plantations

Australian Tree Resources

Regrowth Forest Management

Hardwood Plantations

Pulp and Paper Products

Weed Protection

Composites and Chemical Products

Wood Science and Technology

## Horticulture

Crop Management

Crop Improvement

## Human Nutrition

Customer Research: Market and Consumer Assessment

Functional Foods: Protective Dietary Agents for Human Health

Nutrition Linked Cancers and Bowel Health

Tissue Growth and Repair

## Information Technology

Text-based Information Management

Knowledge-based Technology and Artificial Intelligence

Software Engineering

Data Engineering

Imaging and Multimedia

Human-computer Interaction and Visualisation

Distributed Computing

Simulation, Process Modelling and Spatial Optimisation

Supercomputing Support Group

## Manufacturing Technology

Industrial Automation

Casting, Tooling and Design

Welding and High Energy Processing

Intelligent Manufacturing Systems

## Materials Science and Technology

Alloys Research and Development

Industrial Materials and Systems

Photonics

Electron Beam Lithography

## Mathematics and Statistics

Computational Fluid Dynamics

Display, Analysis and Interpretation of Large Data Sets

Experimental Design

Graphical Presentation of Data and Information

Image Analysis

Image Reconstruction

Mathematical Modelling of Industrial Processes

Operations Research

Quality Improvement

Remote Sensing

Sampling and Monitoring

Signal Analysis

Software Quality

Statistics for Management

## Minerals

Mineral Products

Chemical Products

Metal Products

## Oceanography

Climate and Ocean Processes

Marine Environment and Resources

Regional Seas and the EEZ

## Petroleum Resources

Exploration and Appraisal

Drilling and Completion

Reservoir Management

Unconventional Resources

## 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

## Radiophysics

Telecommunications

Signal and Imaging Technology

Antenna and Microwave Technology

Design, Prototyping and Application of Microwave GaAs Integrated Circuits

Wireless Local Area Networks and Wireless Local Loop

Medical and Ultrasonics Imaging

## Soils

Soils and Environmental Quality

Soils and Rural Production

Soils and Land Resources

## Tropical Animal Production

Health

Livestock Improvement

Efficient and Sustainable Production

### Tropical Crops and Pastures

Tropical Field Crops

Tropical Forages

Land Management
and Agricultural Systems

### Water Resources

Catchment Processes
and Dryland Salinity Management

Urban Water Management

Groundwater Management
and Site Remediation

Rivers and Wetlands:
Conservation and Management

Improving Resource Management
in Irrigated Agriculture

### Wildlife and Ecology

National Rangelands

Ecology and Conservation Mangement
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

### Wool Technology

Physical Processing
and Fibre Specification

Product Innovation and Performance

Chemical Processing and Environment

Fibre Structure and Function

Instrumentation and
Computing Engineering

Leather Research Centre

# 7. Institute/sector advisory committees

Advisory committees for the previous Institutes or for sectors 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 research, the evaluation of that research and the effectiveness of CSIRO in transferring the results of its research into commercial or other practice.

The Committees listed below operated for most of the year 1995-96. New advisory committees are being established following the restructure of CSIRO on 1 July 1996.

## CSIRO Agricultural Sector Advisory Committee (CASAC)

This Committee covers the Institute of Animal Production and Processing, the Institute of Plant Production and Processing and the Institute of Natural Resources and Environment.

### Chair

Mr Trevor Flugge
Wool and grain producer,
Western Australia;
Chairman, Australian Wheat Board;
Director, Grains R&D Corporation;
Past President, Grains Council

### Members

Mrs Marion Becker
Grazier (beef cattle), central Queensland

Mr Keith Campbell
Grazier, southern New South Wales;
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
Ridley Corporation Limited,
food industry scientist

Mr John Mackenzie
Treasurer, National Farmers Federation,
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
Research and Development 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

(CASAC was dis-established
in January 1996.)

## Institute of Natural Resources and Environment Advisory Committee (to March 1996)

### 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 (to March 1996)

### 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 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 (to March 1996)

### Chairman

Dr Ian Gould
Group Executive
CRA Ltd

### Members

Dr SM Richards
Aberfoyle Ltd

Mr JJ Linden
General Manager - Marketing
Gwalia Consolidated Ltd

Mr David Chandler
Pioneer Property

Mr J Hannah
BHP Australia Coal

Dr J Wynhoven
Chief Executive Officer
Connell Wagner

## CSIRO Manufacturing Advisory Board (to March 1996)

### Chair

Dr John Burgess
General Manager,
Research, BHP Limited

Dr Colin Adam
Director, CSIRO Institute
of Industrial Technologies

Mr Warwick Bisley
Managing Director,
Kemcor Australia Pty Ltd

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

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

Dr Peter Farrell
Executive Manager, Rescare Pty Ltd

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

Mr John Innes
Group Executive, Technical Resources,
CRA Limited

Mrs Jeanne Pratt, AO
Director, Pratt Industries

Dr John White
Chief Executive, Transfield
Shipbuilding Pty Ltd

Dr Don Williams
Chairman, Australian National

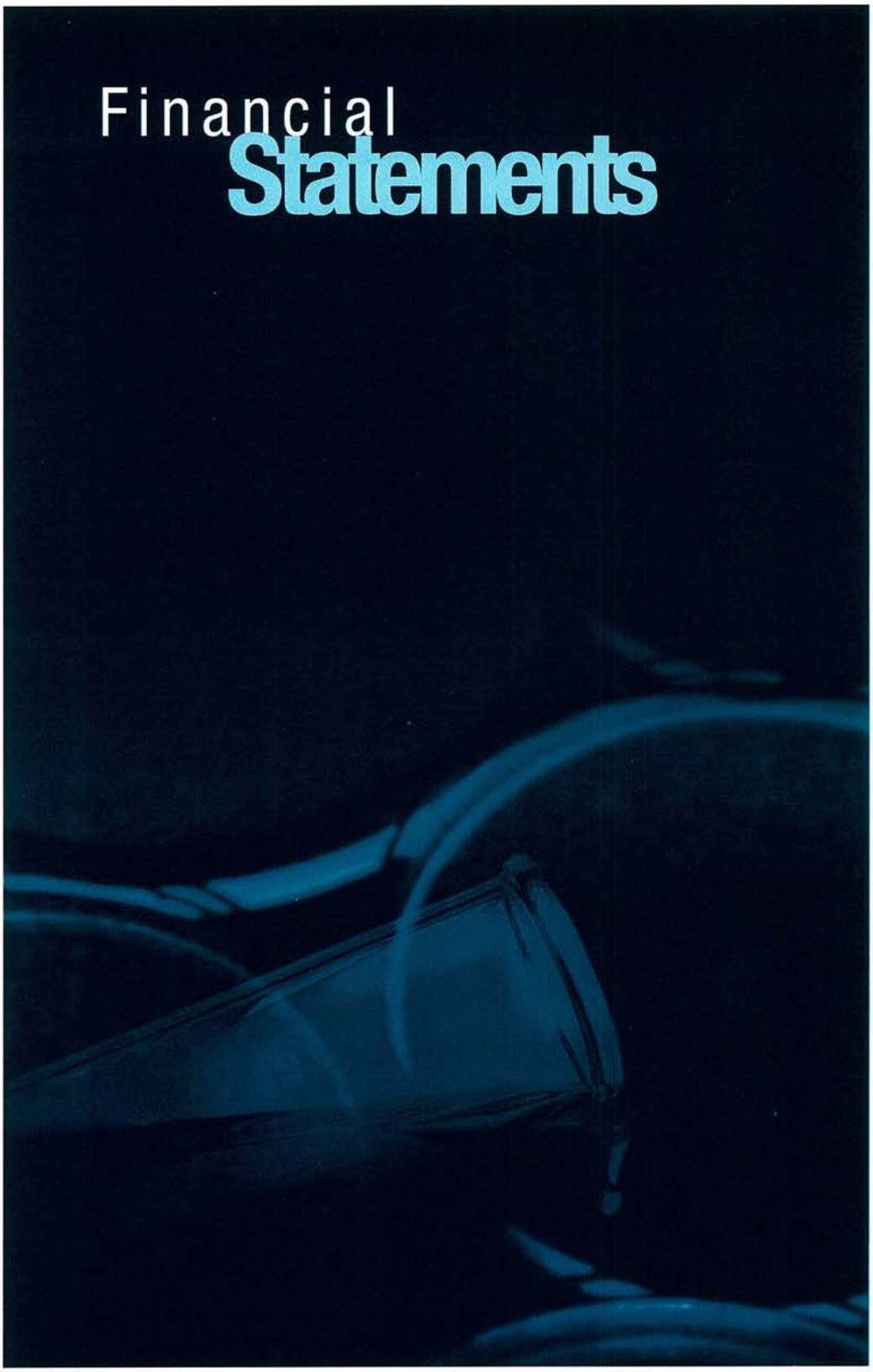
## 8. Publications

CSIRO publishes every year about 4,000 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 Publishing (150 Oxford St, Collingwood, Victoria 3066) or through the National Library's OZLINE database service.

Corporate publications during the year have included:

- *CSIRO Annual Report 1994-95;*
- *CSIRO data book 1996;*
- *Ecos* environmental magazine (quarterly);
- *Rural Research* magazine (quarterly);
- *Research Results* (one issue); and
- *The Helix* (quarterly magazine for Double Helix Club members).

# Financial Statements



# Financial Statements

Australian National Audit Office

## Independent Audit Report

*To the Minister for Industry, Science and Tourism*

***Scope***

I have audited the financial statements of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1996. 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 Tourism.

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(1) 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 1996 and the state of affairs of the Organisation as at the 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

DS Lennie
Executive Director
For the Auditor-General
Canberra
1 October 1996

Address all mail to GPO Box 707 CANBERRA ACT 2601
Centenary House 19 National Circuit BARTON ACT 2600 Phone (06) 203 7300 Fax: (06) 203 7777

# Board members' Statement

In our opinion the attached financial statements of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1996, present fairly the information required by the Minister for Finance Guidelines on Financial Statements of Commonwealth Authorities.

Signed at Townsville this 30th day of September 1996 in accordance with a resolution of the Board Members.

Adrienne E Clarke
Chairman

Malcolm K McIntosh
Chief Executive and Board Member

# Operating Statement
## For the year ended 30 June 1996

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|
| **Net Cost of Services** | | | |
| **Operating expenses** | 2 | | |
| Research Programs | | | |
| Animal Production and Processing | | 119 333 | 126 152 |
| Industrial Technologies | | 97 486 | 96 770 |
| Information Science and Engineering | | 59 254 | 53 643 |
| Minerals, Energy and Construction | | 128 025 | 119 388 |
| Natural Resources and Environment | | 106 832 | 102 257 |
| Plant Production and Processing | | 135 946 | 132 886 |
| Research Support | | 46 575 | 49 073 |
| **Total operating expenses** | | **693 451** | **680 169** |
| **Operating revenues from independent sources** | | | |
| Revenue from research activities and user charges | | 210 544 | 197 263 |
| Other revenue | 3 | 31 449 | 23 015 |
| **Total operating revenues from independent sources** | | **241 993** | **220 278** |
| **Net cost of services** | | **(451 458)** | **(459 891)** |
| **Revenues from Government** | | | |
| **Parliamentary appropriations received** | 2 | **417 597** | **461 583** |
| **Surplus (deficit) of revenues from Government over net cost of services** | | **(33 861)** | **1 692** |
| Accumulated surpluses at beginning of reporting period | | 651 926 | 650 234 |
| **Accumulated surpluses at end of reporting period** | | **618 065** | **651 926** |

The accompanying notes form part of these financial statements

# Statement of Financial Position

## As at 30 June 1996

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|
| **Current assets** | | | |
| Cash | 4 | 12 507 | 11 913 |
| Receivables | 5 | 23 484 | 24 556 |
| Investments | 6 | 29 887 | 60 163 |
| Other | 7 | 16 015 | 16 623 |
| | | 81 893 | 113 255 |
| **Non-current assets** | | | |
| Investments | 6 | 79 437 | 73 788 |
| Property, plant and equipment | 8 | 1 021 736 | 978 220 |
| | | 1 101 173 | 1 052 008 |
| **Total assets** | | **1 183 066** | **1 165 263** |
| **Current liabilities** | | | |
| Creditors | 9 | 20 412 | 17 449 |
| Leases | 13 | 388 | 562 |
| Provisions | 11 | 53 596 | 54 627 |
| Other | 12 | 57 631 | 63 890 |
| | | 132 027 | 136 528 |
| **Non-current liabilities** | | | |
| Borrowings | 10 | 10 220 | 10 220 |
| Leases | 13 | 18 904 | 19 327 |
| Provisions | 11 | 73 521 | 75 258 |
| Other | 12 | 77 922 | 72 273 |
| | | 180 567 | 177 078 |
| **Total liabilities** | | **312 594** | **313 606** |
| **Net assets** | | **870 472** | **851 657** |
| **Equity** | | | |
| Accumulated surpluses | | 618 065 | 651 926 |
| Asset revaluation reserve | 14 | 245 682 | 198 128 |
| Asset realisation reserve | 15 | 6 725 | 1 603 |
| **Total equity** | | **870 472** | **851 657** |

The accompanying notes form part of these financial statements

# Statement of Cash Flows

## For the year ended 30 June 1996

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|
| **Cash flows from operating activities** | | | |
| Parliamentary appropriations | 2 | 417 597 | 461 583 |
| Receipts from research activities and user charges | | 239 901 | 209 204 |
| Interest received | 2 | 4 608 | 5 454 |
| Dividends received | 3 | 9 | – |
| Payments to suppliers and employees | | (634 783) | (613 940) |
| Finance lease charges | 2 | (517) | (599) |
| **Net cash flows provided by operating activities** | 16(b) | **26 815** | **61 702** |
| **Cash flows from investing activities** | | | |
| Payments for property, plant and equipment | | (72 499) | (67 609) |
| Proceeds from sale of property, plant and equipment | | 22 248 | 11 824 |
| Proceeds from sale of investment | | – | 198 |
| **Net cash flows used by investing activities** | | **(50 251)** | **(55 587)** |
| **Cash flows from financing activities** | | | |
| Principal repayment under finance leases | | (597) | (2 436) |
| **Net cash flows used by financing activities** | | **(597)** | **(2 436)** |
| **Net increase/(decrease) in cash held** | | **(24 033)** | **3 679** |
| Cash at beginning of reporting period | | 144 199 | 140 520 |
| **Cash at end of reporting period** | 16(a) | **120 166** | **144 199** |

The accompanying notes form part of these financial statements

# Notes to and forming part of the Financial Statements

Economic Dependency: CSIRO receives approximately two thirds of its funding from Commonwealth Parliamentary appropriations and it has no borrowing powers under the *Science and Industry Research Act*.

## 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

The financial statements are a general purpose financial report.

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 issued by the Minister for Finance which require compliance with Statement of Accounting Concepts, Australian Accounting Standards, Accounting Guidance Releases and other mandatory professional reporting requirements (Consensus Views of the Urgent Issues Group).

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

### 1.3 Principles of consolidation

As at 30 June 1996, CSIRO's in-kind contributions provided approximately 43 per cent 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 17). 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 Foreign currency transactions

Transactions denominated in a foreign currency are converted to Australian currency at the rates of exchange prevailing at the date of the transactions. At balance date, amounts receivable and payable in foreign currency are translated at the exchange rate prevailing at that date and any exchange differences are brought to account 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.

### 1.5 Taxation

In accordance with section 53 of the *Science and Industry Research Act,* CSIRO is exempt from all forms of taxation except fringe benefits tax.

### 1.6 Insurance

As part of its risk management strategy CSIRO has in place insurance cover for a range of risks including industrial special risks, professional indemnity, public and product liability, directors and officers liability/company reimbursement and motor vehicles. The insurance cover is designed to protect CSIRO from losses in excess of normal self insurance.

### 1.7 Segments reporting

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.

### 1.8 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 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.

### 1.9 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.

### 1.10 Leases

A distinction is made between finance leases which effectively transfer from the lessor to the lessee substantially all the risks and benefits incidental to ownership of leased assets and operating leases under which the lessor effectively retains all such risks and benefits.

Where a non-current asset is acquired by means of a finance lease, the asset is capitalised at the present value of minimum lease payments at the inception of the lease and a liability for lease payments recognised at the same amount. Lease payments are allocated between the principal component and the interest expense. Leased assets are amortised over the period of the lease.

Operating lease payments are charged to the Operating Statement on a basis which is representative of the pattern of benefits derived from the leased assets.

### 1.11 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 year in which they are identified.

### 1.12 Investments

#### Equities

Investments are brought to account at the lower of cost or Board valuation which is not in excess of the recoverable amount. The Board considers the nature of the underlying net assets with particular regard to any deferred expenditure on research, development and intellectual property (Note 1.13).

#### Controlled Entities

There are no controlled entities.

#### Associated Companies

Investments in associated companies are carried at lower of cost or Board valuation which is not in excess of the recoverable amount. 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 lower of cost or Board valuation which is not in excess of the recoverable amount.

#### Managed Funds

Managed funds comprise Government, semi-Government and bank endorsed securities which are valued at market values on 30 June 1996.

### 1.13 Research and development expenditure and intellectual property

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

### 1.14 Cooperative Research Centres

The activities attributable to the interests of CSIRO in Cooperative Research Centres have been expensed consistent with Note 1.13. CSIRO's interests in Cooperative Research Centres are disclosed in Note 24.

### 1.15 Property

All land, buildings and leasehold improvements were revalued in June 1996 and the net revaluation increment credited directly to the asset revaluation reserve.

Land which will continue to be used for research activity was valued by CSIRO's registered valuer, GJ Harley, AAVLE at "in use value" and the valuation adopted as Board Members' valuation.

Land designated for possible sale was valued by registered external valuers, Paul McBurnie FVLE(Val), AVLE(Econ), and Ross Stevens AVLE(Val), at market value and the valuation adopted as Board Members' valuation.

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.

### 1.16 Plant and equipment

All plant and equipment is 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 is 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 20).

### 1.17 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 last year and 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.

### 1.18 Employee entitlements

The provision for employee entitlements encompasses annual leave and long service leave. No provision has been made for sick leave as all sick leave is non-vesting and the average sick leave taken by employees is less than the annual entitlement for sick leave.

The provision for annual leave reflects the value of total annual leave entitlements of all employees at 30 June 1996 and is recognised at its nominal value.

The liability for long service leave is recognised and measured at the present value of the estimated future cash flows to be made in respect of all employees at 30 June 1996. In determining the present value of the liability, attrition rates and pay increases through promotion and inflation have been taken into account.

### 1.19 Superannuation

CSIRO discharges its liability for employee superannuation by contributing to the Commonwealth Superannuation (CSS) and the Public Sector (PSS) superannuation schemes which provide retirement, death and disability benefits to employees. Contributions to the schemes are at rates calculated to cover existing and emerging obligations. Current contribution rates are 20.5 per cent of salary (CSS) and 8 per cent of salary (PSS). Either 3 per cent (CSS and PSS members) or 6 per cent (other employees) is contributed for employer productivity benefits. These contribution rates are determined by regular actuarial review.

### 1.20 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.

### 1.21 Cash flows

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

### 1.22 Comparative figures

Where necessary, comparative figures have been adjusted to conform with changes in presentation in these financial statements.

## Note 2 Operating result

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Operating result has been determined: | | |
| After crediting as operating revenues: | | |
| Parliamentary appropriations | | |
| - annual (Bill 1) | 391 997 | 423 283 |
| - capital (Bill 2) | 25 600 | 38 300 |
| Profit on sale of property, plant and equipment | 2 397 | 303 |
| Interest received or due and receivable | 4 608 | 5 454 |
| Abnormal item - prior period adjustment relating to non-current assets | – | (4 382) |
| After charging as operating expenses: | | |
| Finance lease charges | 517 | 599 |
| Wages and salaries related payments | 327 547 | 294 201 |
| Superannuation (including productivity benefits) | 49 886 | 49 518 |
| Provision for long service leave | 4 646 | 13 651 |
| Provision for recreation leave | 27 471 | 30 101 |
| Provision for doubtful debts (Note 1.11) | (965) | 331 |
| Provision for refit of research vessels | 200 | 200 |
| Depreciation and amortisation | 61 132 | 54 883 |
| Amortisation of finance leased assets | 477 | 477 |
| Bad debts written-off | 274 | 38 |
| Loss on sale of investment | – | 62 |
| Operating lease expense | 2 941 | 1 855 |
| Abnormal item - depreciation writeback as a result of changes to depreciation rates on the National Facilities (Note 1.17) | – | (3 359) |

# Notes to and forming part of the Financial Statements

## Note 3 Other revenue

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Department of Primary Industries and Energy's contribution to the cost of the Australian Animal Health Laboratory | 5 779 | 5 944 |
| Dividends | 9 | – |
| Interest | 4 608 | 5 454 |
| Royalties | 3 915 | 2 428 |
| Sale of produce and livestock | 3 299 | 2 289 |
| Fees for provision of services | 9 703 | 4 875 |
| Rental proceeds | 1 529 | 1 170 |
| Net foreign exchange gains | – | 122 |
| Profit on sale of land and buildings | 518 | 578 |
| Profit on sale of plant and equipment | 1 880 | – |
| Miscellaneous | 209 | 155 |
| **Total other revenue** | **31 449** | **23 015** |

## Note 4 Cash

| | | |
|---|---|---|
| Cash at bank and on hand | 10 344 | 11 708 |
| Deposits - at call | 65 | – |
| Managed funds - at call | 2 098 | 205 |
| **Total cash** | **12 507** | **11 913** |

## Note 5 Receivables

| | | |
|---|---|---|
| Trade debtors | 23 866 | 25 880 |
| Advances | 104 | 127 |
| | 23 970 | 26 007 |
| Provision for doubtful debts | (486) | (1 451) |
| **Total receivables** | **23 484** | **24 556** |
| **Ageing of receivables** | | |
| Less than 30 days | 15 262 | 15 975 |
| Between 30 and 60 days | 5 035 | 5 067 |
| Between 60 and 90 days | 1 667 | 1 658 |
| Greater than 90 days | 2 006 | 3 307 |
| | **23 970** | **26 007** |

## Note 6 Investments (Note 1.12)

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|
| **Current** | | | |
| Managed funds | | | |
| Government and semi-Government stocks and bonds | | – | 6 646 |
| Bank endorsed bills and Government guaranteed promissory notes | | 24 925 | 53 517 |
| Negotiable certificate of deposits | | 4 962 | – |
| | | **29 887** | **60 163** |
| **Non-current** | | | |
| R&D Syndicate deposits | | | |
| R&D Syndicate deposits - under contract | 19 | 77 772 | 72 123 |
| | %CSIRO Interest | | |
| Shares - at valuation | | | |
| 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 | 9.2 | 784 | 784 |
| | | 1 479 | 1 479 |
| Provision for diminution in value | | (1 479) | (1 479) |
| | | – | – |
| Shares - at cost | | | |
| Listed companies | | | |
| Queensland Metals Corporation NL | | 1 655 | 1 655 |
| Unlisted companies | | | |
| Other corporations | | 7 | 7 |
| Debentures and unsecured notes - at cost | | 3 | 3 |
| | | 1 665 | 1 665 |
| | | **79 437** | **73 788** |
| **Total investments** | | **109 324** | **133 951** |

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|

## Note 6 Investments (Note 1.12) cont.

Queensland Metals Corporation NL is a public listed company. As at 30 June 1996 the total market value was $2,339,672. CSIRO is a minority shareholder (less than 5 per cent) in the company.

## Note 7 Other assets

| | | | |
|---|---|---|---|
| **Current** | | | |
| Prepayments | | 2 916 | 1 803 |
| Property held for resale - at acquisition cost | | 1 288 | 657 |
| Research work in progress - at cost | 1.8 | 11 811 | 14 163 |
| **Total other assets** | | **16 015** | **16 623** |

## Note 8 Property, plant and equipment (Notes 1.15, 1.16 and 1.17)

| | | |
|---|---|---|
| **Land** | | |
| At cost | – | 4 159 |
| At valuation | 198 648 | 177 515 |
| | 198 648 | 181 674 |
| **Buildings** | | |
| At cost | – | 40 956 |
| At valuation | 568 220 | 524 552 |
| | 568 220 | 565 508 |
| Accumulated depreciation | – | (36 444) |
| | 568 220 | 529 064 |
| Capital works in progress - at cost | 18 165 | 29 348 |
| | 586 385 | 558 412 |
| **Leasehold improvements** | | |
| At cost | – | 19 798 |
| At valuation | 49 142 | 31 691 |
| | 49 142 | 51 489 |
| Accumulated amortisation | – | (3 257) |
| | 49 142 | 48 232 |

# Notes to and forming part of the Financial Statements

## Note 8 Property, plant and equipment (Notes 1.15, 1.16 and 1.17) cont.

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| **Plant and equipment** | | |
| Equipment - at cost | 390 809 | 361 107 |
| Research vessels - at cost | 32 080 | 32 071 |
| | 422 889 | 393 178 |
| Accumulated depreciation | (255 067) | (225 085) |
| Provision for refit of research vessels | (500) | (300) |
| | 167 322 | 167 793 |
| **Buildings and equipment under finance lease** | | |
| Buildings - at valuation | 20 052 | 20 094 |
| Equipment - at cost | 252 | 6 545 |
| | 20 304 | 26 639 |
| Accumulated amortisation | (65) | (4 530) |
| | 20 239 | 22 109 |
| **Total property, plant and equipment** | **1 021 736** | **978 220** |

Total property, plant and equipment includes:

Crown land and land held in Commonwealth title totalling $110,000 (1995 $2,610,000). Negotiations are continuing between CSIRO, the Commonwealth Government and ACT Government to have leases issued in CSIRO's name; and

## Note 8 Property, plant and equipment (Notes 1.15, 1.16 and 1.17) cont.

The National Facilities - Australian Animal Health Laboratory (AAHL), the Australia Telescope (AT) and the Oceanographic Research Vessel *Franklin*. Details of the National Facilities' non-current assets included are as follows:

| | AAHL $000 | AT $000 | *Franklin* $000 | Total 1996 $000 | Total 1995 $000 |
|---|---|---|---|---|---|
| Land - at valuation | 1 450 | – | – | 1 450 | 1 450 |
| Buildings - at valuation | 151 292 | – | – | 151 292 | 146 900 |
| Accumulated depreciation | – | – | – | – | (7 651) |
| | 151 292 | – | – | 151 292 | 139 249 |
| Plant and equipment - at cost | 7 682 | 48 491 | 15 320 | 71 493 | 70 690 |
| Accumulated depreciation | (5 769) | (9 551) | (8 157) | (23 477) | (20 913) |
| Provision for refit | – | – | (400) | (400) | (300) |
| | 1 913 | 38 940 | 6 763 | 47 616 | 49 477 |
| | **154 655** | **38 940** | **6 763** | **200 358** | **190 176** |

Total operating expenses for the three National Facilities for the year amounted to $38,959,015 (1995 $32,398,517) and they have been included in CSIRO's Operating Statement.

## Note 9 Creditors

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Trade creditors | 18 169 | 14 647 |
| Other creditors | 2 243 | 2 802 |
| **Total creditors** | **20 412** | **17 449** |

## Note 10 Borrowings

| | | |
|---|---|---|
| **Loan from the Commonwealth** | **10 220** | **10 220** |

The loan of $10,220,000 (1995 $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 $873,368 (1995 $824,372) has been capitalised on the North Ryde Redevelopment Project.

## Note 11 Provisions

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|
| **Current** | | | |
| Provision for recreation leave | 1.18 | 45 427 | 44 364 |
| Provision for long service leave | 1.18 | 8 169 | 10 263 |
| | | **53 596** | **54 627** |
| **Non-current** | | | |
| Provision for long service leave | 1.18 | **73 521** | **75 258** |
| **Total provisions** | | **127 117** | **129 885** |

## Note 12 Other liabilities

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|
| **Current** | | | |
| Accrued expenses | | 3 029 | 4 174 |
| Research revenue received in advance | 1.8 | 46 928 | 55 868 |
| Trust monies | | 7 674 | 3 848 |
| | | **57 631** | **63 890** |
| **Non-current** | | | |
| Unearned revenue - R&D Syndicates | 19 | **77 922** | **72 273** |
| **Total other liabilities** | | **135 553** | **136 163** |

## Note 13 Lease commitments (Note 1.10)

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Total operating and finance lease rentals contracted for at balance date: | | |
| Payable no later than one year | 5 686 | 3 167 |
| Payable later than one year, but no later than two years | 2 516 | 2 782 |
| Payable later than two years, but no later than five years | 7 093 | 7 388 |
| Payable later than five years | 25 039 | 23 070 |
| **Total lease commitments** | **40 334** | **36 407** |
| Representing: | | |
| Non-cancellable operating leases | 14 601 | 9 384 |
| Finance leases | 25 733 | 27 023 |
| **Total lease commitments** | **40 334** | **36 407** |
| **Non-cancellable operating lease commitments contracted for but not provided for in the accounts:** | | |
| Payable no later than one year | 4 751 | 1 907 |
| Payable later than one year, but no later than two years | 1 581 | 1 826 |
| Payable later than two years, but no later than five years | 4 312 | 4 607 |
| Payable later than five years | 3 957 | 1 044 |
| | **14 601** | **9 384** |
| **Finance lease commitments contracted for and provided for in the accounts:** | | |
| Payable no later than one year | 936 | 1 259 |
| Payable later than one year, but no later than two years | 935 | 957 |
| Payable later than two years, but no later than five years | 2 781 | 2 781 |
| Payable later than five years | 21 081 | 22 026 |
| | 25 733 | 27 023 |
| Deduct, future lease expenditure not provided for in the accounts: | | |
| Maintenance charges | (1) | (69) |
| Future finance charges | (6 440) | (7 065) |
| **Total lease liabilities** | **19 292** | **19 889** |
| Representing lease liabilities | | |
| Current | 388 | 562 |
| Non-current | 18 904 | 19 327 |
| **Total lease liabilities** | **19 292** | **19 889** |

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|
| **Note 14 Asset revaluation reserve** | | | |
| Balance at beginning of year | | 198 128 | 198 628 |
| Surplus on revaluation of properties | | 52 676 | – |
| | | 250 804 | 198 628 |
| Transfer to asset realisation reserve | | (5 122) | (500) |
| **Balance as at end of year** | | **245 682** | **198 128** |
| **Note 15 Asset realisation reserve** | | | |
| Balance at beginning of year | | 1 603 | 1 103 |
| Transfer from asset revaluation reserve | | 5 122 | 500 |
| **Balance as at end of year** | | **6 725** | **1 603** |

## Note 16 Statement of Cash Flows (Note 1.21)

**(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 R&D Syndicate deposits in the Statement of Financial Position as follows:

| | | | |
|---|---|---|---|
| Cash at bank and on hand | 4 | 10 344 | 11 708 |
| Deposits - at call | 4 | 65 | – |
| Managed funds | 4 & 6 | 31 985 | 60 368 |
| R&D Syndicate deposits - under contract | 6 & 19 | 77 772 | 72 123 |
| | | **120 166** | **144 199** |

## Note 16 Statement of Cash Flows (Note 1.21) cont.

| | Notes | 1996 $'000 | 1995 $'000 |
|---|---|---|---|
| **(b) Reconciliation of operating surplus/(deficit) with net cash flows from operations** | | | |
| **Operating surplus/(deficit)** | | **(33 861)** | **1 692** |
| **Non cash flows in operating results** | | | |
| Depreciation and amortisation | 2 | 61 608 | 55 360 |
| (Profit)/loss on disposal of property, plant and equipment | 2 | (2 397) | (303) |
| (Profit)/loss on disposal of investment | 2 | – | 62 |
| Increase/(decrease) in provision for doubtful debts | 5 | (965) | 331 |
| Increase/(decrease) in provision for employee entitlements | 11 | (2 768) | 6 127 |
| Increase/(decrease) in provision for refit of research vessel | 8 | 200 | (100) |
| Increase/(decrease) in provision for legal settlements | 11 | – | (2 012) |
| **Changes in assets and liabilities** | | | |
| (Increase)/decrease in receivables | 5 | 2 037 | (4 334) |
| (Increase)/decrease in other assets | 7 | 608 | 1 842 |
| Increase/(decrease) in creditors | 9 | 2 963 | 2 459 |
| Increase/(decrease) in other current and non-current liabilities | 12 | (610) | 578 |
| **Net cash outflows from operating activities** | | **26 815** | **61 702** |

## Note 17 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 (1995 $3,262,985) to Biomolecular Research Institute Limited (BRI) and $2,135,266 (1995 $1,833,454) to Ceramic Fuel Cells Limited (CFC). The contributions have been in accordance with formal agreements between CSIRO and the related entities and 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 18 Agreements equally proportionally unperformed

**Research agreements**

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

| | 1996 $'000 Income | 1996 $'000 Expend | 1995 $'000 Income | 1995 $'000 Expend |
|---|---|---|---|---|
| Receivable/payable no later than one year | 113 687 | 132 053 | 97 951 | 113 429 |
| Receivable/payable later than one year, but no later than two years | 57 820 | 58 798 | 48 504 | 47 297 |
| Receivable/payable later than two years, but no later than five years | 65 220 | 66 836 | 29 590 | 30 942 |
| Receivable/payable later than five years | 5 019 | 5 330 | 282 | 232 |
| | **241 746** | **263 017** | **176 327** | **191 900** |

**Other agreements**

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

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Payable no later than one year | 33 367 | 20 746 |
| Payable later than one year, but no later than two years | 14 642 | 1 694 |
| Payable later than two years, but no later than five years | 4 320 | 912 |
| Payable later than five years | 3 957 | 432 |
| | **56 286** | **23 784** |

## Note 19 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 fully drawn upon in accordance with the terms of those agreements to meet CSIRO's research contract obligations. The balance of deposits are held as security for CSIRO's obligations under put options.

## Note 20 Resources provided free of charge and not included in the Statement of Financial Position

| | Land $'000 | Buildings $'000 | Plant and equipment $'000 | Total 1996 $'000 | Total 1995 $'000 |
|---|---|---|---|---|---|
| At valuation or cost | 18 834 | 27 483 | 43 222 | 89 539 | 90 796 |
| Accumulated depreciation | – | – | (33 847) | (33 847) | (34 006) |
| | **18 834** | **27 483** | **9 375** | **55 692** | **56 790** |

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 Note 1.16 or provided to CSIRO at little or no cost while 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 not brought to account in the Operating Statement.

## Note 21 Monies held in trust

Monies held in trust are not included in the Statement of Financial Position and are represented by cash at bank and the following investments in equities, bank bills and term deposits :

| | | |
|---|---|---|
| **Investments** | | |
| Advance Bank | 107 | 206 |
| Commonwealth Bank of Australia | 2 521 | 2 521 |
| St George Bank | 110 | 138 |
| M F Cash Management Fund | 1 016 | 1 055 |
| | 3 754 | 3 920 |
| Cash at bank | 103 | 76 |
| | **3 857** | **3 996** |
| The components of trust funds are as follows: | | |
| William McIlrath Trust Fund | 270 | 251 |
| David Rivett Memorial Lecture Fund | 96 | 90 |
| FD McMaster Bequest | 2 361 | 2 441 |
| Sir Ian McLennan Achievement for Industry Award | 114 | 159 |
| The Ken and Yasuko Myer Plant Science Research Fund | 1 016 | 1 055 |
| | **3 857** | **3 996** |

## Note 21 Monies held in trust cont.

Movements in trust funds are as follows:

| | Myer $'000 | McLennan $'000 | McMaster $'000 | McIlrath $'000 | Rivett $'000 | Total 1996 $'000 | Total 1995 $'000 |
|---|---|---|---|---|---|---|---|
| Balance at beginning of year | 1 055 | 159 | 2 441 | 251 | 90 | 3 996 | 3 937 |
| Add, Receipts during year | – | 2 | – | – | – | 2 | 2 |
| Add, Interest and dividends | 64 | 10 | 181 | 19 | 6 | 280 | 249 |
| Less, Expenditure | (103) | (57) | (261) | – | – | (421) | (192) |
| **Balance as at end of year** | **1 016** | **114** | **2 361** | **270** | **96** | **3 857** | **3 996** |

## Note 22 Contingent liabilities

Contingent liabilities for which no provision has been made in the accounts as at 30 June 1996 were:

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Performance guarantee | – | 92 |
| Estimated legal claims arising from employment, motor vehicle accidents and contractual disputes. These matters are being fully defended. | 819 | 80 |
| | **819** | **172** |

In addition to the above, CSIRO has been notified of a number of potential claims relating to the spread of the Rabbit Calicivirus Disease. At this stage there is insufficient information to assess CSIRO's potential financial exposure, if any, to such claims.

# Notes to and forming part of the Financial Statements

## Note 23 Auditor's remuneration

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Amounts received, or due and receivable, by the Australian National Audit Office for: | | |
| Auditing the accounts | 280 | 274 |
| Auditing the Cooperative Research Centres | 3 | – |
| (No other services were provided by the auditor) | | |
| | **283** | **274** |

## Note 24 Cooperative Research Centres (CRCs)

The Cooperative 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 1996 CSIRO is a participant in 52 CRCs and CSIRO's interest in each is listed as follows :

| Names of Cooperative Research Centres | CSIRO's Equity Interest (%) (excluding Commonwealth contributions) |
|---|---|
| MANUFACTURING TECHNOLOGY | |
| Materials Welding and Joining | 49 |
| Polymer Blends | 34 |
| Molecular Engineering and Technology: Sensing and Diagnostic Technologies | 44 |
| Industrial Plant Biopolymers | 25 |
| Intelligent Manufacturing Systems and Technologies | 30 |
| Alloy and Solidification Technology | 50 |
| INFORMATION AND COMMUNICATION TECHNOLOGY | |
| Intelligent Decision Systems | 7 |
| Robust and Adaptive Systems | 22 |
| Australian Photonics | 2 |
| Advanced Computational Systems | 35 |
| Research Data Network | 13 |
| MINING AND ENERGY | |
| Mining Technology and Equipment | 73 |
| G K Williams CRC for Extractive Metallurgy | 52 |
| Australian Petroleum | 61 |

## Note 24 Cooperative Research Centres (CRCs) cont.

| Names of Cooperative Research Centres | CSIRO's Equity Interest (%) (excluding Commonwealth contributions) |
|---|---|
| MINING AND ENERGY cont. | |
| A J Parker CRC for Hydrometallurgy | 49 |
| Australia Mineral Exploration Technologies | 48 |
| New Technologies for Power Generation from Low Rank Coal | 10 |
| Australian Geodynamics | 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 |
| International Food Manufacturing and Packaging Science | 14 |
| 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 |

## Note 24 Cooperative Research Centres (CRCs) cont.

| Names of Cooperative 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 25 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:

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Board Members' remuneration | 641 | 357 |
| Payments to superannuation funds for Board Members | 64 | 76 |
| | **705** | **433** |

The number of Board Members whose total remuneration fell within the following bands:

| $ | | | 1996 Number | 1995 Number |
|---|---|---|---|---|
| Nil | - | 10 000 | 3 | 3 |
| 10 001 | - | 20 000 | 5 | 7 |
| 20 001 | - | 30 000 | 1 | – |
| 30 001 | - | 40 000 | – | 1 |
| 40 001 | - | 50 000 | 1 | – |
| 70 001 | - | 80 000 | – | 1 |
| 110 001 | - | 120 000 | 1 | – |
| 190 001 | - | 200 000 | – | 1 |
| 430 001 | - | 440 000* | 1 | – |

*Includes payments on termination of employment to the former Chief Executive

# Notes to and forming part of the Financial Statements

## Note 26 Executive officers' remuneration

| | 1996 $'000 | 1995 $'000 |
|---|---|---|
| Remuneration received or due and receivable by Executive officers | **2 016** | **1 761** |

| $ | 1996 Number | 1995 Number |
|---|---|---|
| The number of Executive officers included in these figures are shown below in the relevant income bands: | | |
| 110 001 - 120 000 | 1 | – |
| 160 001 - 170 000 | 2 | 1 |
| 170 001 - 180 000 | 1 | 2 |
| 180 001 - 190 000 | – | 1 |
| 190 001 - 200 000 | – | 3 |
| 200 001 - 210 000 | 1 | 1 |
| 210 001 - 220 000 | 1 | – |
| 220 001 - 230 000 | 1 | – |
| 260 001 - 270 000 | – | 1 |
| 310 001 - 320 000* | 1 | – |
| 430 001 - 440 000* | 1 | – |

* Includes payments on termination of employment.

## Note 27 Related party disclosures

**Board Members** – The Board Members of CSIRO during the financial year were:

AE Clarke (Chairman)
MK McIntosh
RM Green (Completed term, 4 February 1996)
JR de Laeter (Completed term, 4 December 1995)
EGC Tan
SM Richards
DS Shears
NC Stokes
G Taylor
EJ Woods
S Hollway (Resigned, 22 March 1996)
KW Davern

**Remuneration** - Information on remuneration of Board Members is disclosed in Note 25.

### Board Members' interests in contracts

Since 1 July 1995 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 25 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 AE Clarke, is a Director of Western Mining Corporation Limited, Australian Mutual Provident Fund Society, Woolworths Limited, Tridan Limited (Group) and Plant Cell Biology Research Centre, and a Board Member of a Cooperative 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, Dr MK McIntosh is also a Director of an associated company of CSIRO, Gene Shears Pty Ltd. It has 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 SM Richards is Chairman 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, Mr NC Stokes was until May 1996 a Director of Continental Venture Capital Limited and is a Director of 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 JR de Laeter is a Director of Westralian Sands Pty Ltd and a Board Member of two Cooperative 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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